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Some Important Industries in the Mauryan Age

BY

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Forest Industries.

Chandragupta's government could realise the importance of forests and forest industries. A special Forest Officer[1] was appointed and forests were classified according as they were productive, non-productive, pleasure forests, etc. Great significance was attached to productive forests. These were well guarded by employing watchmen whose function it was to see that no damage or theft was caused to the forest produce in general. Those who trespassed were fined and those who had caused damage to the property were to pay compensation. Even here the humane nature of the administration is evident from the fact that in periods of calamities, such a trespass was not considered an offence and the offender who did it out of sheer necessity was let free. There were timber forests containing a number of first class trees like teak which were essential for building houses and fortresses, for building boats and for furniture. Great care was bestowed on these productive forests.

Then came bamboo forests.[2] As many as eight kinds of bamboo are mentioned. Some were hollow, some were not:

1. Ar. śās. Bk. II Ch. XVII.
2. *Ibid.*

some were hard and some were soft. Some had thorns and others had no thorns. Besides a variety of canes, there were forests of creepers which were again in much demand by the people for some use or other. The value and use of fibrous plants like hemp were understood, and a group of plants of this variety is mentioned as being preserved by the state for the use of the people at large. Add to this the flower gardens. The people of Chandragupta's times were very aesthetic in their taste and decoration with flowers especially by women folk was a common daily feature. Some of these flowers might have been used in worshipping images or for preparing medicines. For we are told of a number of medicinal and poisonous plants.[3] roots and fruits, which it was impossible to get ordinarily. The forests supplied the physician with indigenous drugs with which he was able to prepare medicines and decoctions.

There were trees again which supplied leaves. Palmyra and birch came under this category. Basket making and other cottage industries were done by means of the leaves. Some plants yielded material for making ropes, and these were requisitioned largely by the public. In fact rope making was an extensive industry. Some forests yielded iron, lead and other metals also. Domestic utensils were made of barks of trees and clay.

Everything in the forest was turned to economic purpose. Such was the avidity with which the state proceeded to industrialise the country. The forests again yielded very many necessaries of life. The Government of Chandragupta made no hestitation in exploiting them to the maximum advantage. For example the skins of several animals[4] were put into use. The animals mentioned are alligator, leopard, porpoise, lion, tiger, elephant, buffalo and others. Not only the skins of animals but other products of the animals were also taken into account. The bones, the bile, sinew, teeth, horn, hoofs and tails of these animals were put to different uses. These were used for making beads, musical instruments, medicine and others. A good amount of charcoal, bran and ashes was yielded by the forests. The most essential for man, firewood without which cooking could not be done was

3. Ausadha varga: visavarga.
4. Ar. śās. Bk. II Ch. XVII.

supplied by the forests. So also fodder for the domestic animals. In this way the forests were exploited and added to a considerable extent to the revenues of the state and the welfare of the people. Chandragupta's government did not allow anything to be wasted. The economic value of every article was known and the utmost care was taken to put everything to some productive use.

Agricultural Industry.—India being primarily an agricultural country, the state took all possible steps to grow more food and to make the people economically self sufficient. There is no reason to believe that Chandragupta's government imported food stuffs from outside the Indian world. The Department of agriculture took effective steps to grow more and more food. All facilities which would help to grow more food were given. It is said[5] that the work of the agriculturists would not suffer for want of ploughs and other necessary instruments or of bullocks, or for lack of workmen like blacksmiths, carpenters, boners, ropemakers who would assist in making the agricultural implements and repairing them. Similarly irrigation facilities were afforded and the state realised the importance and value of irrigation to agriculture.

The Department was manned by officials who were versed in the theory and practice of agricultural science. Soil surveys were often made and the quantity of rainfall properly assessed. Wherever rainfall lacked there was a system of canals and channels to carry the water to the cultivable and cultivated fields. For providing such facilities the state levied a water tax which was often determined by the quantity of the produce. In places where irrigation was by carrying water on shoulders, the rate was one-fourth of the produce; if by water lifts, one-third of the produce; if by channels from rivers, tanks, and wells one-third or one-fourth according to the nature of the soil. The officials of the Department knew which soil was most fitted to the growing of particular crops. Care was bestowed in the selection of seeds of grain to be grown. The grain seeds were exposed to mist and heat for a period of seven days, the seeds of *mudga* and *masha* for three days; in the case of sugar-cane, bulbous roots, special treatment was accorded by some mixture of honey, clarified

5. Ar. śās. Bk. II Ch. XXIV.

butter, the fat of the hog and cowdung. The seed was sown on lands which had been often and satisfactorily ploughed. The same attention was given to the manuring of the lands. We are told that when seeds sprouted, they were manured with a haul of small fishes and with the milk of snuhi (Euphorbia Antiquonum). The seed sowing was done at the proper seasons of the year.[6] Rice crops and cereals like sesamum were generally sown at the beginning of the rainy season, mudga, and masha in the middle season, while barely, wheat, linseed, mustard and others in the last part of the season. The Department would watch changes in the season and adjust the growing accordingly. Crops were classified as wet crops[7] winter crops[8] or summer crops.[9] Ordinarily there were two crops raised in a year. In some cases three crops were also raised. This is possible in parts of the country where the rainfall was free from wind and not mingled with sunshine.

Their scientific knowledge was so correct that the choice of soil for growing of special plants and roots was accurate and there was no wastage of any kind. River banks which were subject to beating by foam were considered best for cultivating pumpkin, gourd and the like. In places where water was profuse, long pepper, grapes and sugarcane were cultivated. The neighbourhood of wells and tanks was chosen for growing vegetables and roots. Greens were grown on low grounds while medicinal herbs were planted in marshy places. Some of the herbs and roots were cultivated in pots also.

In addition to the vast activities of this department to secure maximum food material to the communities at large, private enterprise was also encouraged. Crops were of three kinds—first absolutely necessary for life like rice, secondly of secondary importance like vegetables, and thirdly of ordinary value like sugarcane. With this view the Department tackled the food question and made the country dependent on itself. It has been already said that private enterprise was given a fillip in this "grow-more-food" cam-

6. *Ibid.*
7. Kedāra.
8. Haimana.
9. Graiṣmika.

paign. It cannot be said that all lands were brought under cultivation. There were still vast acres which were not cultivated due to lack of adequate facilities. If enterprising individuals offered to cultivate them the state encouraged them by giving lands on very generous and attractive terms. All that was required by the state was to give it a portion of the produce from one fifth to ½ as the case might be. In some cases where cultivation was very difficult further consideration was shown and concessions granted, so that the cultivator would not be put to any hardship whatsoever. This regulation shows that the state was anxious to grow more food but at the same time not to hit the poor labourer below the belt.

