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"Patañjali's *Yoga Sūtras* and the *Siddhis*,"
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reflected in the extremity of the measures that participants willingly endure in service of their production. As argued in detail elsewhere, more systematic analysis of this large but uneven literature, supplemented in the future by better-informed and better-equipped field studies and by parallel studies in the laboratory, can be expected with high confidence to elucidate the psychophysiological basis of these powerful effects, and thus potentially lead to more efficient means of inducing them (E. F. Kelly & Locke, 1981b; R. G. Locke & Kelly, 1985).

At present, however, the most promising and available pathway toward experimental study of mystical states clearly lies in their methodical cultivation using the central meditative disciplines developed by the wisdom traditions. As indicated earlier, these traditions are fundamentally coherent in their overall psychological contours, though differing in many details, and their deep convergence on matters of both method and results gives to the whole, in our minds, the appearance of nascent psychological fact.

There has been a steady growth of interest in meditation since the 1960s, but the amount of research progress has so far remained rather disappointing, especially from the perspective of this chapter. To be sure, it has been shown repeatedly that even elementary practice of meditation techniques can lead to a variety of clinically significant psychophysiological consequences, and the resulting marriage of meditation research with behavioral medicine and psychotherapy undoubtedly represents a public-health development of considerable practical importance (Andresen, 2000; Lehrer & Woolfolk, 1993; M. Murphy & Donovan, 1997; Shapiro & Walsh, 1984). We have barely scratched the surface, however, in terms of using meditation to gain experimental access to the higher forms of transformative ecstatic and mystical experience that comprise its principal long-term objective. Although this subject is much too large to review in detail here, we wish to record a few basic observations on the status and prospects of such research.

As in the case of contemporary experimental work on hypnotism, a large proportion of existing research on meditation fails even to make significant contact with the intended subject matter. Many published studies reflect an appalling ignorance of the traditional literatures, assuming that the word "meditation" refers both to some single universal technique and to a correspondingly unitary state of consciousness, and that practice of the technique, however elementary, is operationally equivalent to induction of that state. A large proportion of existing studies are superficial and perfunctory, relying for their subjects upon convenience samples of undergraduates and other meditation beginners whose attainments surely fall far short of the point at which most traditional meditation manuals even begin their instruction. It should hardly be surprising that such studies have generally produced correspondingly banal results (Davidson, 1976; M. Murphy & Donovan, 1997; Schuman, 1980; Shapiro & Walsh, 1984; M. A. West, 1987).

The relatively small amount of work so far carried out with advanced practitioners, however, has already produced a variety of more intriguing

findings suggestive of what potentially lies ahead. As Michael Murphy, himself a very experienced meditator, puts it in his overview of meditation research (M. Murphy & Donovan, 1997): "Contemporary research does not illumine the full range of experience described in the contemplative scriptures and the oral traditions from which they come. Modern studies give us only a first picture of the foothills, with a few glimpses of the peaks. Still, what they give us corresponds in several ways with the traditional accounts" (p. 44). We will next briefly review just a few of these more promising "glimpses." The crucial feature these examples have in common is that they involve an apparent conjunction between unusual conscious states or events and physiological conditions or events that also lie well outside the normal range.

First is the conjunction of mystical experience with "deathlike" states in the body. As James observes in *VRE*, "in the condition called *raptus* or ravishment by theologians, breathing and circulation are so depressed that it is a question among the doctors whether the soul be or be not temporarily dissevered from the body" (p. 316). Underhill (1911/1974) similarly states that in prolonged instances of rapture "the body is cold and rigid, remaining in the exact position which it occupied at the oncoming of the ecstasy, however difficult and unnatural this pose may be. Sometimes entrancement is so deep that there is complete anesthesia" (p. 359). Myers reports Socrates as having remained standing in one place under such conditions, immobile, for periods ranging from several hours to more than a day (*HP*, vol. 2, p. 99). Several modern cases of this sort, involving meditating Yogis buried in airtight chambers, were reviewed in Chapter 3, and see Arbman (1968) for more.

