

Towards an Ecological History of India

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Human societies are strongly dependent on their resource base. Changes in this base, in technologies and social modes of resource-use and the conflicts which arise over access to resources are important elements of human history. Each of the wave of human populations which colonised India beginning more than a hundred years ago brought with them their own brand of technology and social mode of resource use. The resultant population itself evolved new technologies and modes of resource use. It is possible that many of the taboos, the rules and regulations of a society incorporate the 'ecological wisdom' of the particular civilisation

A rereading of the social history of the subcontinent affords valuable insights into its ecological history as well. For instance, the ecological prudence of the settled pre-Aryan settlements probably came into disastrous conflict with the lack of such understanding among the nomadic Aryan tribes. At least part of the appeal of early Buddhism may have been partly rooted in its taboo on animal sacrifices in a period when the economically necessary animals were already dwindling. It is suggested here that the emergence of caste may have been the response to the saturation of capacity of the land to support human populations at the prevalent level of technology and the strong competition for the resources of the land

RECENT decades have witnessed increasing attention being focused on the state of the natural resource base of our country, and the social conflicts arising out of its depletion. While we now have some documentation of this during the colonial and post-colonial periods, little has been written on the ecological history of the subcontinent prior to the British conquest. This article is a preliminary attempt in that direction.

INTRODUCTION

All human civilisations are intimately related to the resources of the lands they inhabit and lands and waters they have access to and are affected by. This is because man, more than any other living creature, has succeeded in eliminating predators, competing animal species and lately even diseases as factors limiting his populations. Moreover, man has developed ever increasing demands on resources combined with ever increasing abilities to utilise them, far outstripping his biological necessities.¹ Human societies are therefore strongly dependent on their resource base, and changes in this resource base and in technologies and social modes of resource use as well as conflicts over access to resources are important elements of human history.

The subcontinent of India lying in the wet and dry tropics is a region potentially rich in natural resources. It has been colonised by wave after wave of human populations beginning more than a hundred thousand years ago. Each of these has brought with it its own brand of technology and social mode of resource use; ranging from the earliest hunting gathering Proto-australoids to the Caucasoids from the industrial nations of Europe. At the same time, the resulting population on the Indian subcontinent has itself grown and evolved new technologies and modes of resource use. This paper is an attempt to sketch these developments. Since I am an ecologist and not a student of history, the attempt is necessarily preliminary and somewhat speculative, and possibly flawed. Nevertheless, I venture to outline these ideas in the hope that they

would eventually lead to a working programme of some real interest

ECOLOGICAL PRUDENCE

Any behaviour pattern ensuring increased access to them is apt to be favoured in populations limited by resources. The commonest behaviour directed towards this goal in man's animal ancestors is territoriality, i.e. exclusion of potential competitors of the same species from a region of space. Territorial behaviour can be quite flexible, varying in time and space with the nature of the resource and the need for it. Further, territories may be held by individuals, by mated pairs, or by a group of related individuals. Humans are a social species, banded in a group of at least a few tens of individuals that co-operate in hunting larger prey and in defence against predators and enemies.² Hence, at the hunting gathering stage of the society, human groups would defend territories harbouring their food resources in most productive and stable environments. However, in less productive and fluctuating environments the size of territory sufficient to support the group may be too large for effective exclusion of competing groups. At this stage of economy, the hunter gatherer populations would accumulate at any time little surplus which could be usurped by a competing human population. The inter-group competition would therefore focus on control over group territories. Such competition would be most intense in productive, stable environments like flat alluvial plains, and mildest in harsh, unstable ones like hill ranges in a desert.

The health of the resource base sustaining it would play a significant role in determining the well-being and competitive ability of any territorial tribe of hunter gatherers. This would be particularly critical in highly productive and constant environments such as alluvial plains where the populations would grow close to the carrying capacity of the environment. On the other hand, where territories are ill-defined and populations mobile and maintained below the carrying capacity due to large temporal fluctuations,

a social group would have much less at stake in prudent, sustainable use of the resources of any specific locality. We therefore expect a gradient of cultural practices of ecological prudence, from being strong in productive and stable environments to being much weaker in harsher and/or less stable habitats.³

There is abundant evidence of a number of practices of ecological prudence which seem to date from the hunter gatherer stage and which still survive in many human cultures. By ecological prudence we mean exercise of restraint in the exploitation of natural resources such that the yields realised from any resource are substantially increased in the long-run even though the restraint implies foregoing some benefit at the present. Such restraint could take the form of a restriction on total yield from a resource (such as a limit on the weekly amount of fuel wood collected by each household from a communal grove), a restriction on the method of exploitation of the resource (such as taboo against use of metal implements for cutting wood from the orans of Rajasthan), a restriction on exploitation of the resource at certain stages of life history (such as taboo against killing a pregnant doe amongst the Phasepardhis of Maharashtra), or a restriction on exploitation of the resource at certain localities (such as taboo against cutting any tree in a sacred grove or killing any animal from a sacred pond).³

In fact, many of the whole spectrum of practices of nature conservation amongst primitive cultures described with such erudition by Frazer in "Golden Bough", or by Rapaport in the more recent "Pigs for Ancestors" might have been adaptive in enabling the human groups to use their resource base in a sustainable fashion.⁴ The restraints necessary to achieve this would go against the immediate self-interests of individual members of the group, but be in favour of the long-term interests of the group as a whole. The notion of 'sacred' and taboos related to such a notion may have originated largely to enforce on individuals behaviour in the larger interest of the

group.⁵ It is of course possible that it may have been increasingly employed during the course of history to serve narrower interests of a group of individuals acquiring a monopoly over dealings with sacred phenomena.