Wages were paid in proportion to the amount of work turned out by the labourers and workmen engaged in the service. While one is prepared to admit that the payments were largely in kind, cash payments were also made. A pana and a quarter is said to be monthly wages for these labourers.[10] Artisans who assisted the field labourers were paid a little more. This applied to the watchman, gardener and others. So long as the labourer was properly fed and looked after, he had no grievance. As the Government was built on the solid foundation of dharma, the Government suffered persons who were professedly engaged in religious purposes to take fruits and flowers free, as also rice and barley for sacrificial and similar other purposes. After harvest, there might be such grains scattered in the fields, which if properly gathered would yield a good quantity. The poor people were allowed to gather such grains for their personal use. Proper arrangements were made for heaping the harvested grains in large piles in the threshing floors which were situated close to one another. One other regulation quite healthy in character was that no field workman was allowed to keep fire. It was feared that a fire would consume the field corn and cause ruin and loss to the cultivator.

To the country which regarded agricultural wealth as the only wealth, it is no wonder that every state in ancient India whether in the south or north took keen interest in promoting irrigational conveniences. And Chandragupta's government was no exception. It actively helped the ryots in growing more food and in bring-

10. Sapādapaṇikam Māsam Dadyāt.

ing waste lands under cultivation. It knew the value of a decent and economic living for even the labourer and village officials. So it provided the village headman, physicians, watchmen, veterinary surgeons, horse trainers, and messengers with rent-free lands. They were to enjoy the produce during the tenure of their service or perhaps for their life.

Reference has already been made to the facilities for irrigation to lands which were not fed by rains. The one term *setu* stands for bridges, water courses and embankments. These were thrown throughout the length and breadth of the empire. The four methods of irrigation referred to earlier were in force. These and other sources of irrigation were carefully looked after so that water did not run into waste. Every endeavour was made to carry the water to all the required places. Even wind was used for driving power. By the expression *Srotoyantra pravartimam* one has to infer the use of windmills in large numbers. Apart from the testimony of the Arthaśāstra, we have the evidence of Megasthenes on this interesting subject.

Megasthenes writes: 'the greater part of the soil is under irrigation and consequently bears two crops in the course of a year. Some superintend the rivers, measure the land as is done in Egypt, and inspect the sluices by which water is let out from the main canals into other branches so that every one may have an equal supply of it'. No one should cause damage to the wet fields and gardens and those who did were punished, the punishment being double the value of the damage. Among other regulations provided for in the Arthaśāstra is that the water of a lower tank should not submerge the irrigated field by a higher tank. The flow of water from the higher to the lower tank should not be stopped unless the lower tank had ceased to be useful for three consecutive years. Emptying a tank of its water was also punishable. Repairing, improving, extending and restoring water works were also the function of the irrigation department.[11] The same attention was bestowed on the sluice gates through which alone water could be let out. Persons who placed obstruction of any sort with the supply of water intended for cultivation were also punished.

11. Ar. śās: Bk. II Ch. XXIV.

Improvement of Livestock.—Allied with agriculture is the protection and improvement of cattle. There was a special department[12] which attended to the grazing grounds and meadows for the proper supply of fodder to the cattle. So far as the state was concerned there was a register of cattle wherein was fixed the scale and standard of diet in accordance with the working capacity of each animal. Bulls and bullocks were yoked to the plough. They were fed on meadow grass, ordinary grass, oil cakes, bran, salt, oil, flesh, curds, etc. As the ploughing of fields depended on the health of the bulls, they were carefully reared. Several officials joined together in looking after the welfare of these animals. The superintendents of cows,[13] of pastures, of agriculture, co-operated in their bringing up so as to assure a good breed of bullocks.

Textile Industry.—The textile industry was the next important industry that demanded the attention of the state. In more than one place in the Arthaśāstra, emphasis is placed on the importance and value of cotton growing, cotton being the necessary commodity for clothing. The state nationalised this industry and employed duly qualified persons to manufacture clothes, and bed sheets from out of cotton, skin, silk and ropes. The ropes were generally made of fibres, hemp and flax. Straps and other articles were made of skins and barks of trees specially suitable for such purposes.

There were both skilled workers and ordinary workers.[14] The wages were determined on the quality of the threads spun and the quantity turned out. Three sorts were distinguished—fine, middle quality and coarse. One feature about this industry is that the majoriy of the workers employed were women. Generally widows, cripple women, young girls, mendicant women, mothers of prostitutes, the aged and devadasis no more in the employ of temple service were recruited as workers in textiles. In fact by this device the state secured to provide employment to the otherwise unemployed womenfolk of the country. Woollen, cotton, and silk manufactures were undertaken. While the women were employed to work on coarse and rough varieties, it is reasonable to state, that skilled workmen were employed in manufacturing fine clothes.

12. *Ibid* Ch. XXXIV.
13. Ar. śās. Bk. II. Ch. XXIX.
14. *Ibid.* Ch. XXIII.

Different kinds of garments, blankets, curtains were also manufactured as also mail armour.

It was a general custom that women went to the local weaving house at dawn and presented their spinnings and other stuff and received wages[15] from the weaving superintendent. The latter was expected to examine the threads and fabrics and pay the wages accordingly. It was enjoined that the official should not look at her face or engage in any talk with her. There should be no delay in paying the wages to these women workers who liked to get back to their homes before morning actually set in. But there were other women workers who were not in the habit of going out of their residences. Women whose husbands had gone abroad, the cripple, the aged and the young girls, those who were physically unable to move out were other workers who had no other means to earn their livelihood. These were provided with work and arrangements were made to carry the spun stuff from their homes by special messengers who were invariably maid servants who belonged probably to the menial staff of the weaving establishment.

