case. This was hafted high on the face, as in *Pongo* but unlike *Pan*; brain volume was probably in the ape range. In this feature, and in facial profile, jaw joint morphology, malar morphology, orbital shape and disposition, and overall palatal shape, the specimen is quite orang-like. In other features the two species differ; for example, in tooth morphology and wear, and in the considerable fossil midfacial length and ramus height.

Compared with the few other Miocene facial or cranial specimens known, GSP 15000 differs from *Proconsul africanus*[1] and *Proconsul nyanzae*[16] in being more like living pongids, and also differs from the possibly middle Miocene palate and face from Moroto in Uganda[6]. Among other late Miocene hominoids, it is most like the *Sivapithecus* face from Yassiören[4] and less like *Ouranopithecus* from Ravin de la Pluie[3]. However, detailed comparisons with all these specimens, and with those from Lufeng[5] in China and from the Pliocene deposits at Hadar, Ethiopia[2], have not yet been completed.

As reconstruction and analysis of GSP 15000 continues, attention is being paid to the biomechanical meaning and potential functional significance of facial, mandibular and dental features; this involves detailed understanding of equivalent parts in modern systems. As these studies proceed it should be possible to develop a clearer understanding of the significance of the attributes frequently used in taxonomic and phylogenetic analyses. In particular, this will help evaluate the 'primitive' or 'derived' nature of character states.

Meanwhile, there are several similarities between GSP 15000 and *Pongo* that may turn out to be shared derived features. I doubt that *S. indicus* itself is ancestral to *Pongo*; however, I consider it likely that a similar late Miocene species, probably an Asian one, was. To what extent *S. indicus* resembles the last common ancestor of all living pongids and hominids is unclear. There are a few resemblances in mandibular and dental morphology (thick enamel, megadonty, mandibular robusticity) between Pliocene *Australopithecus* and *Sivapithecus* and similar late Miocene species, which may be primitive retentions. If so, in those features at least, the African pongids would be derived rather than primitive, which would have important consequences for the interpretation of hominid origins. However, it would be better to wait until more complete late Miocene hominoid material is recovered, especially from Africa, before constructing evolutionary stories.

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Body temperature changes during the practice of g Tum-mo yoga

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Since meditative practices are associated with changes that are consistent with decreased activity of the sympathetic nervous system[1–7], it is conceivable that measurable body temperature changes accompany advanced meditative states. With the help of H.H. the Dalai Lama, we have investigated such a possibility on three practitioners of the advanced Tibetan Buddhist meditational practice known as g Tum-mo (heat) yoga living in Upper Dharamsala, India. We report here that in a study performed there in February 1981, we found that these subjects exhibited the capacity to increase the temperature of their fingers and toes by as much as 8.3 °C.

g Tum-mo yoga is a form of meditation which allegedly allows its practitioners to alter body temperature. Previously, only subjective descriptions of this phenomenon existed: "The neophytes sit on the ground, cross-legged and naked. Sheets are dipped in icy water, each man wraps himself in one of them and must dry it on his body. As soon as the sheet has become dry, it is again dipped in the water and placed on the novice's body to be dried as before. The operation goes on in that way until daybreak. Then he who has dried the largest number of sheets is declared the winner of the competition"[8].

During the practice of g Tum-mo yoga, '*prāna*' (literally, 'wind' or 'air') is withdrawn from the scattered condition of normal consciousness and is made to enter into the 'central channel' inside the body. Then, through the alleged dissolution of these winds in the central channel, the 'internal heat' is ignited. The physiological changes are, therefore, a by-product of a religious practice.

Each of the three monks in the present investigation had spent more than 6 years practising g Tum-mo daily and had lived most of the past 10 years in near-isolation in unheated, uninsulated stone huts ~4 × 7 m. The floors were earthen and the roofs made of large slate slabs or flattened tin cans. The huts were in isolated locales in the foothills of the Himalayan Mountains at altitudes of 1,800–2,800 m, outside the town of Upper Dharamsala. The first two subjects were studied in their hermitages while the third was studied in a hotel room in Upper Dharamsala. Each participated in the investigation after being asked to do so by H. H. the Dalai Lama. Verbal informed consent was obtained from the three subjects through our translator (J.H.).