Acceptance of such practices of ecological prudence institutionalised with the help of a notion of sacredness apparently did not guarantee long-term sustainability of all resources supporting human populations, although it may have significantly contributed to such a goal. In any event, such practices could not be expected to be fully effective, for the human societies would have to come up with the prescriptions through a process of a patchwork of trial and error. In particular, the practices are apt to become inappropriate in face of a rapid environmental or technological change or a social change imposed from outside. It is, in fact, suspected that a number of mammalian populations supporting human societies went extinct at the end of Pleistocene in many parts of the world. This happened on the Indian subcontinent as well with extinction of species such as hippopotamus and baboons recorded earlier in the fossils of Narmada bed.⁶ These extinctions may have been related to overhunting in a period of rapid climatic change following the withdrawal of the ice age some 10,000 years ago.⁷

NEOLITHIC REVOLUTION

The human species with its symbolic language developed at least by the time of the cave paintings of 25000 years ago, had the capacity to come up with entirely novel ways of resource use when faced with exhaustion of resources it earlier depended upon. The mass extinctions of large mammalian prey at the end of the ice age in many parts of the world, seems to have ushered in such a revolution in resource use through cultivation of plants and domestication of animals.⁸ It is now believed that there were a number of centres of plant and animal domestication, though India was not one of the major centres. It is possible that the impact of changes following the onset of interglacial was minimal on the Indian subcontinent, so that its indigenous populations were under no pressure to domesticate plants and animals, although the fowl is likely to have been domesticated in India.⁸

There were however several important centres of domestication in lands not too distant from India. Wheat and barley were brought under cultivation in west and central Asia some 10,000 years ago. Rice began to be cultivated in southeast Asia not long afterwards, as also tuber crops like yams. Millets were domesticated in Africa. Cattle were domesticated on steppes of Asia, as were horses. Sheep and goat were domesticated in dry tracts of west Asia, while buffalo was domesticated in southeast Asia.⁸ Whether the communities that participated in this neolithic revolution bettered their

quality of life is a matter of dispute, some anthropologists arguing that the hunter gatherers were citizens of the original affluent society.⁹ It is however clear that the new agricultural and pastoral societies that came on the world scene had a definite competitive edge over the hunter gatherers under many circumstances. This is due to the fact that agriculture and pastoralism can support much higher population densities than hunting gathering permitting an increase in the numbers available for aggression. Furthermore, agriculture and pastoralism at least seasonally generate a large surplus of grain and meat on hooves which makes possible free time and organisation of aggression on a far larger scale than is possible for the hunter gatherers. The new technologies developed by the agricultural-pastoral societies, such as the working of metals and the use of horse also render them more effective in aggression.

Given their new resource base, the agricultural-pastoral populations are expected to expand outwards from the various centres of origin of domesticated plants and animals. In the process they would usurp and occupy new territories. In addition, their technologies could be adopted by hunter-gatherer tribals with whom they would come in contact. Both of these would result in a diffusion of the more advanced technologies from centres of their origin. Such cultural diffusion of agriculture from mideast northward into Europe has been well-documented by archaeological evidence. A similar process of eastward diffusion must have brought these technologies to northeast India some seven thousand years ago.¹⁰ A parallel process of diffusion of paddy and yam culture must have brought it to the northeastern India somewhat later. Apart from these land routes, migrations across the sea must have brought in other elements; especially millets from Africa into peninsular India.

SHIFTING CULTIVATION

Agricultural production is based on tapping the fertility of soils on which plants grow.¹¹ The soils themselves are a product of the vegetation, animal and microbial life and can make up for the loss of fertility sustained through cultivation if put back under the cover of natural vegetation for a sufficient length of time. This of course is the principle of shifting cultivation which must have been the earliest form of agriculture except where the soil fertility was replenished through special processes such as flooding and deposition of nutrient rich silt by a river. A given plot of land is cultivated after a gap, sometimes of decades in this primitive system of agriculture. Much of the land under this system would therefore remain under various successional stages of natural vegetation which may be even richer than the natural vegetation in game animals such as ungulates. Hunting therefore would continue to play a significant role in the economy of

the shifting cultivators. A band of hunting gathering tribe would then become transformed into a hamlet of shifting cultivators. This certainly appears to be the case with many tribal populations of northeastern and central India. Such bands are organised into tribes which hold all land as a communal territory of the tribe. The natural living resources of this territory continue to be of value to the human occupants in many ways; as game, as source of fuelwood and so on. The health of this resource base would therefore continue to be of significance in determining the well-being and competitive ability of the tribe, and they may be expected to retain the cultural practices of ecological prudence. There are indeed a variety of such practices including sacred groves and regulated use of communal groves for fuelwood that continue to be a part of the culture of the northeastern and central Indian tribal belt.¹² Such practices have presumably played a vital role in enabling these tribal societies of shifting cultivators-cum-hunter gatherers to remain in equilibrium with their environmental resources till their resource base was encroached upon first by more advanced agricultural and then by industrial societies.

NOMADIC PASTORALS

Shifting cultivation can be sustained only if the rainfall is adequate; at least 800 mm a year, so that a cover of natural vegetation builds up rapidly over the fallowed land. In drier tracts the crop yields would be too low and the period of fallow required to rebuild the soil fertility too long for agriculture to be a feasible system of resource use.¹¹ In such tracts the hunter gatherers would tend to be displaced not by cultivators, but by pastoralists. The mainstay of such pastoralism would be the cattle, sheep and goat brought in from the west and central Asia. If such animals are to provide the bulk of subsistence, the animal: human ratio necessarily has to be rather high, at least of the order of 10 cattle or 30-40 sheep or goat per head. This implies a total of 500 cattle or 1500-2000 sheep or goat for a band of 50 pastoralists. It is impossible to maintain such herds in a single restricted locality for any length of time: the natural solution is a nomadic life style. But such a nomadic life style implies the absence of well-defined, well-defended territories and consequently an unfavourable milieu for cultural practices of ecological prudence. In such dry tracts dominated by nomadic pastorals, one therefore expects a greater tendency towards overuse and exhaustion of natural resources. Indeed the first well-documented example in India of such exhaustion of natural resources is provided by Ailchin's study of the neolithic cattle-keepers of the semi-arid tracts of peninsular India. The archaeological evidence examined by him suggests that the fences of the cattle pens at the camps of these pastorals were constructed out of

timber at earlier periods. Their replacement by stone walls at a later period around 1500 B C suggests that this region had by then suffered considerable deforestation.¹³