The superintendent was in active touch with the workers and those who turned out good work were encouraged with award of prizes which included oils, scents and flowers. Special consideration was shown to the labourers who worked on holidays. Strict rules were enforced with a view to get proper work at the stipulated time. If the finished product fell short of the supplied raw material, wages were cut down in proportion to the misappropriation of raw material. Stringent measures were taken against those who stole or ran away with such raw material. The worker who having received wages in advance did not do the work at the stipulated time had her thumb cut off. This might seem a heavy penalty but unless the state enforced such strict regulations, there would have been a tendency to neglect the work entrusted to them.

The Office of the State Goldsmith.—More allied to the department of industries was the establishment of the state goldsmith.[16] He was in charge of the manufacture of gold and silver ornaments, etc. The office of the goldsmith consisted of four rooms all covered

15. Bhāṇḍavetanavinimayam.
16. Ar. śās. Bk. II. Ch. XIII.

by one door. This means every room led from one to the other. Besides this office there were shops where the jewellery were exhibited in a central place on prominent high roads of the city. Every shop was in charge of an experienced goldsmith. He was answerable to the state goldsmith who apparently centralised the industry. Different varieties of gold—the best, the middle and low quality were in stock and ready for sale. The goldsmith knew the process of removing the impurity of the gold procured. In the same way there were varieties of silver. They could distinguish the best from the bad, the pure from the impure. Gold of 16 carats and 17 carats was known. Deception was early detected. Touchstones were used for this purpose. The colour was tested by some heating process. That which put on black or blue hue after heating was considered impure gold.

The goldsmith's office undertook to prepare various kinds of ornaments. Besides preparing ornaments in solid gold, they made hollow jewellery and could set gems in gold as for instance ear rings and rings for fingers. The office was well regulated. Only employees could enter the office. Other persons who visited the office were examined before they went into it as also on leaving it. Even their person and dress were examined. This precaution was intended to prevent fraud, theft or misappropriation of any sort. Honest and efficient workmen were employed for this service. Workmen who would not finish the work would be asked to leave it at a particular place in the centre of the office. When he would come and resume work next morning he would receive it from the office. This was to continue until it was turned into a finished product. Finished articles were examined both morning and evening and were kept in a safe place under lock and key, together with the seal of the worker and the office manager. Proper care was taken in the use of balance and standard weights". Weighing balance and counter weights should be got from the state goldsmith only. Use of false balances with bad slings and pans was relentlessly punished. The same punishment attended the use of spurious stones and counterfeit gold and silver. Things were made to order. Old things could be repaired on payment of the fee prescribed. Skilled artisans who were in this establishment knew soldering, preparing amalgams, enclosing and gilding as also hammering, cutting, scratching, and rubbing.

Bodhi and Visnupada in N. W. India and Toponymic Duplication

By

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The dust of one's own native soil, one's birth-place, one's mother-land, never leaves one's feet, however far, across land and even sea, one might migrate in quest of life, employment or adventure. The dust clings even to the disappointed and unemployed person who heaves in despair "I shall shake the dust of this place off my feet". The moment success attends him in his new habitation, he begins to ponder over with a warmth his original home; a nostalgia spreads over him, and he seeks some consolation by recreating his original home in the new melieu. The adventurous conqueror re-erects in his new territorial find, his proud native-land, and as a standing symbol of his superiority and gain re-names his new place after his own old home. With the migration and colonisation of peoples, there takes place thus a migration and colonisation of place-names also. If a Tanjorean in Madras feels like calling his bunglow Cauvery Nivas, he is adopting the same most natural thing which the authors of the names New York and New South Wales did.

The history of place-names in several parts of this vast country of India is full of instances of this toponymic migration, forming at it does a valuable aid to trace the history and fortunes of different peoples and their political power and cultural expansion. Tiruvālaṅgāḍu near Arakonam in the Chittore District and Tiruvālaṅgāḍu near Kumbhakonam in the Tanjore District is a case of topographical homonomy carrying in its womb the history of how during the reign of the Tanjore chiefs, in the 17th cent. A.D., the distinguished scholar Gaṅgādhara Vājapeyin of the Tiruvālaṅgāḍu in the northern district became at the instance of the southern prince, the donee of the Cauvery village of the same name. A perusal of Cola history and Cola inscriptions reveals to us the existence within south India of tracts of country and their chiefs called

after the well-known north Indian territory and dynasty names. The Mazhavas and their Mazavarnāḍu (Uḍayārpālayam) are known as Mālava. There was a Cedimaṇḍalam on the banks of the Pennār, covering "the hilly area round about Tirukkoyilūr, Kiḷiyūr etc.",[1] and its chiefs were called Cedirāyas. Similarly the country ruled over by the Bāṇas, the Naḍunāḍu, was called Magadhaimaṇḍalam, and it covered portions from Tiruppātiripuliyūr to Salem; and the former town, Tiruppātiripuliyūr, was actually called also Pāṭalī-(Pātiri in Tamil) puttira after the renowned capital of the Magadha country in east India. When the Indian people went out of the country by land and sea and built the kingdoms of their Greater India, they called them Kāmboja and Campā. Close to Sumatra is an island called Madura. Says Col. G. E. Gerini in his valuable work "Researches on Ptolemy's Geography of Eastern Asia,"[2] p. 121: "One should not be in the least surprised at finding so many Sanskrit names of peoples, regions, and cities transported here from India, especially from its northern part, and often distributed in a similar topographical order as they originally occurred there. This latter circumstance is particularly interesting, and constitutes perhaps the most striking example of what we may be permitted to term toponymic mimicry that we know of. Already we have noticed the homology in the distribution and relative location of geographical names, between the coast of Arakan and the western sea-board of India at similar latitudes. * * * The same imitation is carried on with some degree of accuracy in so far as the relative positions of the topographical names are concerned, from the Gulf of Martaban across to Lāos and the greater part of northern Indo-China. In fact, while we have here a second Mālwa and another Daśārṇa, representing respectively western and eastern Laos, as already noticed, we find, further north in Yünnan a second Gāndhara, as well as Mithila and Videha or Videhā, a Campā in the east (Annam) and a Malaya in the south (Malay Peninsula). * * * * while its (Indo-China) southern divisions, including Malay Peninsula, were called after similarly located regions of South of India. Such coincidences are due to the fact that a double

1. For Cedimāṇḍala and Cedirāyas, see Prof. K. A. Nilakantha Sastri, Colas, II, pp. 70 fn. 200, 202, 775. This tract was also known as Malāḍu; see Colas, I, pp. 53, 401.
2. Royal Asiatic Society Monographs No. 1. London, 1909.

stream of emigrants from India flowed into Indo-China at a very early period. * * * * the other coming from the south, reached Indo-China by sea and its influence extended mainly over the Malay Peninsula, Siam, Kamboja and Southern Annam".