Several more recent experimental studies have also indicated the existence of a lower-level version of the same or similar phenomena in advanced practitioners of Transcendental Meditation (TM)—specifically, the occurrence of spontaneous respiratory suspensions, more frequent and of longer duration than those occurring in control subjects, which tend strongly to be associated with episodes of pure or "transcendental" consciousness and a fairly consistent pattern of correlated changes in measures of autonomic and cortical activity (Baddawi, Wallace, Orme-Johnson, & Royzere, 1984; Farrow & Hebert, 1982; Travis & Wallace, 1997). Whether these physiological occurrences are causes or consequences of the transient alterations in conscious state is not clear, but they provide at minimum simple and effective markers for use in further studies. The association with breathing patterns is also especially interesting inasmuch as the respiratory system is a transitional system having both involuntary and voluntary levels of control, and deliberate manipulation of breathing patterns *(pranayama,* in Patanjali's system) has always been a major component of meditative disciplines. It is certain that such practices can strongly influence the concentrations of blood gases, among other things, and hence directly or indirectly affect many autonomic and central nervous system functions. For example, recent studies indicate that meditation techniques involving deliberately slow breath-

ing produce pronounced oscillations and high variability of heart rate, a sensitive indicator of autonomic tuning (Peng et al., 1999), and that forced unilateral breathing through individual nostrils, a common component of *pranayama* and related techniques, produces both systematic shifts in cerebral dominance and correlated changes in performance on hemispherically specialized cognitive tasks (Jella & Shannahoff-Khalsa, 1993; K. Morris, 1998). Clearly, this area will provide a rich field for further investigation (see also Austin, 1999, chap. 22).[62]

We next give two further examples involving apparent correlations between unusual conscious states and unusual states of the central nervous system, as reflected in the behavior of EEG measures. Our primary historical source for both sorts of effects is the remarkable paper by Das and Gastaut (1957), which we regard—despite its imperfections—as a landmark in the field and a model of how to proceed. Crucial to their success was the circumstance that Das, a native Indian, had been closely associated since infancy with a Yogic community, and consequently was able to recruit from among its members seven very advanced practitioners of a local form of concentrative meditation. The experiments themselves, some 20 in all, were carried out in Calcutta, in a plain but air-conditioned room, using portable physiological instrumentation supplied by Gastaut.[63] Following preparations for recording (four channels of EEG recorded in a variety of derivations from 10 scalp electrodes, two channels EKG or heart activity, and two channels EMG or muscle activity recorded from the quadriceps via concentric needles), subjects assumed the cross-legged lotus position on a large couch, performed some preliminary breathing exercises, and began their meditations. Physiological data were recorded continuously on paper strip-charts, and subsequently transported to Marseille for analysis by Gastaut.

The results, in a word, are stunning. First, these highly trained subjects were able to remain for *hours* in a state of perfect physical immobility and relaxation, with no visible trace of muscle activity in quadriceps EMG or frontal EEG leads. During this time, moreover, progressive and systematic changes of a dramatic sort occurred in their EEGs. Most significantly, the deepest stages of meditation, including at least one reported episode of Yogic ecstasy, were accompanied by the emergence of fast rhythmic activity all over the scalp at progressively increasing frequencies of 20, 30, and ultimately even 40 Hz. During the ecstasy itself, this fast (gamma-range) EEG activity also reached extraordinary amplitudes, on the order of 150 microvolts peak-to-peak (Figure 3, F). Das and Gastaut interpret these EEG results as revealing a state of extreme cortical excitation accompanying the

62. Following the imposition of governmental restrictions on use of LSD in research with humans, Grof developed a technique he calls "holotropic breathwork," a kind of music-assisted hyperventilation which he claims produces similar, if less dramatic effects. Although we have not specifically investigated it, this claim seems to us rather dubious and reinforces our more general concerns about the possible role of expectancies and demand characteristics throughout Grof's research, including his psychedelic research (see also Wulff, 2000).

63. This is the same Henri Gastaut, distinguished French epileptologist, who figured in our earlier discussion of Dostoevsky's "ecstatic seizures."

unusual concentration of inwardly focused attention that these subjects were evidently able to achieve. In support of the latter they also remark in passing that the high-frequency, high-amplitude EEG rhythms, once established, were completely unaffected by any form of auditory, visual, tactile, or nociceptive (painful) stimulation.

This paper is brief, lacks important information regarding details of the stimulation and recording procedures, contains no statistical analyses, and in various other ways falls short of what we might now routinely expect from state-of-the-art psychophysiology research reports. Nevertheless, we believe it deserves to be taken very seriously.[64] The physiological findings are startling, to be sure, but in a way that makes considerable sense. Furthermore, and more importantly, they have been corroborated at least in part in a number of subsequent studies, and in particular by those relatively few studies which exhibit a similar degree of selectivity in regard to the qualifications of subjects and the choice of data epochs subjected to analysis.