SETTLED AGRICULTURE

The output of grain or meat per head continues to be low in the societies of shifting cultivators, as well as nomadic pastoralists. These systems of resource-use therefore do not permit of any large fraction of population engaged in activities other than producing, gathering or preparing the food. Each adult member of the group performs a whole range of activities including warfare with other tribes, although there may be a certain amount of specialisation as with shamans or traders of the hunter-gatherer stage. The more advanced agricultural societies with substantial surpluses and division of labour would arise in the fertile river valleys where the annual floods replenishing nutrient reserves would make possible highly productive settled agriculture. This surplus would support a variety of specialists. The shamans of hunter gatherer tribes would emerge as priests, the traders would also gain in importance, and there would be a greater variety and number of artisans. But most significantly, such a society would have a professional class of warriors whose business in life would lie in physical coercion. This coercion would be used to usurp the surplus from some human group, generally under assurance of protection from the activities of other usurpers. Initially, the warriors, the priests, the artisans, the traders are likely to emerge from different bands within the same endogamous tribe. In more complex societies they may form separate endogamous groups themselves, while contributing to a break-down of barriers of endogamy amongst other tribes.¹⁴

HARAPPAN CIVILISATION

The so-called Harappan civilisation in the river valleys of the northwestern India was such a society based on highly productive settled agriculture. We may note that its seals depict the peepal tree which belongs to the genus *Ficus*, members of which are widely considered sacred and spared the axe not only in India but in many other parts of Asia and Africa. The genus *Ficus* is a group of plants that occupies a wide range of habitats and produces fruit over extended periods. Its fruit is an important food resource for many species of birds and mammals in seasons when other sources are in very short supply, so that biologists consider *Ficus* a keystone resource for maintenance of bird and mammalian populations in many tropical forest communities.¹⁵ It is plausible that the protection so widely extended to *Ficus* was part of ecological wisdom of many societies, helping to maintain intact animals they continued to prey on even after adoption of highly productive agriculture.

The Harappan culture came to an end

between 2000-1500 BC. This could have been caused by a climatic change or bad water management sharply reducing the surplus available from agriculture. It could have been caused without either by a gradual exhaustion of soil fertility over millennia of cultivation, or it might have been the handiwork of the so-called Aryan tribes invading from the northwest. The mode of subsistence of the Aryans probably resembled that of castes like Bhati Rajputs of Jaisalmer today. These people have large herds of cattle and sheep which form the backbone of their economy. They may remain sedentary for a few months looking after a small patch of cultivation in years of favourable rainfall; there is no cultivation in years of poor rainfall. In the dry season they move extensively with their animal herds. Traditionally they were excellent horsemen, and while on the move indulged in raiding more prosperous agricultural settlements.

ARYAN INVASIONS

These so-called Aryan or Vedic tribes moving into India, perhaps in response to some environmental change in their original habitat, were superior aggressors probably by virtue of their possession of iron weapons and horse chariots.¹⁶ They ritually sacrificed cattle from amongst their large herds at yagnas. They were led in aggressive encounters by chiefs who perhaps rose to their position through personal capabilities. Other members of the tribe included priests who maintained the tribal lore and presided at rituals. These tribes with a pastoral nomadic background are unlikely to have brought with them a strong tradition of ecological prudence.

The Indian subcontinent must have been covered by a mosaic of settled cultivation in the drier river valleys where tree growth could be cleared with ease, shifting cultivation in tracts of good rainfall, and nomadic cattle and sheep keeping in the dry tracts of northwest and southern peninsula at the time of arrival of the Vedic people. In addition, rivers and sea coast would have fishing populations, and there would be hunter gatherers, pure and simple, in pockets in very dry or very wet and malarial tracts. Except in the regions of intensive cultivation, most of these populations may have remained socially organised as endogamous tribes. Iron was the one element of technology brought in by the Vedic tribes which could, in this setting, contribute to a newer pattern of resource-use by making possible clearing of thicker forests of wetter river valleys. These would then become the focus of the most intense competition involving the migrant Vedic and indigenous populations. A well-known incident in such a struggle is the clearing of the Khandava forest on the bank of Yamuna by the Pandavas. It is narrated in Mahabharata (c 1100 BC), believed to be largely based on historical happenings,

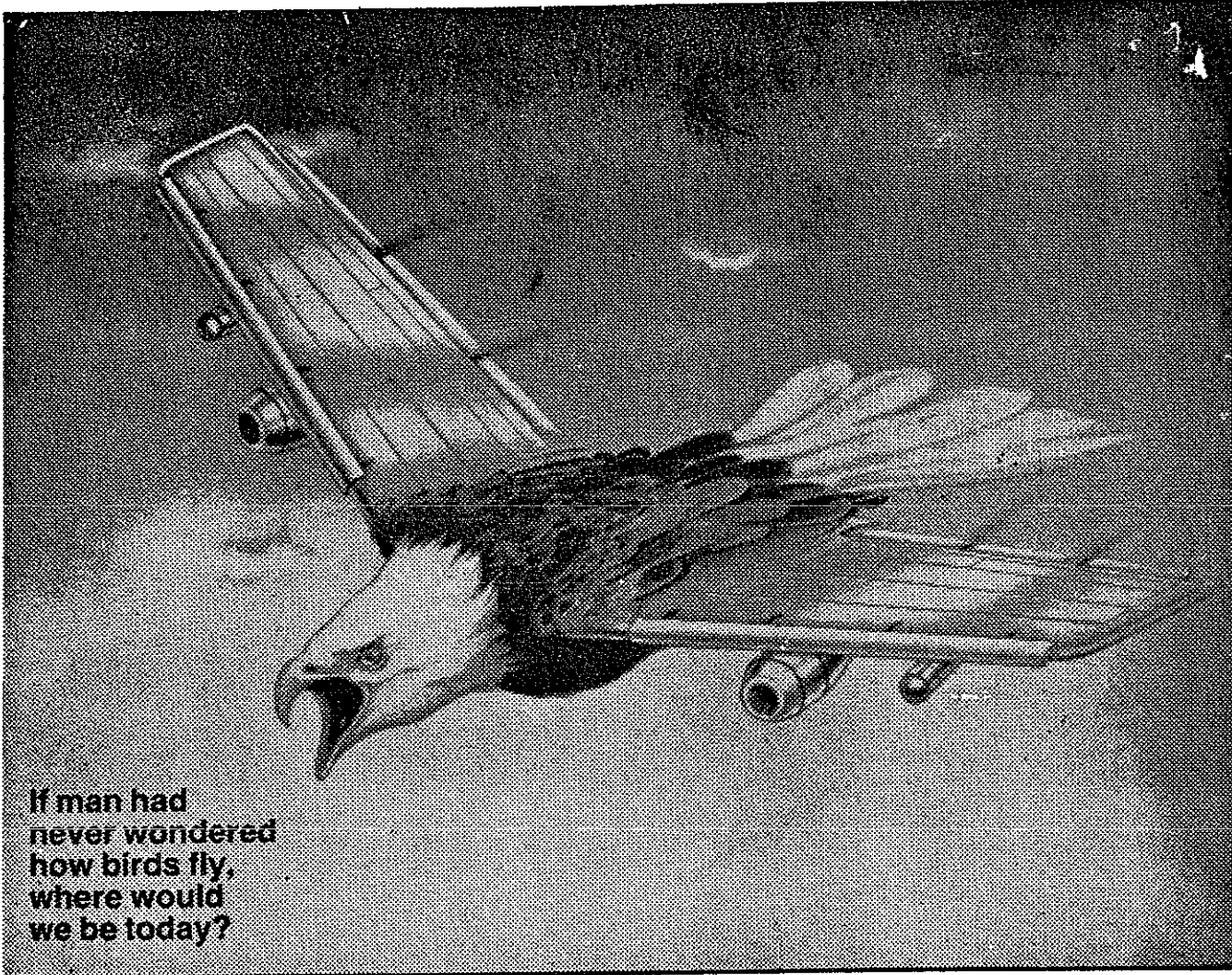
that at the request of the fire god Agni, Krishna and Arjuna set fire to the entire Khandava forest driving back into fire any creature who tried to escape. This included Nagas, presumably the indigenous population of this forest. Pandavas then established a human settlement at this site. This is then an instant of an advanced agricultural-pastoral people completely replacing the indigenous people at a lower level of technology and establishing a new pattern of resource use.¹⁷