The idea of 'Greater' in the expression "Greater India" was expressed in ancient India by the Sanskrit word 'Mahā—' (Mahat-great), as far example, Mahākosala. A new adjoining territory thus comes to have the same name with the addition of the word 'Mahat', when there is an expansion of the people. Sometimes, owing to the pressure of a stronger power from one direction, there is a shift in the territory, as in the case of the Karṇāṭa that has fallen from Kalyāṇ in course of time to Mysore. Sometimes peoples transport themselves or shift too far, and thus even distant countries come to have the same name.

Leaving for the present the north Indian names which have migrated to south India, we can see that in north India itself this process called by Gerini 'toponymic mimicry' had its play. Recently, I came across an information in the Rāmāyaṇa which would be a good illustration of the process of toponymic duplication. The North-West of India is of great significance to anybody who values Indian culture. Pāṇini, the great Sanskrit grammarain, hailed from Śālātura in this region.[3] The north-western countries of Gāndhāra or Gandharva,[4] Kekaya and Madra played important parts in the epics; from Kekaya came queen Kaikeyī who got Rāma banished; Gāndhāra and Madra contributed the queens Gāndhārī and Mādrī to the Mahābhārata. The Sindhu-Sauvīras, the Araṭṭas and Bāhlikas belonged to this part of India. In the Uttarakāṇḍa of the Rāmāyaṇa we find, in cantos 100-101, Bharata, and his two sons Takṣa and Puṣkala, with the help of Bharata's uncle Aśvapatti Kekaya Yudhājit, conquer the Gāndhāra country or Gāndharvaviṣaya, and the two sons of Bharata establish themselves at Takṣaśilā and Puṣkalāvata.[5] The Kekaya and Gāndhāra were contiguous countries. In the Ayodhyākāṇḍa of the Rāmāyaṇa, soon after the demise of

3. For its location, see map IV. facing p. 54 of Cunningham's Ancient Geography of India, edited with Introduction and Notes by S. N. Majumdar Sastri, Calcutta, 1924.

4. Strabo's Gandaritis; Ptolemy's Gandaroe.

5. Greek: Peukelaotis or Peucolaitis.

Daśaratha, we have a description of Vasiṣṭha's messengers going from Ayodhyā to the Kekaya country to fetch Bharata who was staying with his uncle Yudhājit. The messengers go west, reach Hastināpura, cross the Ganges, traverse the countries Pāñcāla and Kurujāṅgala, cross the Sarasvatī at Kurukṣetra, and then cross another river Śaradaṇḍā. The next noteworthy landmark mentioned as lying on their way is a Tree called Satyopayācana with a Caitya at its foot. They enter Triliṅga[6] then and then cross Ajakūla. The messengers then come to a place which is thus described in the different recensions:

बौद्धानां नगरं ययुः । N. W. Recension, II. 74·14.
बोधीनां नगरं ययुः । Gorresio's edn. II. 72·15.
ते बोधिभवनाच्च्युताः । Kumbhakonam edn. II. 68·17.

The messengers then cross the Śataḍru, the Bāhlika country and the Sudāsa country (Gorresio) or the Sudāman mountain (Kumbhakonam). Then they see what is uniformly found in all the editions as Viṣṇupāda.

विष्णोः पदं प्रेक्षमाणाः ।

After seeing this, they arrive at the Kekaya capital which is called in all the editions Girivraja.

गिरिव्रजं पुरवरम् ।

It is interesting to note that the huge trees, Vanaspatis, served as landmarks and objects of worship on the way. We have here a tree with a temple-structure at its foot, Caitya, which the messengers bow to.

समूलचैत्यमासाद्य वृक्षं सत्योपयाचनम् ।
अभिगम्य प्रणम्यैनम् । Gorresio and N. W.
सकूलवृक्षमासाद्य दिव्यं सत्योपयाचनम् । Kumbh.

6. According to the different recensions of the Rāmāyaṇa, there are some slight differences in the place-names mentioned here. Thus Triliṅga in the N. W. recension occurs as Bhūliṅga in Gorresio's edition and Kuliṅga in the southern text.

From its descriptive name, Satyopayācana, we gather that travellers prayed to it and had their requests fulfilled by its divine qualities. A better known instance of such a tree occurs in the same Ayodhyākāṇḍa, the Banian known as Śyāma on the southern bank of the Jumna which the exiled brothers and Sītā pass by, and to which Sītā prays that they might carry out their vow of forest life and return safely.[7] This Tree Satyopayācana was however not the only celebrated holy Tree on the way of the messengers; there was another, a Holy Peepul, or a group of them, Bodhīnām nagaram or Bodhibhavanam, as the Rāmāyana says, which we shall now consider.

The above noted description of the journey of the messengers to Kekaya speaks of three places in the North-west of India, Bodhi, Viṣṇupāda and Girivraja, names which at once reminds us of the east of India, of Bihar, of what was known as Magadha, the home of the Buddha and the country of the Mauryas. It is well-known that the capital of this eastern Magadha, Rājagṛha, had the other name Girivraja also. Bodhi and Viṣṇupāda are also well-known sites in Gayā. How do these names appear in the west of India? The explanation is the same toponymic process which we noticed at the opening of this article. The Bodhi or Aśvatha, the Holy Peepul, is a tree as much sacred to Brahminism, as to Buddhism, its sanctity going to the Vedic times. The Bodhi and Viṣṇupāda must have been two places sacred to the Brāhmans in the North-west of India and these names of sacred places must have been taken by the people with them when they migrated from the west to the east, when expansion took place from the land of the Sindhu to that of the Ganges. Neither in Cunningham's Mahābodhi nor in R. L. Mitra's Buddha Gayā do we find any reference to a Bodhi, a Viṣṇupāda and a Girivraja in the N. W. of India. The latter, R. L. Mitra, says that the Brahminical glorification and importance of sites at Gayā is a post-Buddhistic creation. But it is possible that even in Buddha's time there were in the east holy sites like Bodhi and Viṣṇupāda,[8] and these were not only pre-Buddha, but Brāhminical and really duplicated from the N. W. of India. That there

