

minded, the US system is frighteningly conformist, in contrast to the Indian (non)system. Invitations to conferences, and research grants are definitely more likely to come your way, if you have been doing epsilon physics in popular areas. I know of absolutely world class physicists here, who have routinely been getting the cold shoulder for doing excellent things but not using the right buzz words. Secure research funding, and lack of tight structure give the physicist in India a much greater freedom to choose the topics of research. Increasingly, people have been using this option in India, and I know of several excellent Condensed Matter people doing somewhat non-standard things. The absence of bunching does give a somewhat non-professional look to the outside observer, not many PRL's come out, etc. However, this *laissez-faire* way of doing Science, akin in some sense to the individualism of a Bhimsen Joshi rendering, or a Subhash Gupte googly, is quite uniquely Indian, and I submit, a positive and healthy alternative to 'over-organized physics'.

Glass ceilings are ubiquitous: if one prejudice does not get you then another will, and the only question is of degree. Luckily this does not seem to be too much of a problem in condensed matter physics in either country at least at this time.

Roundup

In summary I have presented some of

my thoughts on a few questions that often arise in conversations. Of the various families of organizations that I listed above, I have spoken mostly about the DAE family and TIFR in particular where I grew up. Of late the Institute of Physics in Bhubaneswar and Institute of Mathematical Studies (Madras), both belonging to this family, have shown a very positive and mature policy in hiring very good young theorists, and seem all set to take off in a big way. In the UGC family, IISc Bangalore has clearly been the leader all along, and has played a pivotal role in organizing many meetings in condensed matter physics, but seems to be at a somewhat saturated state as far as hirings go. The Jawaharlal Nehru University in Delhi has been hiring vigorously and has a strong group in nonlinear systems. The IITs seem to be floundering somewhat in their research, despite very good work done there in the past, their charter clearly defines physics as a service faculty with teaching as the main goal. There are very good people in the IITs, but somehow their role, at least at the present, seems to be to produce the best graduate students for Princeton and Harvard!

Excellent individuals dot the landscape in India, working at several places around the country. It is not too difficult to locate a good condensed matter theorist within a 500 mile diameter circle in most parts of India. This was absolutely not the case some 15 years ago when I started out, and is

very encouraging to my eye. Perhaps the next decade will see a further growth in India in this area, there is after all no shortage of people (!), or even of good physicists of Indian origin, as the gathering here indicates.

Postscript

After the talk I received very interesting comments and questions during the discussion period, some of which, having had no first hand knowledge of, I could not answer. I was asked many questions about experimental condensed matter physics, the question of how top heavy are most groups, do group leaders allow freedom to juniors, of funding prospects, and whether an individual experimentalist going back, could hope to make a difference. I was asked whether women scientists should expect to face any discrimination. If the reader has any experience in this regard, please write in (to *Curr. Sci.*, also): there definitely is a group of Indian scientists in the US, who want to know the answer.

I was informed that Dr V. Berezinski, to whom I had a 'generic' reference in the talk, had an untimely demise in 1982, after a very brief but brilliant scientific career.

B. Sriram Shastry is in AT&T Bell Laboratories, 600 Mountain Avenue, Murray Hill, NJ 07974, USA

OPINION

Why man has no predator

M. G. Watve

The question why carnivores sometimes turn man-eaters has been frequently discussed in the literature¹⁻³. It is, however, always taken for granted that man is not the natural prey of any carnivore. The question as to why it is so has never been seriously addressed. The early hominids certainly had predators⁴. In some stage of evolution human ancestors became practically free

of predatory pressures. The various explanations given are habitat partitioning, improved defences, and carnivory by man.

Habitat partitioning, however, has never been complete. Effective self-defence due to improved weapons, fire and shelter could not have been sufficient to ward off predators completely. The present century man-eaters have

demonstrated this. Many man-eaters have entered villages, smashed open doors, and carried their victims. People carrying weapons were also taken effortlessly^{3,5,6}. It is therefore unlikely that weapons, fire and shelter were sufficient anti-predator defences. An organized armed group defence may be effective against predators, but slight dispersal during foraging in the forest is sufficient

for the quick killing big cats. In Sunderbans, tigers did not attack groups. Majority of man-eating cases (74.6%) occurred during collection of minor forest produce when people were dispersed⁷. Animals with effective group defences like Gaur or Wild buffalo are also hunted opportunistically by large carnivores^{8,9}.

It is a popular belief that carnivores do not eat carnivores and therefore predators may avoid eating the 'hunting ape'. The reason for avoiding carnivore-eating may be the increased risk of acquiring infections or parasites like *Trichinella* or hydatids¹⁰. However in spite of this risk, eating other carnivores is not uncommon. Also the carrion-eating wild pigs, which are mainly responsible for transmission of *Trichinella* infection, are on the prey lists of many predators¹⁰. Moreover, humans eating cooked food are relatively free of these parasites and therefore must be safer to eat.

I suggest here, what may be a better explanation for avoidance of man-eating by carnivores, which is not incompatible with any or all of the above explanations but provides a new dimension to the problem.

The hypothesis: predators as optimum foragers

The prey choice models of optimum foraging theory¹¹ say that a predator will prefer one species of prey, completely ignoring the other if the benefit to cost ratio of the former is substantially greater and the former is abundant enough. Interestingly the abundance of the latter does not matter. This model is attractive enough since Siddiqi and Choudhury⁷ find no correlation between densities of human settlements inside the tiger habitat and cases of man-eating. On the other hand it is usually agreed that man-eating occurs where the 'natural' prey becomes scarce^{3,12,13}.