Skin temperature was measured in the area of the navel and lumbar region, the chest (nipple), left forearm, left fifth finger nailbed, left calf, left fifth toe nailbed and forehead using small disk thermistors (Yellow Springs Instrument Corporation (YSI), model 427) that were attached to the skin with plastic tape. Rectal temperature was monitored by means of a YSI rectal catheter probe inserted 10 cm beyond the anal sphincter. Air temperature was measured by YSI thermistor air probe (model 405) as well as with a conventional sling psychrometer which was used to measure psychrometric wet bulb temperature to calculate relative humidity. All wires were connected to a multichannel (YSI) switch box (model 4002) and connected to a YSI wide-range Telethermometer (model 42) with a 60 °C range. Heart rate was monitored with a San-EI (model 2D16) Pulse-

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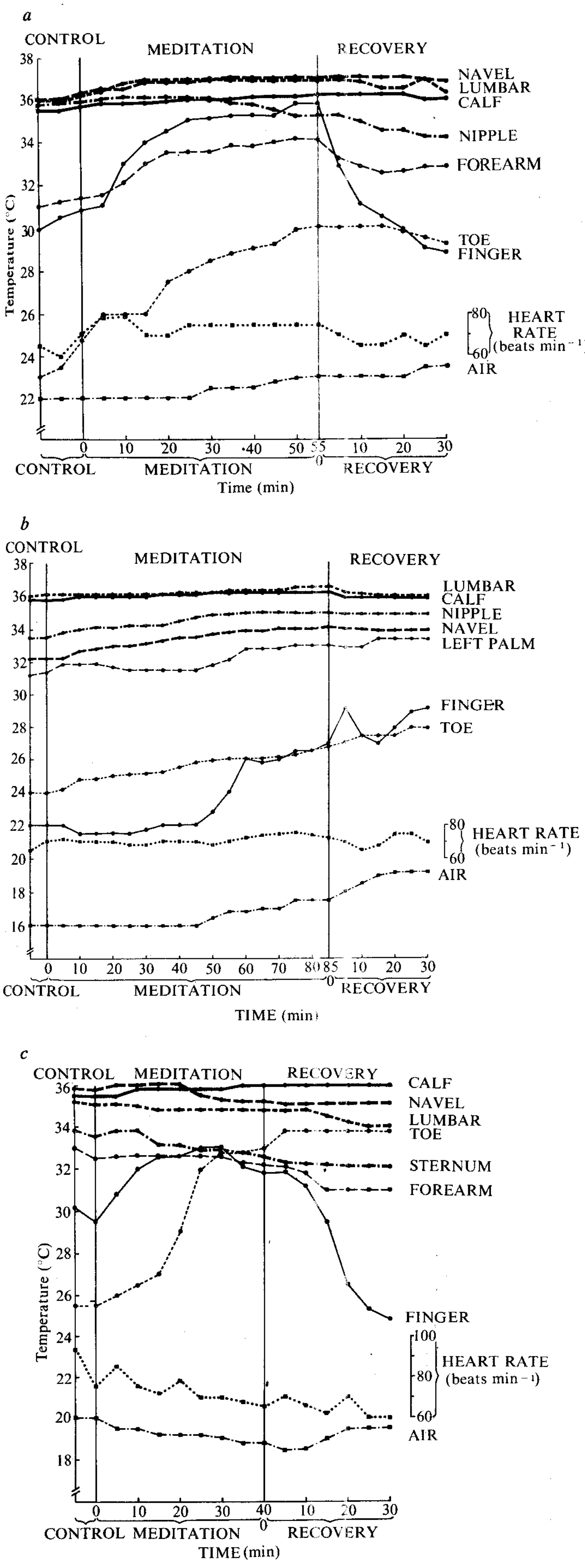

Fig. 1 Skin and air temperature and heart rate changes before, during and after the practice of g Tum-mo meditation in subjects G.J. (*a*), J.T. (*b*) and L.T. (*c*).

meter monitor which used a digital probe to sense each pulse of blood flowing into the thumb. Measurements were taken sequentially and tabulated every 5 min during control, meditation and recovery periods.