7. Ayodhyā 55, 23-25.

8. It is already well-known places of sanctity that a new prophet will naturally go to.

was already in the time of Buddha a Holy Peepal tree one and half miles south east of Puruṣapura (Peshawar) is known from Cunningham's account in his Ancient Indian Geography (p. 91). This Peepul was 100 ft. in height and the Buddha is said to have visited it. As for a Viṣṇupāda in the N.W. of India, we know that the Iron Pillar at Meharauli near Delhi on which we have the inscription of a king named Candra, whom Dr. R. C. Majumdar has recently identified on the basis of a Kotanese inscription as Kaniṣka,[9] mentions a hill named Viṣṇupāda on which the pillar originally stood.[10] It is noteworthy that in the first verse of this inscription the king is said to have defeated first the Vaṅgas, then crossed the Sindhu and conquered the Vāhlikas. Regarding the Girivraja, capital of the Kekayas in the N.W., it is identified by Cunningham with Girjāk or the modern Jalālpur on the Jhelum.[11]

All this would mean that Magadha in the east was a colony of the Magadha in the north-west, and that the Magadhan Capital Girivraja in the east was an off-shoot of the Kekayan capital Girivraja in the N.W. There is nothing unnatural in such a supposition when we find that the territory known as Gurajat was originally in the Punjab, and in Yuan Chwang's time was found to occupy a part of Rajputana.[12] The word Māgadha means a musician-minstrel, and the Gāndhāra country, which gave us the musicians, Gandharvas, and this Magadha of Māgadhas might have been once contiguous territories. In Atharvaveda V. 22·14, fever is wished away to the regions of Gāndhāris, Mūjavants, Aṅgas and Magadhas. From this and other Vedic references, orientalists generally assume[13] that Magadha in the east, like Anga, Vaṅga with which Magadha is once mentioned as Vaṅga-Magadha, and Videha were fresh

9. Candra, it is said, is the Sanskrit name which Kaniṣka assumed according to the Koṭanese inscription. See R. C. Majumdar, Journal of the Royal Asiatic Society, Bengal, IX. i. 1943.

10. See Fleet, Gupta Inscriptions, pp. 139-142.

11. See Cunningham, Arch. Survey, II. Simla, 1871. p. 14. See map VI. facing p. 120 of Cunningham's Ancient Indian Geography. It is strange that in the Arch. Survey Memoir (No. 58) by Dr. B. C. Law on Rājagṛha in Ancient Literature, there is no reference to a Girivraja in the N.W.

12. See map VI facing p. 120 and Notes p. 685, Cunningham's Anc. Ind. Geo. as also map facing p. 106, Antiquities of Cambā State by Vogel, pt. 1.

13. See Vedic Index, Macdonell and Keith, pt. II. pp. 116-7.

Āryan colonies in the east, not yet sufficiently made orthodox, still populated with non-Āryans and hence held in disrepute during later Vedic times. To be held in disrepute in later Vedic times, a country may also very well be a region in the N.W., which some groups of the settlers had left for an eastern region, either owing to the intrusion of aliens there[14] or owing to the persistence there of unlivable conditions like the fever of Atharvaveda V. 22·14. A reference to an older habitat and its well-known name is more natural. Mūjavant is the place where Soma grew. The mention of these with Gāndhāra would indicate a north-western provenance for Magadha also. Even the Vaṅga in the compound Vaṅga-Magadha need not mean an eastern Vaṅga; for the Meharauli Pillar inscription speaks of a Vaṅga along with the Indus and the Vāhlikas. In the Ṛgveda, Magadha is not mentioned, but Kīkaṭa is mentioned, and Kīkaṭa is generally taken as Magadha. Is Kīkaṭa then Kekaya? Are the eastern Magadha, and its Bodhi, Viṣṇupāda and Girivraja replicas of those in the N. W. Kekaya, brought to the east by the colonists?

14. Such a state when its people have fallen off from their customs is implied in the abuse which Karṇa pours on this country of Śalya, the Madras, as also on the neighbouring Gāndhra and Vāhlika regions, in the Karṇa parvan of the Mahābhārata.

Geography in the Vidya Bhawan Open-Air Session

AN EDUCATIONAL EXPERIMENT.

By

KEDARNATH SRI WASTAVA,

Vidya Bhawan Udaipur.

For centuries learning totally depended upon classroom abstractions. But the schools of the world are faced to-day with a new problem and a new outlook. Every effort is being made to re-organise our everyday methods of teaching in the light of child psychology. The doctrine of 'learning by doing' has begun to affect the whole machinery of education. Scores of methods have been devised by pedagogues for the teaching of different school subjects, but we have failed to change the fate of Geography. In India, particularly, it is the most neglected branch of knowledge. Even in higher education it is highly discouraging to find that no requisite attention has been paid to the encouragement and progress of the subject. Hence, Geography more than any other subject calls for a profound change in the spirit, aims and methods of its teaching in Schools. Every year, Vidya Bhawan organises an Open-Air Session which may be considered as taking us a step forward in the development of the technique of progressive education in India.

It would be a digression to dwell upon the educational, psychological, physiological, hygienic and sociological values of this unique educational experiment although it is a very fascinating field to explore.

The recent "Raidas Open-Air Session" named after the great Hindi Poet Raidas, the Guru of Mira, was held in Kundeshwar where he is said to have lived. The place is situated nearly fourteen miles north of Udaipur among beautiful ranges of the Aravalli.

Our group, Bhugol Shreni, which was to pursue geographical studies, consisted of 16 students coming from classes VI to IX and four pupil-teachers of the Vidya Bhawan Training College. One

teacher and myself were put in charge of the Shreni work. Proper care was taken to put together children of the same age and with similar aptitudes and interests.

The syllabus of studies was specially proposed for the Open-Air Session keeping in view the possibilities and scope for Geographical studies of the region. While framing the detailed syllabus of work the ideal before us was what we call "creativity" in education. We believe that the only sound approach to its study is the creative approach through which one learns to study the real Geography of the world by actually creating the Geography of some region. This is the ideal we are striving for. Active help of the Shreni leader was sought in framing the syllabus, because he with the teacher had made a cursory reconnaissance of the region.