The reported absence of responsiveness to external stimulation, for example, would naturally be expected in anyone who has achieved what Patanjali terms *pratyahara*, withdrawal of the senses, or isolation from the sensory environment. Additional and very striking examples of this phenomenon were soon provided by Anand et al. (1961a), again working in India with Yogis purportedly capable of entering states of *samadhi*. In two of these, strong auditory, visual, tactile, and thermal stimuli which invariably produced blocking of ongoing EEG in the normal state failed to do so during meditation. Two other Yogis showed no changes in parietal EEG during protracted (45–55 minute) immersion of their hands in near-freezing water (4°C). A later EEG study of advanced TM practitioners by Banquet (1973) similarly showed that the EEG patterns accompanying brief episodes of "deep meditation" or "transcendence" were not altered by flash and click stimuli.

Unresponsiveness to external stimuli during deep states of concentrative meditation seems to us surely a real phenomenon. Indeed, it seems an exaggerated and voluntary form of a phenomenon of selective attention that all of us encounter spontaneously from time to time in the course of everyday life, a stock example here being the football player so intent upon the game that he fails to realize until afterward that he has suffered a painful injury.[65] A natural extension of the existing studies would be to compare the psychophysiological responses of advanced meditators to identical stimuli delivered *inside* versus *outside* episodes of increased absorption, as indexed for example by momentary breath suspension. On the psychophysical side

64. Recall here too that this study provided Gellhorn and Kiely (1972) with the principal stimulus for their theoretical ruminations about neurophysiological correlates of mystical states.

65. We mention in passing that a widely cited debunking study by D. E. Becker and Shapiro (1981) has no impact here, because it deals only with *habituation* of the EEG blocking normally produced by sensory stimulation, and not with the abnormal *absence* of blocking, even by very strong stimuli, observed by others under conditions of deep meditative absorption. Indeed, we see little sign in their data that any such states occurred.

we would expect stimuli delivered during such episodes to be both less detectable and of lower subjective magnitude when successfully detected. Furthermore, analysis of the associated evoked potentials could reveal precisely where this blockage occurs, whether at the level of the thalamus, as hypothesized by Austin (1999), or somewhere else in the CNS .

The gamma-frequency EEG activity reported by Das and Gastaut is of even greater interest, and we believe this too is a real phenomenon. It certainly cannot be casually dismissed, as it was for example by Fenwick (1987, p. 106), as EMG artifact arising from the scalp musculature. Das and Gastaut themselves were fully aware of this possibility and provide no less than seven arguments against it. Most fundamentally, the activity is not "diffuse" or wideband but "fusiform" or spindle-shaped, nearly monochromatic at a dominant frequency, and equally visible in regions such as the top of the head (vertex) that are relatively remote from scalp muscles. Moreover, this dominant rhythm itself shifts progressively toward the higher frequencies characteristic of deep meditative states and then remains there, stable, for hours. The original paper gives only a few small-scale illustrations of the relevant phenomena, but in subsequent correspondence with one of us (EFK), Gastaut himself, who had of course examined all of the original recordings in detail, stood firmly behind these published descriptions.

Supportive findings have again also appeared in relevant parts of the subsequent EEG literature.[66] In the Banquet (1973) study, for example, the EEG patterns that accompanied the deepest meditative states, and only these, specifically included spatially generalized moderate-amplitude fast activity in the vicinity of 40 Hz. Even stronger confirmatory evidence has recently been found in a study of eight highly experienced Tibetan Buddhist meditators by Lutz, Grieschar, Rawlings, Ricard, and Davidson (2004), who also point out the theoretical connection between coherent large-scale gamma oscillations of this sort and perceptual "binding" as conceived by contemporary global-workspace theorists. Also potentially relevant here is the curious fact that nitrous oxide, a known psychedelic agent, has been shown to produce high-amplitude gamma-band EEG activity, mainly in frontal areas (Yamamura, Fukuda, Takeya, Goto, & Furukawa, 1981).

The central point of this highly selective review is not to claim that anything has yet been definitively established in regard to physiological correlates of deep meditative and mystical states, but only that we already have substantial, empirically grounded indications that such correlates exist and are accessible to well-conceived imaging studies of the sorts outlined above. We will conclude with three further observations concerning the future of such research.

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66. One possible exception here is the study of Anand et al. (1961a), who specifically state that they did *not* observe the high-frequency, high-amplitude EEG activity reported by Das and Gastaut. It is not clear, however, whether their experimental conditions, physiological instrumentation, and EEG recording procedures were fully comparable.