The first subject, Ven. G. J., aged 59 yr, sat in the cross-legged 'Lotus' posture. During a 55-min period of g Tum-mo meditation, his finger temperature increased 5.9 °C and his toe temperature 7.0 °C (Fig. 1*a*). In the recovery period, finger temperature returned to baseline levels, while toe temperature, with the toes protected against heat loss by the lotus position, remained elevated. Navel and lumbar temperatures increased by 1 °C during the meditative period. Rectal temperature was unchanged. Air temperature slowly increased from 22.0 to 23.5 °C during the hour. Heart rate increased slightly, by 2 beats per min, during the meditative period and then returned to baseline levels.

Finger temperature in the second subject, Ven. J. T., aged 46 yr, increased 7.2 °C, the highest levels being recorded in the recovery period at a time when the subject claimed that, although he had stopped meditating, the subjective experience of g Tum-mo heat had continued (Fig. 1*b*). A similar pattern with a 4.0 °C increase was noted in the toe temperature. Navel temperature increased 1.9 °C and nipple temperature 1.5 °C. Rectal temperature was unchanged. Air temperature slowly increased within the hut from 16 °C to 19.2 °C, the most marked changes occurring late in the recovery period. Heart rate was essentially unchanged throughout.

The third subject, Ven. L. T., was 50 yr old. Because his g Tum-mo changes started any time he was in a sitting posture, baseline measurements were taken in the upright posture. We first performed measurements on this subject outside his hut. However, high radiant heat temperatures hampered skin temperature measurements and since our visit coincided with the celebration of the Tibetan New Year, when the monk walked to Upper Dharamsala to listen to a lecture given by H. H. the Dalai Lama, we studied him again in a cool hotel room. His finger temperature rose 3.15 °C while toe temperature increased 8.3 °C (Fig. 1*c*). There were no other large changes in skin temperature. Rectal temperature was unchanged. Air temperature within the hotel room decreased during the meditation period from 20 to 18.5 °C, and then rose to 19.5 °C in the recovery period. Heart rate decreased after assuming the sitting position and continued to fall slowly throughout the experiment.

The subjects in the current experiment exhibited a greater capacity to warm fingers than has been previously recorded during hypnosis and after biofeedback training[9–15]. Although it is possible that the practitioners had learned to increase their metabolism to produce more body heat, this seems unlikely. Even though they were all lean, the monks claimed not to require more than a 'normal' amount of food. Furthermore, their resting heart rates were within normal limits. The most likely mechanism to account for the increase in finger and toe temperature is vasodilation. Although no direct measurements of peripheral blood flow were made, others have calculated that during the simple meditative process of transcendental meditation, there is a 44% increase in nonhepatic, nonrenal blood flow[16] and they hypothesized an increase in skin or cerebral blood flow or both.

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Preferences for cousins in Japanese quail

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Early experience affects the mating preferences of many birds and mammals[1,2]. The plasticity of behaviour is such that individuals reared with a member of another species may subsequently choose to mate with that species[3–6]. Recent evidence suggests that the most strongly preferred mates are slightly different from individuals that are familiar from early life[7–9]. The implication of these findings is that an individual is able to strike an optimal balance between inbreeding and outbreeding by learning about its immediate kin and mating with a member of the opposite sex that is slightly different from its immediate kin[1,10]. What such a balance might amount to in practice has previously been uncertain. I report here that Japanese quail of both sexes, having been reared with their siblings, subsequently prefer a first cousin of the opposite sex.

The Japanese quail (22 males and 13 females) tested in this experiment were obtained from eggs laid by four different pairs in our laboratory colony. Eggs from a given pair were collected over 2-week periods and placed simultaneously in a separate compartment in an incubator. When transferred 13 days after the start of incubation to a hatching incubator, eggs were again kept in separate families and hatched separately. Within a day of hatching in the dark, the chicks were transferred to rearing pens and kept in true families in the same conditions as those used in previous experiments[7,9]. The birds were isolated 30 days after hatching. Testing started at 60 days, when the quail were sexually mature.