A few days before we started the syllabus was thoroughly discussed with the Shreni members and elections were held for the posts of Shreni leader, two transport members and one medical incharge. Adequate supplies for clothing, bedding and other equipments of camp life including the Geographical instruments were arranged.

At 9. a.m. on Saturday, the 14th November the expedition started on foot for the land "more delightful, healthy and fertile", a site better supplied with Geographical information, with rich forests, hills, ridges and ravines. We could easily discover on the faces of the children that spirit of enquiry and exploration which Columbus might have had while voyaging to the West. On the way the boys were given practice in map-reading. They verified on the 6 inch to a mile Survey Map, the Geographical symbols with the objects in their natural setting. Real success in map-reading was exhibited when we found them tracing easily the route leading to the destination through the undulating country with the help of the Survey Map.

Eklingji was reached in the evening. The place lies five miles East of Kundeshwar with its historic temples and lakes. Indra Sagar is a hill-girt lake where the boys were to run lines of soundings. Before starting the work one of the colleagues gave a discourse on the history, importance and different methods of sounding generally used in the world. It seemed well first to map the area of the lake by a plane-table. In a boat, with a hand made

plumb-line, some fifty feet long, the boys started the adventurous and long-awaited task as if the whole of the lake was to be churned in no moment. Was it haste or something more sublime? Nay! it was that natural craving which impels every child. However, the work started in right earnest and in a few hours duration they were able to run all possible lines of soundings well distributed over the whole lake. Contour lines were plotted on the map at an interval of 2 ft. and finally shaded with proper gradations. Sections across the lake were also drawn. Were not these maps their own creation? Originality, self-expression, self-activity and creativeness of the children were thus encouraged through this purposeful, intrinsically valuable and pleasure-giving activity. On the other hand it helped them greatly in understanding contour lines, which remain generally so very abstract to most of the school children. Furthermore, it could successfully bring home to the children a reality in marine study.

On the 16th evening we reached Kundeshwar, our long-awaited destination with the camels laden with our luggage. We cannot forget the adventurous journey along with the three camels. Actual study of the Geography of the area started on the 17th morning.

The programme other than the Shreni work was common for all the Shrenies of the Open-Air Session which were also pursuing studies in different branches of knowledge. Different Shrenies reached Kundeshwar from different routes.

Accompanied by the Shreni leader we made a preliminary reconnaissance of the whole valley to be studied. Work was started on the basis of the regional concept of Geography.

The necessity of mapping the whole area was first realised and boys were grouped to facilitate the work. By simple plane-tabling the area was mapped with our assistance. We could not extend the scope of work, because of certain limitations, for instance the small number of boys, the short period of time at our disposal and the tender age of the boys who are not accustomed to stand the hardships of such life. However, a map of the undulating landscape was prepared. As surveying includes the mapping of land-forms, the necessity arose of inserting other details as well as to run lines of levels. With a simple hand made water-level, the relief of the

hills was found out and contour lines were plotted and shaded. Cross-sections of the contoured hills were also drawn. Soils of the area were examined by the children.

Drainage system of the area was fully studied and the boys further traced the source and course of "Raidas Ganga", one of the main springs of the region.

Land utilisation maps were prepared through simple dot and shading methods.

A detailed study of the natural vegetation was then attempted. The forests are rich and dense, undisturbed by the artificialities of modern life. A pair of wild tigers visited the camping ground and it helped the boys full well to realise what kind of forests are needed for these lords of the jungle to live in. The green tall grass amid the rich forests increased the natural beauty of the place which was such as to inspire artistic taste in the children. Such artistic stimulus really brought some effective and significant improvement in the boys' creative work.

Much has been said about the structure, physiography and natural vegetation of the region as studied by the children. Hence a few remarks on the study of climatic control of the region will not be out of place. Climate of a region cannot be studied in a few days, so it is better to use the term weather.

It seemed well to establish a Meteorological Station to reveal the secrets of weather. I gave a general talk on the importance of Meteorological study in modern life as well as in aviation, on the instruments used, on the standard conditions adopted by the Meteorological Department of the Government of India under which the instruments should be exposed, the precautions to be taken in the use of different instruments and lastly when and how to record the readings and draw graphs. The following simple instruments were used:—

(a) Weather Cock prepared by the boys.
(b) Six's Max. and Min. Thermometer.
(c) Rain Gauge.
(d) Aneroid Barometer.
(e) Dry and wet bulb thermometers.

A student—Superintendent of the Meteorological Station was appointed whose chief duty was to read and record the readings. Charts indicating clearly the hours for taking the readings of different instruments as adopted in India were prepared to facilitate the Superintendent's work. Records of daily observations were maintained. The boys prepared graphs and charts showing:—

(1) Hourly temperature for 24 hours.
(2) Hourly pressure for 24 hours.
(3) Relation of mean daily temperature with mean pressure.
(4) Relation of mean daily temperature with mean relative humidity.
(5) Daily range of temperature.
(6) Graphical representation of daily weather.
(7) Symbolic representation of daily weather.
(8) Relative-humidity chart and other weather symbol charts and a daily weather bulletin was issued for insertion in "Kundeshwar", the new daily organ of the boys' Open-Air Session.

The boys found out the rhythmic fluctuation of pressure which depended on the time of the day, for instance the pressure increased to a max. of 27·83″ at about 10 a.m., fell away to a min. of 27·74″ at 4 p.m., increased again to a second max. of 27·79″ at 10 p.m. and decreased to a second min. of 27·77″ at 4 a.m. Similarly, fluctuations in temperature were marked at different hours of the day.

The mean daily temperature recorded was 67·3°F, mean daily range of temperature 42·1°F, mean pressure 27·76″ and mean relative humidity 61%. These figures are based on the observations made during the period from 19th to 27th November 1942.

The striking feature of the vale was the occurrence of katabatic winds which were caused by the action of gravity on steep slopes. With the rapid loss of heat by radiation the hills became cold, and air resting on them chilled, and being on slopes moved downward under the action of gravity. The inversion of temperature was clearly understood by them when they received the refreshing and warmer weather as they ascended more and more up the hills. After sunset, the valley was filled with chilled air which no one could imagine.