The land suitable for settled, intensive agriculture would be limited in the drier Indus valley and the upper reaches of the Yamuna-Ganga valley. These were the tracts first colonised by the predominantly cattle herding Vedic tribes. Such a terrain would provide for them abundant grazing lands and they would continue to combine agriculture with large-scale cattle herding. Cattle raiding would continue on a significant scale and leadership evolve within the tribe in the context of such raids. There would also be warfare with the local populations—Dasas, Nagas, Asuras for the occupation of land.

Mahabharata includes yet another episode of interest from our point of view; mrigasvapnabhaya—or the fear of animal dreams. It is narrated that at one time Pandavas were camping in the forest, hunting avidly. Their pace of hunting so decimated the wild animal populations that they appeared in Yudhishtira's dream and pleaded that Pandavas move to another part of forest to let their populations recover. This the Pandavas agreed to do.¹⁷ This episode suggests that the Vedic tribes relished wild meat and its hunting and were aware of the need to avoid overharvesting the animal populations. At the same time, it is possible that the hunting and depletion of wild animals might have helped the Vedic people in their struggle with the indigenous populations by weakening the latter, just as the white settlers wiped out the bisons of North American prairies to weaken the Amerindian tribes that heavily depended on this resource.

FERTILE PLAINS OF GANGA

Centuries following the Mahabharata war witnessed the clearing and agricultural settlement of the lower, wetter reaches of Ganga valley, a process largely completed by the time of Buddha (c 600 BC). Unlike the settlement of Khandava forest, this process might have involved a lesser element of actual replacement of indigenous people by the Vedic tribes, and a greater element of diffusion of technology of use of iron tools to clear the thicker forests and to plough the heavier soils. This is suggested by the fact that Vedic rituals and sacrifices did not assume, in this region, the importance they had in earlier times in Punjab.¹⁴ Fertile land makes up a much larger fraction of total land in this region, so that as cultivation progressed, there would be a much smaller proportion available to provide grazing for cat-



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tle in comparison with Sind and Punjab. This would lead to a reduction in the number of cattle that can be maintained. Since cattle provided the motive power needed for agricultural operations, a careful use of the cattle would assume importance. This would render difficult large-scale animal sacrifices at Yagnas. This could have been an important factor underlying the rise of Buddhism as the agricultural settlement came to cover this entire region.¹⁶

What kind of social organisation do we expect to prevail in such an advanced agricultural society? The communal territories of endogamous tribes practising shifting agriculture are likely to have broken down. In fact there is evidence that individual control of land came to play a more and more significant role in this society. Many of the indigenous people, defeated and driven off the land as the forests were cleared, were probably absorbed in the new societies as farm labourers and menial servants. All of this would imply that many different endogamous groups would now come to overlap geographically, to live together. This could lead both to a breakdown of old barriers of endogamy, and erection of new ones. An important element of Buddha's teaching was the ethical equality of different social classes and strata. In one of his dialogues he argues against the notion that different communities were like different biological species by pointing out that while interspecific hybrids amongst different biological species tended to be infertile, this was not so with intercommunal marriages. It is therefore possible that there was a significant breakdown of barriers of endogamy amongst different tribes in this period. At the same time, it is possible that there was differentiation and gradual erection of barriers even within originally unified groups with increasing social stratification. Thus, the Rajanyas, the Brahmins and the Vis from within the tribes in ascendance may have come to gradually cease intermarrying amongst themselves.¹⁴

AGE OF EMPIRES

The completion of agricultural colonisation of the fertile tracts of lower Ganga valley by 6th century BC must have resulted in large levels of surpluses in agriculture. This would enable a large fraction of the population to take to crafts, trade and warfare leading to the erection of kingdoms and empires for the first time on the Indian continent. The centre of gravity of this society lay in Bihar with its combination of fertile land and iron and coal fields. The following thousand years were a period of empires with prosperous trade, of many advances in the so-called high culture and in science and technology.¹⁸

Such a society thriving on high levels of surpluses would attempt to enhance these further. This is reflected in many prescrip-

tions in Kautilya's Arthashastra.¹⁹ It emphasises the need to bring new lands under cultivation by settling hunting-gathering tribes who generate little surplus for the state. The Arthashastra also recommends that princes set apart large hunting reserves, as well as elephant forests. Elephants were an important element of armies and Arthashastra prescribes death penalty to anyone killing an elephant. The curious fact that none of the present day tribals of South India (many of whom eat all other wild mammals including monkeys and rats) consume elephant meat suggests that such a restriction might, in fact, have been enforced by the ruling classes through the length and breadth of India. It is only the Nagas and some other tribes of northeastern India, from regions presumably always out of control of any Indian kingdom that consume elephant flesh today. The ban on hunting in hunting preserves, often very extensive, may also have helped in forcing tribals to take to agriculture.