Further Guidelines for Future Research and Theory

First and foremost, we emphasize again, and again as in the case of genius, the vital importance of focusing more future research on the real thing—here, genuinely deep meditative and mystical states and persons who experience these—rather than on conveniently available but inadequate surrogates. Furthermore, although it would now be technically possible and certainly worthwhile to carry out more comprehensive and penetrating field studies of the Das and Gastaut sort, it should not really be necessary to travel to places such as India or Japan to find suitable subjects. One long-term consequence of the culture wars of the 1960s is the creation throughout the Western world of sizeable cadres of individuals seriously engaged with meditation and other transformative practices, at least some of whom would surely be willing to participate in meaningful scientific research conducted by sympathetic investigators.

Second, collection of new data should be far the highest priority until we really know something about what is going on in these unusual individuals and states. Most of the theorizing that we have seen so far is very premature, and implicitly presupposes that information derived from neurophysiological and neuropsychological investigations of "ordinary" cognitive functions can be extrapolated freely and without limit to "extraordinary" ones. This approach fails to take into consideration recent neuroscientific research revealing a previously unrecognized degree of plasticity even in the adult nervous system. The human brain is heavily weighted toward top-down anatomical connectivity and shows remarkable functional adaptability at all time scales, from milliseconds upward, with numerous mechanisms available to make some of these functional changes—for good or ill—persistent or even permanent (Gilbert, 1998; Kohn & Whitsel, 2002; Merzenich, Recanzone, Jenkins, Allard, & Rudo, 1988; Taub, Uswatte, & Elbert, 2002; see also Chapter 1). Such effects seem *a priori* likely to be reflected in the anatomical structure and functional organization of the brains of long-term practitioners of meditation and other transformative disciplines (as well as in persons who have undergone powerful mystical-type experiences), and indeed some evidence of topographically specific anatomical changes in meditators has recently appeared (Lazar et al., 2005). We should study these anatomical and functional arrangements directly, and with minimal presuppositions regarding their possible form.

This need for better empirical grounding also bears strongly upon our final suggestion, which is this: The more we can learn about the nature of *essential* physiological changes associated with deep meditative and mystical states, the better will be our chances of learning how to encourage or reproduce these states under controlled experimental conditions, which in turn will permit us to study both the states themselves and associated supernormal phenomena in greater detail. What is to be avoided here is the premature closing of scientific accounts that gave rise in the 1970s to the first generation of EEG biofeedback devices. During that period, some

promising early demonstrations of a possible association between EEG alpha abundance and pleasurable mental states spawned a cottage industry of electronics entrepreneurs manufacturing low-cost alpha trainers, which were then purchased by other experimenters, who used them to conduct further studies of the same sort, and so on. We need to break out of this kind of vicious circularity by first gaining a much fuller and clearer picture of what the relevant physiological conditions are, and only then trying to find improved ways of creating or supporting them. We think the long-term prospects for providing improved access to mystical experiences in this way are actually rather good, and that society as a whole could only benefit in consequence. Myers and James would surely agree.

Conclusion

Mysticism has largely been ignored by mainstream psychology and philosophy for most of the past century. The encyclopedic *Oxford Companion to the Mind*, for example, barely mentions the subject, and in a recent and massive scholarly anthology on philosophy and consciousness (Block, Flanagan, & Güzeldere, 1997) the word "mysticism" and its cognates appear *nowhere* in the index. The central aim of the present chapter has been to help restore this neglected topic to what earlier thinkers such as Myers and James believed to be its proper place in the foreground of a worthy scientific psychology.

At first it seemed as if 20th-century psychology was well on the way to reducing consciousness to a scientific nullity. This perverse trend has been reversed, however, and consciousness has reappeared on the map of science, although it is still viewed by many as if it were some sort of alien intruder, or "nomological dangler," something best excised, whenever possible, like a hanging nail. But a serious study of mysticism forces us to go beyond merely acknowledging that consciousness is "real" and needs to be explained, to a recognition that it plays a uniquely significant role in cognition generally, and that its reality is of a different order than anything else encountered in the empirical world.

In the first place it is an incontrovertible and empirically grounded fact that the mystical domain comprises large numbers of real human experiences—experiences, moreover, which are often uniquely powerful and transformative—and that experiences of this sort lie at or near the foundations of religions generally and thus even of civilization itself.

Furthermore, careful survey and analysis of the reported experiences reveals that at the core of this domain lies a robust, deeply significant, and still mysterious psychological phenomenon—the introvertive mystical experience of pure, unitary, undifferentiated, self-reflexive consciousness—the singular properties of which pose profound challenges to all mechanist, physicalist, and computationalist theories of human mind and personality.