Next item on the proposed syllabus was the study of agriculture of the region. Agriculture is a term with a vast connotation and really it takes a very long period to understand what it implies if boys are not given opportunities to learn by experience. Great enthusiasm was shown by the boys in the study of agricultural methods. They realised the worthwhileness of the bullock-drawn primitive wooden plough in the chain of Indian agriculture, although it may seem absurd to the Western eye. Primitive methods of manuring the fields also caught their attention. Chief crops of the area are maize, barley, wheat and sugar cane given in the order of their production. It was the time for sowing barley and one boy with the permission of the farmer participated in the sowing process. Much information was obtained from the farmers regarding the processes of agriculture, particularly the yield per bigha. Through cartographic representation of the collected economic data about half a dozen maps were prepared, particularly showing the yield of different fields.

A talk on the factors responsible for the settlement of population was given by one of the pupil-teachers of the Training College attached to the Bhugol Shreni. An account of the talk was written by every student in close correlation with the local conditions.

Finally the boys conducted a social and economic survey of Banslia, a village in the vicinity. The data collected is very interesting as it has a poor population of 46, consisting of 32 Bhils, 8 Muslims and 6 Rajputs. The population was classified according to age and sex as adopted by the Census Department in India and it was very interesting to note that there was only one child under the age of one and 6 men and women above the age of 40.

Romantic life, folk songs, social and religious customs and primitive dances of Bhils did not fail to arrest our attention. The Bhils are the descendents of the pre-Dravidian race who form the oldest population of whom we have any knowledge. The Bhils with dark-brown skin, medium stature and thick lips are the aborigines of very low culture. Mewar is a land greatly inhabited by Bhils, and still more, Bhils of Banslia village are quite cut off from the niceties of life. They are still proud of the help they had once offered to Rana Pratap at a time when he was in difficulty. Their life was the most remarkable instance to help the boys to see and understand the relation of man with his natural environment.

Through cartographic representation of the collected data of Banslia the boys prepared charts to show:—

1. the earning capacity of the people,
2. the classification of population according to sex and age,
3. the diseases prevalent,

and 4. the sick people in each caste.

With the people they discussed the problems of child marriage and succeeded to find out the causes responsible for illiteracy existing in the village. The boy-artist of the Shreni painted a view of Banslia village

Live-stock of the village is poor, it having 5 hens, 30 goats, 15 bullocks, 10 cows and 3 camels.

In addition to the work mentioned above the following projects were undertaken by the boys:—

1. Camping ground.
2. Routes followed by different Shrenies.
3. Perennial irrigation system.

A beautiful working dam was constructed across a spring and the water was diverted through canals and distributaries to far off fields This project was a real success.

Most remarkable instance of the boys' initiative and interest in the work was exhibited when one of them raised a question (while collecting the data regarding live-stock of Banslia) why do the cows of this village give one lb of milk per day on the average? What about the cows of Europe and other countries of the world? It is difficult to describe here in words the spontaneous and inherent curiosity and Socratic attitude that the boys showed at that moment. He personally felt the need for learning Geography and thus started in right spirit, picking bits of knowledge as he needed them for his own satisfaction. He collected information from books and through bar diagrams showed the milking capacity of cows in different important countries of the world; Netherlands topping the list having average milk production of 20 lbs. per day per cow, in contrast to 1 lb. in Banslia village. He also indicated his

intentions to discover the causes for this marked contrast in milk production.

This incident should be considered a sure sign of success which this educational experiment is achieving year by year. With every bit of Geographical information received through experience, the Geography of the whole world is revealed to the children.

On the 29th November we started on foot back for Vidya Bhawan where we still sing the songs of those happy and delightful days.

This is 'what' and 'how' the Geography of the vale of Kundeshwar our boys created. It is through the creative approach and spirit that our boys are picking up Geographical knowledge. This is the good cause Vidya Bhawan has been and is still striving for.

The unique educational experiment which has been put before you is not so much a method of teaching as a method of approach to the subject which is based on child-psychology and the spirit of Heurism which is highly respected by modern educators.

Sugar-cane in Western U. P.

BY

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Sugar-cane is indigenous to India. In the United Provinces of Agra and Oudh it is one of the most important summer crops. United Provinces grow more sugar-cane than any other province of India.

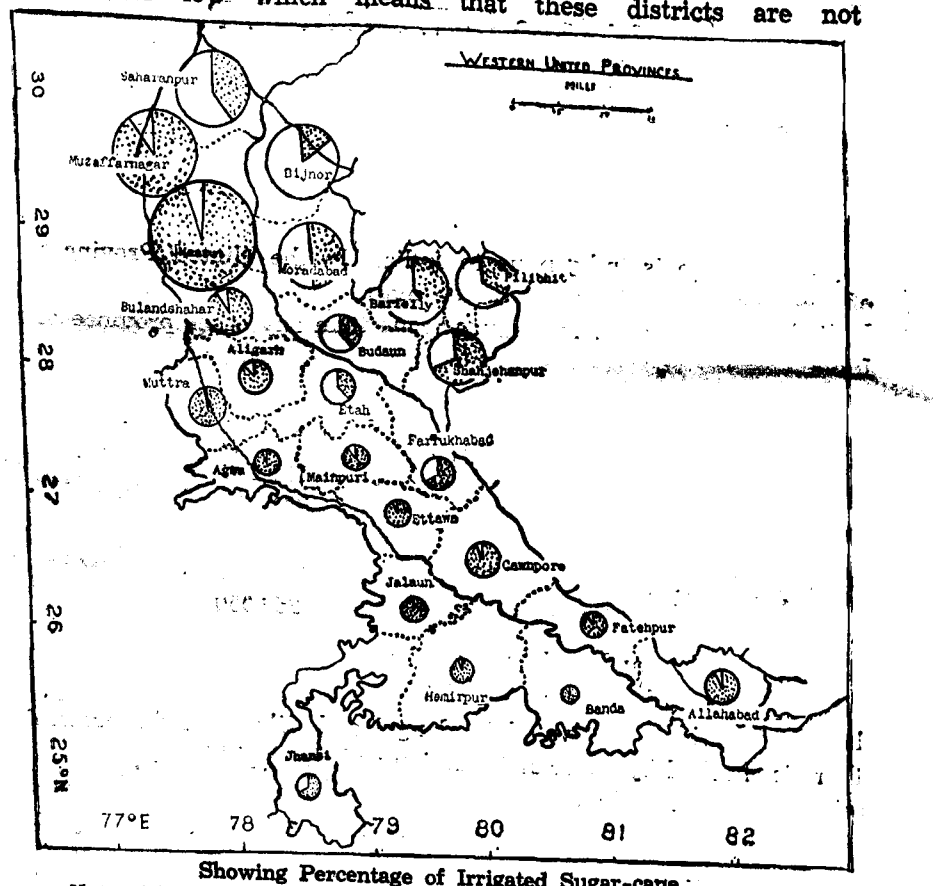
	Acres.
United Provinces	2,063,000
Punjab	336,000
Bihar and Orissa	371,000
Bengal	330,000
Madras	322,000
Bombay	256,000