The age of empires drew to a close in the second half of first millennium AD.¹⁸ It is reasonable to suspect that the breakup of empires was caused by a fall in the level of surplus that could be extracted from agricultural production. Such a fall could have been caused by a climatic change, a gradual depletion of social fertility over centuries of intensive cultivation, or a gradual growth in population dependent on agri-

culture. Such a decline in surplus would also imply a fall in trade, and a weakening of the position of traders who had lent strong support to Buddhism. This was perhaps the reason for a decline of Buddhism within India around the same time, leading to the emergence of a new syncretic form of Hinduism and a crystallisation of the caste society.

THE CASTE SOCIETY

We suggest that the emergence of the new Hindu caste society was a response to the saturation of the capacity of land to support the human population at the level of technology then prevalent and the consequent strong competition for the resources of the land. For the caste organisation has many features which tend to minimise competition amongst and within the different castes and to promote prudent use of resources. This has been well-documented for the artisan and service castes involved in the Jajmani system. Thus, there are members of only one caste each of carpenter, potter, barber, etc, in any group of villages. Furthermore, within each such caste competition is regulated through the device of each household of artisan/service caste having the exclusive right of dealing with a specific set of other caste households.

The regulation of competition for natural resources is however best illustrated by that component of the society most directly de-

TABLE 1: PHASES IN THE ECOLOGICAL TRANSFORMATION OF THE INDIAN SUBCONTINENT

The dates, tentative for earlier periods, are indicated in brackets

(i) Subcontinent covered by a population of hunter-gatherers with well defined territories in more productive localities and nomadism in semi-arid and arid zones (100,000 B C to 5000 B C).

(ii) Animal husbandry and agriculture slowly replace hunting gathering over many parts of the country. Intensive agriculture in flood plains of rivers in dry tracts comes to support an urban civilisation. Gradual deforestation of semi-arid and arid tracts. (5000 B C to 1500 B C).

(iii) Immigration of vedic people with knowledge of iron permits the agricultural colonisation of the wetter river valleys such as gangetic plains. Per capita cattle holdings decline so that ritual sacrifice of cattle becomes burdensome (1500 B C to 600 B C)

(iv) Completion of agricultural colonisation of the subcontinent provides large surpluses making possible major empires covering the subcontinent. Levels of surpluses decrease over time leading to a decline in trade and breakdown of empires (600 B C to 800 A D).

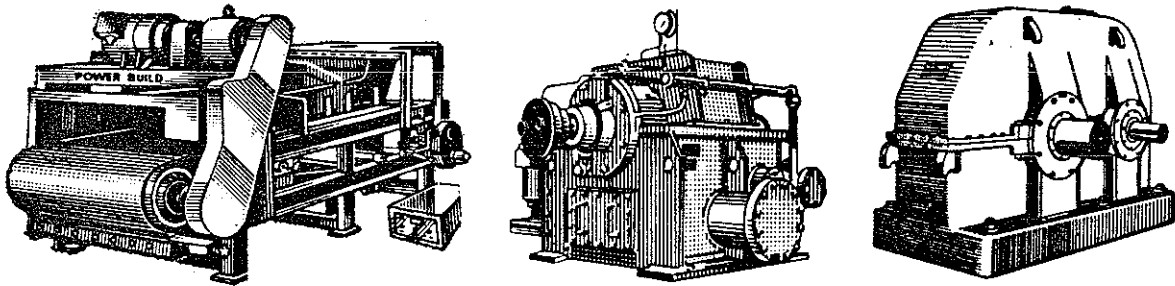
(v) The subcontinent is fully saturated by agricultural and pastoral populations with acute competition for natural resources. This is accompanied by the crystallisation of a caste society which regulates this competition in a fashion that promotes ecologically prudent use of the natural resources. The caste society remains in an approximate equilibrium with the resource base of the subcontinent (800 A D to 1800 A D).

(vi) The British conquest of India opens up the natural resources of the country to exploitation by an industrial civilisation dependent on a much more intensive use of resources. The farmers are compelled to produce raw material for British industry and the forests taken over from communal control and exploited in a totally unregulated fashion. (1800 A D to 1857 A D).

(vii) The resources of the subcontinent are exploited in a more systematic fashion in the British imperial interests with continuing alienation of rural population from access to resources traditionally managed by them (1857 A D to 1918 A D).

(viii) The urban-industrial sector in India begins to develop and makes increasing demands on the natural resources of the country which are exploited in a non-sustainable fashion. At the same time, more and more land unfit for sustained cultivation is brought under the plough by a rapidly increasing population of the subcontinent. The net result is serious loss of productivity of land over more than one third of the country's surface. (1918 A D to date).

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pend on the resources of the land.²⁰ Our first example of this comes from the relatively simple society of the high rainfall tracts near the crest of the Maharashtra western ghats, largely made up of small, often single clan settlements of two castes, Kunbis and Gavlis. Here the Kunbis lived (and still do) in the lower valleys, while the Gavlis lived (and still do) on the upper hill terraces. The major occupation of Gavlis was keeping large herds of buffaloes and cattle. They used to curdle the milk, consuming buttermilk at home and bartering the butter for cereal grains and other necessities. The protein requirements of the Gavlis were met from the buttermilk and they did almost no hunting. The Gavlis also practised some shifting cultivation on the upper hill terraces. The Kunbis on the other hand practised paddy cultivation in the river valleys and shifting cultivation on the lower hill slopes. They kept only a few cattle for draft purposes which produced little milk. To meet their protein requirements the Kunbis hunted a great deal. Thus, the cultivation of valleys and lower hill slopes was restricted to Kunbis and of hill terraces to Gavlis, maintenance of livestock and use of fodder and grazing resources was largely with Gavlis, while Kunbis had the monopoly of hunting wild animals.