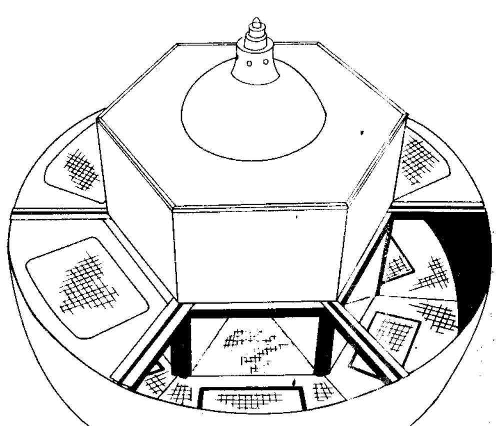

Fig. 1 Apparatus used for testing preferences of adult Japanese quail. Stimulus birds were put singly in the inner compartments, which were painted white and lit from above. The outward-facing windows were fitted with one-way screens. A test bird could move freely round the black unlit outer part of the apparatus. A pedal in front of each window operated a microswitch.

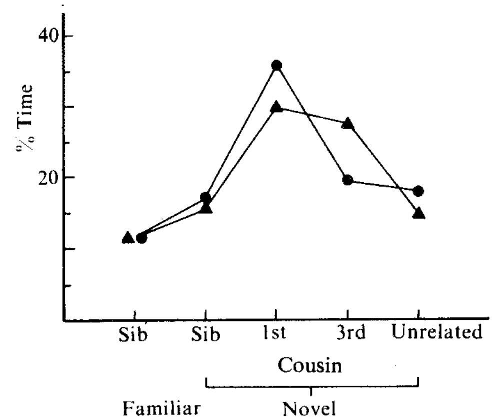

Fig. 2 The mean percentage time spent by adult Japanese quail near members of the opposite sex that were either familiar siblings (Sib), novel siblings, novel first cousins, novel third cousins, or novel unrelated individuals. The chance level is 20%. ▲, Males ($n = 22$); ●, females ($n = 13$).

The pedigrees of the quail in the colony were known for at least four generations and pairings had been carefully arranged. It was possible, therefore, to test all birds with a variety of members of the opposite sex that were of different degrees of relationship but of the same age. In addition, some true siblings were reared separately so that when the birds were tested, they were given choices between familiar and novel siblings, novel first and third cousins, and novel unrelated members of the opposite sex.

The apparatus used for testing the adult quail is shown in Fig. 1. The compartments in which the stimulus birds were placed faced outwards from the centre of the apparatus. The inside walls were painted white and the outside wall consisted of a one-way screen. The outward-facing windows were used so that the test bird was not visible to the stimulus birds. The outer runway was painted black and the test bird could move freely from one window to the next. To eliminate possible bias, when a test bird was initially introduced into the apparatus, it was placed in front of a compartment containing a different stimulus bird from the one tested previously. Furthermore, food and water for the test bird were placed on the outside wall opposite the compartment of every stimulus bird. Each test session lasted 30 min. Pedals which triggered microswitches were placed in front of the compartment of each stimulus bird. The time spent in front of each of these stimulus birds was recorded automatically and expressed as a percentage of the total time spent in front of all five types of stimulus bird.

Figure 2 shows the mean percentage duration spent in front of each category of stimulus bird by both adult males and females. Table 1 gives the scores for each individual. The males were slightly more ready than females to spend time near a third cousin of the opposite sex. However, in this sample at least, the behaviour of the two sexes were statistically indistinguishable and, for the purpose of the analysis, these data were pooled. First, all the data were examined using the Friedman test and the overall deviation from chance was found to be statistically significant ($\chi^2 = 10.07$, $P < 0.05$). Second, the time spent near each category of stimulus bird was compared with the time spent near each other category of stimulus bird using the Wilcoxon matched-pairs test. The time spent near novel first cousins was significantly greater than that spent near both familiar and novel siblings ($z = 3.02$, $P < 0.01$ and $z = 2.23$, $P < 0.05$, respectively). The time spent near novel first cousins was also