It is difficult to explain, however, why the benefit to cost ratio of man-eating should be very low compared to other prey species. One of the most popular theories of man-eating has been that when an animal, due to injuries or old age, is unable to kill its usual prey, it finds humans the easiest prey⁵. Even though this point of view is disputed¹⁴ and all cases of man-eating are not

associated with disabled predators, the point generally agreed upon is that killing a human is much easier than killing most other large mammals¹. Therefore the time and energy inputs and number of failures in man-eating could be much lower than wild prey. On the other hand, human meat is comparable in quantity to that of medium-sized deer and antelope species. Since the risk of getting hydatids is less in eating humans who consume cooked food, carnivores should prefer man-eating to eating other animals like dogs, which leopards often do.

I suggest that the factor that could have altered the cost benefits may be mortuary practices. Mortuary practices and death rites of some kind or the other are cultural traits which all human societies have in common. After these rituals started several thousands of years ago, the dead body suddenly became important for humans. No other animal (with the possible exception of elephants) is known to get back the body of the dead. Humans started doing so. This must have changed the cost benefit ratio of man-eating. If people are successful in getting the victim's body back when it is only partly eaten, the benefit to the predator would reduce considerably. If the frequency of recovering the victim's body is high and the time lapsed between killing and recovery is low, the benefit to cost ratio would turn unfavourable enough to change the prey choice and the predators (assuming that they are optimum foragers) would eventually give up man-eating.

Can we test the hypothesis?

The best experiment to test this hypothesis, ideally, would be not to allow any death rites by people sharing habitats with predators for 'sufficient time' and see whether predators revert back to man-eating. Such an experiment cannot be performed for obvious reasons. However, in the documented history such experiments have been inadvertently performed repeatedly many times with clear-cut results. Unfortunately the records are only anecdotal and no quantitative data are available.

Of the two man-eating leopards of Kumaon, which together killed 525 human beings, one followed a severe

outbreak of cholera, and the other followed an influenza epidemic. In both cases mass deaths made the usual cremation practices impossible^{5,6}. Man-eating by wolves in Cawnpore and Hoshangabad followed scavenging on human corpses during a severe famine, and so was man-eating by leopards and hyenas in Ruanda¹. During jungle warfare, many corpses lie unburied which could have resulted in similar outcomes. Man-eating increased in Korea and Vietnam after the well-known wars in these areas¹⁵ and in Burma after the Second World War³. This suggests that whenever predators are allowed to feed on human meat either by hunting or scavenging, they are likely to turn man-eaters. This may be because of the altered cost benefits or may simply be a consequence of developing a taste for human flesh. In either case death rituals do not allow this to happen.

In Sunderbans, where man-eating tigers have been most common, prey scarcity did not seem to be the cause⁷. Here because of marshland, tide and thick vegetation, accidental deaths as well as victims of man-eaters are often not found¹⁴. It is possible that because of the low frequency of recovering the dead, the cost-benefits of man-eating might not have been so unfavourable for the tiger. The distribution of man-eaters has been shown to correlate with the tide level². The tide possibly wipes off spoor and drag marks and makes the search more difficult. It is possible to test this idea by looking at the frequency and the mean time lapse of recovering the body in various tiger habitats and correlating with frequencies of man-eating.

Archaeologically, the beginning of burials and the end of man-eating by carnivores seem to coincide. Burials evidently started from the neanderthal period. The preneanderthals were still a prey to wild carnivores¹⁶. Carnivore gnaw marks are found occasionally on the neanderthal bones¹⁷, but then on apparently they become rare.

A link between death rites and man-eaters is seen in the folklore throughout South-East Asia. If a dead does not receive appropriate ritual treatment, his soul may linger on earth and take the shape of a wild animal to wreak vengeance upon his enemies¹⁸. In many communities the souls of those who die

a violent death, during hunting, fighting, or killed by beasts are considered particularly dangerous and therefore their bodies must receive special treatments^{18,19}. The nailed coffins, the heavy stones that weigh down the grave are meant to 'prevent the soul from returning', but in practice they serve the function of making the corpses inaccessible to predators. Removing flesh from the bones of the dead²⁰, or cremation serves the same purpose. Although in some communities corpses are exposed, it is done on trees, raised platforms or 'towers of silence'²¹, making them inaccessible to ground predators.

Burial practices are usually said to have no adaptive significance. But viewed in the context of the present argument they seem to have a definite and major ecological role to play.

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 M. G. Watve is in Life Research Foundation, 10 'Pranav', 1000/6-C Navi Peth, Pune 411 030, India

**SREE CHITRA TIRUNAL INSTITUTE FOR
 MEDICAL SCIENCES AND TECHNOLOGY
 THIRUVANANTHAPURAM 695 001**

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1. The entry (9) Assistant Professor (Neurology) to be read as (9) Assistant Professor Neurosurgery
2. The qualification etc. prescribed there under to be read as follows:

Qualification

1. A medical qualification included in the Indian Medical Council Act, 1956.
2. MCh/FRCS (C)/American Speciality Board Certification/Diploma of the National Board in the speciality.
3. One year teaching and/or research after MCh or its equivalent qualification in the case of 2-year course/just after MCh or equivalent Course in the case of 3-year course/6 years after MBBS with MCh or equivalent qualification in the case of direct 5-year course.

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