Another beautiful instance of resource partitioning is provided by the hunting practices of the ecological guild of three non-pastoral nomadic castes of Tirumal Nandiwallas, Vaidus and Phasepardhis. Between themselves these three castes used to do most of the hunting in the uncultivated tracts away from villages in the semi-arid region of western Maharashtra. The Phasepardhis were primarily hunter-gatherers bartering some of the game for other goods. The Tirumal Nandiwallas and Vaidus had other primary occupations such as performance of bull play, dispensing herbal medicines, selling trinkets, midwifery etc, but hunted extensively for their own consumption.

Some five years ago, we initiated an investigation of the hunting practices of these three castes with the presumption that they hunted much the same animals in the same tract. However our investigations showed that the three groups differed markedly in the hunting techniques employed. Thus the Tirumal Nandiwallas specialised in hunting with dogs, the average number of dogs per household being five even today. These dogs are used in locating, chasing and killing much of their prey which predominantly includes hyaena, leopard cat, wild pig, hare and porcupine. The Vaidus kept a smaller number of dogs, an average of 1.5 per household today. Instead they specialised in catching smaller carnivores like mongooses, toddy cat and domestic cat in traps baited often with squirrels. They also specialised in catching freshwater animals such as crabs and turtles and crocodiles in the olden days. The Phasepardhis never used dogs, but in-

stead used a trained cow to enter a herd of blackbuck or deer laying snares as they moved hiding behind the cow. They also used to snare birds, particularly partridges, quails and peafowl on a large scale. What is striking in this case is that while the hunting techniques employed do differ in this significant fashion, none of them are so sophisticated as to preclude their adoption by another caste. Thus the Phasepardhis could have easily added the Vaidus' baited traps to their own snares. The fact that they had not done so points to a genuine cultural adjustment to reduce competition with other castes hunting in the same region.

This region also has an ecological guild of four castes displaying some domesticated animal to the villagers for entertainment or religious purposes, and an overlapping guild of two castes weaving and selling baskets. It is notable that they all used different species for these purposes. Thus, of the four castes displaying animals, the Darweshis used the tiger or the sloth bear, Nandiwallas the bull, Garodis the cobra and other species of snakes and Makadwallas the bonnet macaque. The Makadwallas also wove baskets, employing exclusively leaves of the Palmyra palm, while another basket weaving community, the Kaikadis exclusively utilised the bamboos.

TERRITORIAL EXCLUSION

We thus have a number of instances of sympatric castes, i.e. castes which overlap in their geographical distribution diversifying their ecological niches by specialising on different resources. The cultivator castes which otherwise occupy identical niches and have a broad geographical overlap coexist by competitively excluding each other from particular pieces of land through land ownership. However, pastoral and nomadic castes which did not own land are not expected to have tolerated geographical overlap with another caste identical in its ways of subsistence. An equivalent of Gause's principle of competitive exclusion, namely, that no two castes occupying identical ecological niches can coexist in a sympatric fashion should hold for such castes.

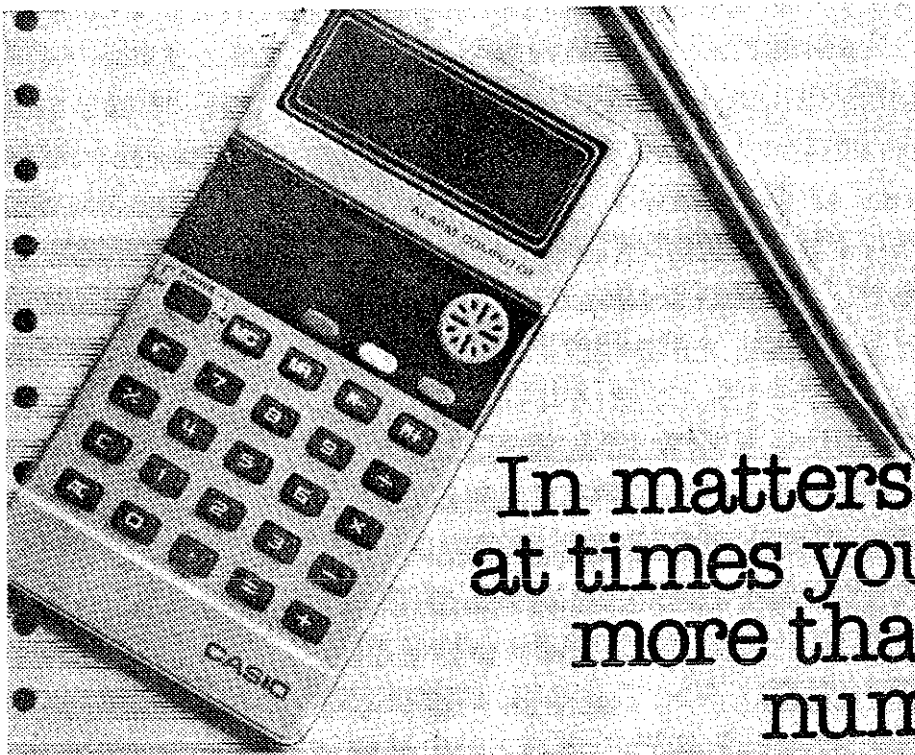
The operation of this principle is nicely illustrated by two castes of Nandiwallas which had and largely continue to have an identical mode of subsistence. These two castes, Tirumal Nandiwallas and Fulmali Nandiwallas are both non-pastoral nomads, making a living by the display of the sacred bull, by selling trinkets and by hunting. They both originated from a common ancestral stock in Andhra Pradesh. The Tirumal Nandiwallas migrated into Maharashtra about 800 years ago, while the Fulmali Nandiwallas did so only 300 years ago. While they have developed complete reproductive isolation, their way of making a living and their culture has remained essentially identical. They thus exemplify castes with completely identical ecological niches.

It is, therefore, notable that Tirumal Nandiwallas and Fulmali Nandiwallas show no geographical overlap whatsoever, i.e. they are completely allopatric. The base village of Tirumal Nandiwallas is Wadapuri in Pune district, while the 39 base villages of Fulmali Nandiwallas are distributed over the districts of Ahmednagar, Bhir, Aurangabad and Nasik. Both these Nandiwalla castes used to, and still largely do, spend the rainy season in their base camps and then spread out over a dry season territory to visit villages to display the bull and sell trinkets. There was, and even today is, a complete absence of overlap in the dry season migratory range of the two Nandiwalla castes.²⁰

Thus different caste populations traditionally moderated or largely removed inter-caste competition for limiting resources through diversification in resource use or territorialisation. It was noted above that sedentary artisan or service castes further moderated competition within the caste by assigning to individual households exclusive rights of dealing with specific households of other castes, while the cultivator castes did so by land ownership. The nomadic pastoral as well as non-pastoral castes achieved this moderation of intracaste competition by assigning exclusive rights to move over certain territory to individual households. Thus, every family of Tirumal Nandiwallas had and even today has exclusive rights to visit certain villages, respected by all other families of their caste, with heavy punishment levied by the caste council for any transgression of this convention. The rights are heritable and may be sold, but only to another family of the same clan within the caste. The Fulmali Nandiwallas have a similar, albeit a less well-defined system. Another instance of this phenomenon is provided by the pastoral nomadic caste of Hatkars. These shepherds spend the rainy season in their base villages in the semi-arid tract and move over a wide territory during the eight months of dry season to graze their flocks of sheep. While setting out on the migration after the rains, each settlement leaves as a single band moving in a traditionally predetermined direction. As the band moves it continues to split along kinship lines into progressively smaller groups each moving in its own specific direction, till the group of families constituting the ultimate unit of the flock reaches its own territory. This composite territory of the small group of families is hereditarily handed down from generation to generation and may be encroached upon only with special permission in times of serious distress by other shepherd families.²⁰

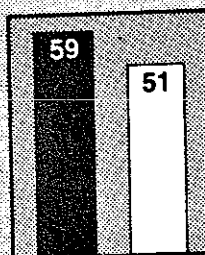
PRUDENT PREDATORS

There is thus a strong suggestion that castes within Indian society, particularly those directly dependent on natural plant and animal resources had developed specific ways of utilising these resources which,

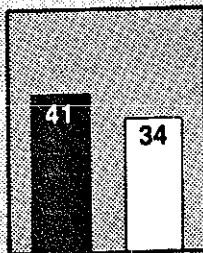


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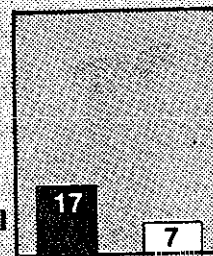
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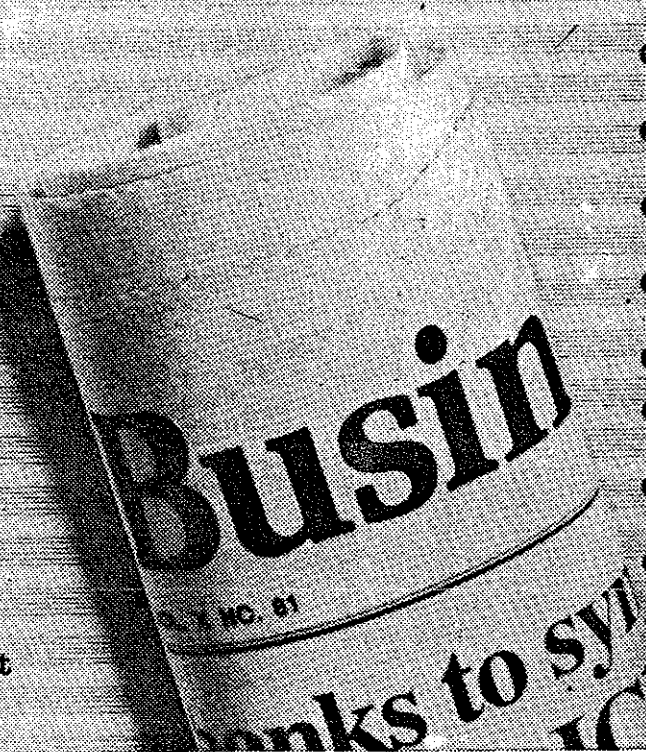
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coupled with territoriality, ensured that a particular limiting resource in a particular geographical region was more or less exclusively utilised by a particular lineage. The lineage would be aware that the resource had supported it for generations past and will have to continue to support it for generations to come.

A significant consequence of this would be to promote the assumption of cultural traditions of prudent exploitation of the natural resources. While exercising such prudence any human lineage would be sacrificing some immediate use of the resource. It can be expected to do so only if it is assured of even greater benefit from the higher resource levels at a later date. For this to hold the following conditions should be met:

(a) Some other lineage should not usurp the resource when it becomes available at a higher level at a later time; and

(b) The resource should continue to be of value to the lineage adopting prudence. Thus, that lineage should not shift to the use of some entirely different set of resources within that geographical region, or to some entirely different geographical region when the resource becomes available at a higher level at a later date.

The mode of resource utilisation evolved by the Indian society clearly fulfilled these conditions. We therefore, expect the assumption of a number of cultural practices resulting in a sustainable use of natural resources by the caste groups which have come to constitute not only the genetic, but also the cultural units of the Indian society. To cite just one example, the Phasepardhis mentioned above reported that traditionally they did not kill a pregnant doe or a fawn of blackbuck caught in their snares, but let it loose. The same Phasepardhi lineage would of course be hunting the same blackbuck populations at a later time and would benefit from such prudence.

The social organisation of castes (defined here as the endogamous group, sometimes termed a sub-caste), has many parallels with tribal societies. Both are endogamous, reproductively isolated populations traditionally distributed over a restricted geographical range, and largely governing their own affairs. Furthermore, the genetic heterogeneity within a caste-cluster, such as Brahmins of Maharashtra, suggests that each Brahmin caste (termed sub-caste according to the more prevalent usages) may have had a distinct ethnic origin. The minor, cultural differences amongst castes, for instance between the small-wheel and big-wheel potters of the potter caste-cluster of Maharashtra also point to distinct origins. All of this lends credence to Irawati Karve's contention that many of the present day endogamous castes of the Indian society may have been derived from endogamous tribes of an earlier times.²¹ We know that several attempts to break down the barriers of endogamy amongst such groups in the

second millennium A D, for instance, Lingayats and Sikhs failed to achieve the objective.

While such endogamous castes have been the genetic and cultural units of the Indian society, at least for the last thousand years, and much longer if many of these have their origin in endogamous tribes, the functional unit of the Indian society is the multi-caste village. In such a village the different castes coexisted in a network of complementary relationships, minimising the intercaste as well as intracaste competition through the devices mentioned above. This does not mean that the different caste groups shared available resources equitably; this was not at all the case. The castes lower in hierarchy often had to accept a much less than proportional share.^{20,21} Nevertheless, there was widespread agreement on the pattern of sharing of resources, so that the village community as a whole (and not just individual caste groups) could assume traditions of prudent use of communal resources such as communal forests and grazing lands.³ It is our contention that this social organisation probably permitted the maintenance of an approximate equilibrium between the resources and human populations on the subcontinent till the impact of the European civilisations.

CHANGES IN THE DESERT

We suggest then that the thousand years prior to the British conquest was a period of relatively stable populations, stagnant technologies and only minor changes in the resource use pattern on the Indian subcontinent. One possibility to the contrary is that of continued overuse and depletion of desert environments with their large nomadic populations. The establishment of a Hindu sect known as Bishnois during the fifteenth century AD may have been a response of the settled farming communities of the desert, with a greater stake in sustainable resource use, to this situation. Bishnois afford strict protection to all wild life, and more interestingly to a tree, Khejdi (*Prosopis cineraria*). This tree has multifarious uses, providing food, fodder, fuel and fencing material. A Bishnoi farmer traditionally did not pluck even a tiny seedling of Khejdi growing anywhere on his farm; so that their villages had excellent tree cover. It is recorded that 363 Bishnois permitted themselves to be killed while trying to save Khejdi trees from being cut at the order of the king of Jodhpur in the seventeenth century. A field visit to Bishnoi villages today provides convincing evidence of the positive value of the protection of Khejdi trees for the quality of life of the villagers.³

THE MARATHAS

While the sedentary farming communities of the desert may have responded to environmental degradation through new traditions of ecological prudence, one of the

responses of the nomadic communities may have been to move out. One such group was the Rajputs, who probably combined raiding settled villages with animal herding. They fanned over many parts of western and northern India and are believed to be the ancestors of the high caste Marathas of Maharashtra. In the western ghats tracts of Maharashtra, for example, such Rajput Maratha families apparently settled down in the fertile valleys during fourteenth to sixteenth centuries displacing the indigenous shifting cultivator caste of Kolis and pastoral caste of Dhangars. From amongst these arose Shivaji Bhonsale, the founder of the Maratha empire that dominated the politics of India during the late seventeenth and whole of eighteenth century.²²

The Maratha kingdom could survive in the seventeenth century by taking tactical advantage of the difficult forested terrain of the Maharashtra western ghats. It is therefore natural that one of Shivaji's edicts warns his officers against any cutting of trees on the slopes of his hill forts. Another of his edicts specifies that his officers may cut timber trees like teak with prior official sanction, but should never cut any fruit yielding trees such as mango or jackfruit as this would mean serious hardships for the local population. Shivaji also built up a strong navy to contend with the European challenge on the coast. The construction of ships for his navy needed large quantities of teak and Shivaji's admiral, Kanhoji Angre started special teak plantations for ship-building in the coastal district of Ratnagiri. It is interesting to note that the British foresters have completely ignored the record of these plantations, described extensively in Campbell's "Gazetteer of the Ratnagiri District", and have claimed that the first ever teak plantations in India were raised in early nineteenth century in Malabar under British supervision.²³

EUROPEAN CONQUESTS

The Judeo-Christian tradition had its birth amongst the nomads of the desert tracts of the mid-east, and this may be part of the reason why it espouses an ethic of aggressive control over nature.²⁴ As Christianity spread over Europe, it attacked and destroyed earlier pagan practices of ecological prudence, cutting down sacred oak trees to build churches in their place. Inevitably the natural resource base of Christian Europe was depleted over the centuries, continuing a process that had begun around mediterranean with the Greek civilisation itself.²⁵ Then came the Little Ice Age of Europe between fifteenth and seventeenth centuries, further depressing the carrying capacity of the land.⁷

This seems to have triggered the European age of exploration, embracing the rest of the globe. The Europeans had already begun their advances in science and technology, providing them, for instance with a

superiority in firing canons more accurately from a ship on the seas. At the same time, the discovery of the steam engine permitted efficient utilisation of easily available fossil energy, resulting in a qualitative change in man's ability to use natural resources. The Europeans then spread over the earth, conquering lands to gain access to their natural resources. Where the indigenous populations were small and at a relatively primitive level of technology, they were brushed aside or liquidated as in the Americas or in Australia. Where they were substantial, and at an advanced level of technology, as in India, the Europeans employed different techniques to usurp the resources of the territory. But we shall not go further into this story here, part of which will be taken up in another article in this issue (see Ramachandra Guha, 'Scientific Forestry and Social Change in Uttarakhand').

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World Trade in First Half of 1985

IMPORTS of developing countries showed a further decline in the first half of 1985, following the decreases in the three preceding years. Imports in the first half of 1985 amounted to \$ 236.7 billion, 5.7 per cent below those in the same period a year earlier. With exports in the first six months of 1985 having fallen by a more sizable 9.9 per cent from the same period a year earlier, the developing countries recorded a trade deficit of \$ 1.4 billion in the first half of 1985, in contrast to the \$ 10.1 billion surplus registered in the first half of 1984.

The group of non-oil developing countries reported a smaller drop in imports in the first half of 1985 relative to that for all developing countries. Imports of the non-oil group totalled \$ 182 billion in the first half of 1985, 2.1 per cent below the first six months of 1984; with exports for the same period totalling \$ 163.6 billion, 5.7 per cent below the level of the first half of 1984, the non-oil group recorded a trade deficit of \$ 18.4 billion in the first half of 1985.

For the oil exporting developing countries, imports of \$ 27.8 billion and exports of \$ 71.5 billion for the first quarter of 1985 were 18 per cent below the first half of 1984.

Exports of the industrial countries increased in the third quarter of 1985. Export values totalled \$ 303.1 billion, 5.2 per cent higher than in the third quarter of 1984. The overall increase resulted from rises, relative to the corresponding quarter of 1984, for all reporting countries except the United States and Australia. Exports of the Federal Republic of Germany recorded the steepest gain in the third quarter; at \$ 45.8 billion, they were 13.4 per cent above the third quarter of 1984. US exports, by contrast, amounted to \$ 50.3 billion in the third quarter, 5.5 per cent below the year earlier quarter.