Temperature and moisture are the most important factors in the cultivation of sugar-cane. Naturally sugar-cane should have been more widely cultivated in Bengal and Bihar but the growth there is checked by "poor soil aeration and the rapid increase of the rain-inundated area,"[1] where rice is naturally a more suitable crop. The conditions are favourably met in U.P., hence its supremacy in the sugar-cane cultivation.

The limiting factor in the sugar-cane distribution in the U.P. is the supply of irrigation water by canals and tube-wells or the natural rainfall. It is seen that the sugar-cane belt lies in the northern and north-western parts of our area. The map showing the percentage of irrigated sugar-cane shows that except in the northern districts of Pilibhit, Barielly and Bijnor, sugar-cane is mostly irrigated. Now if we compare this map with the one showing the distribution of rainfall, we will find that the above named districts get much more rainfall than any other in our area. Then

1. Howard, A., Crop Production in India. p. 124.

if we compare it with the map showing the percentage of total irrigated area, we will find that the percentage in these districts is rather low which means that these districts are not



Showing Percentage of Irrigated Sugar-cane.

Note.—The circles represent total area under sugar-cane and the dotted space represents irrigated area under the same.

amply served by irrigational facilities. We can now conclude that the limiting factor in the sugar-cane cultivation of our area is the supply of cheap irrigation water. Another limiting factor is the low atmospheric humidity which prevails in the U.P. from March to June when there is practically no rainfall and to mitigate this factor too, the supply of cheap irrigation water is necessary.[2] Sugar-cane is generally planted in the end of February or the

2. Ibid p. 125.

beginning of March with the help of irrigation. Then all through the rainy season the crop goes on thriving well and then till the end of November the cane is ripened, further growth is checked and the crushing begins as the advent of cold season in November is rather a limiting factor in cane growth and had the temperature at this period been higher, the growth would have continued and the crop would not have been compelled to mature early. The conditions in Java and Cuba on the other hand, are very favourable and the yield there is much higher. This limiting factor of growth brings in the necessity of introducing canes of short duration and rapid growth.

It has been said before that the distribution of sugar cane in our area is mostly controlled by irrigation and also to some extent by the soil conditions which draw the line of demarcation between the districts of Bundelkhand, parts of Muttra and Agra and the rest of the region. It means to say that the most important development in the sugar-cane of our region has been the introduction of irrigation and wherever irrigation is better, the cultivation of sugar-cane has improved. The infertile districts which we have named above are quite insignificant in the matter of cane cultivation and no substantial improvement has been possible there, either in respect of irrigation or soil development.

One of the most important improvements that may be effected in future should include a further extension of irrigation facilities in the more fertile region, especially in the districts that are now poorly served by irrigational works. The introduction of State tube-wells or canals in the districts of Etah, Mainpuri, Farrukhabad, Ettawa, Cawnpore, Fatehpur and Allahabad may be considered. The districts of Bijnor, Moradabad, and Budaun may be benefited by the introduction of the Eastern Ganges Canal, a project that has been proposed several times but was always abandoned. The proposed canal connection between the river Sarda and the Ganges may be of value to the cane cultivation of Pilibhit, Bareilly, Badaun and Shahjehanpur. I do not recommend the introduction of any particular form of irrigation but I do think that a further extension of cheaper and more extensive irrigational facilities either by the introduction of new canals, tube-wells, or anything else may be of value to the sugar-cane cultivation of the area.

India consumes most of its sugar and even then, the demand is so great that about a million tons of sugar is imported yearly.

This goes on to prove that both the cultivation and industry are in a poor state. The cultivation involves the yield per acre and if an acre of land can produce more and if more sugar can be extracted from the canes, the production of sugar could be considerably increased. The former could be effected by the introduction of high yielding cane varieties (the temperature factor should be borne in mind), better manures, better irrigation and immunity from disease. The latter could be done by introducing better methods of cane crushing and sugar making involving less waste.

Developments have been attempted in both these directions by the Government agency; in the former case by the inauguration of sugar research stations to find out better varieties and better methods of cultivation and in the latter case by the construction of scientific sugar factories and improving the local methods of sugar making.

The production of improved varieties in India dates back to the year 1912 when work was started at Coimbatore. The Government farm at Shahjehanpur has played a very important part in the cane development of our area and of the Province as a whole. Varieties found out at Coimbatore by selection and breeding methods are tested at Shahjehanpur to find out whether they are suitable for cultivation in this area. The Imperial Council of Agricultural Research has given a new life to the work. Amongst other items of agricultural development, the Council has in its programme "the selection of canes better suited to the important sugar cane districts than the existing varieties and the improvement of the cultivation," as one of its important items.

Experiments have revealed that amongst the improved varieties[3] Co 385 and Co 350 are held as the best early maturing varieties. Though they are not high yielders, their early maturing nature facilitates the early running of the factories. They are ready for crushing by the end of October. Co 312 is said to be the best medium variety. It is ready for crushing by the first week of December. At Muzaffarnagar Government farm and at the

3. Sir John Russell, Report on the work of the Imperial Council of Agricultural Research in applying science to crop production in India. p. 102; and the cost statements made by the various agricultural officers, the author had this good fortune to visit.

Palehra farm, Daurala,[4] the author was repeatedly told that Co 421 is better than Co 312 and that it has all the chances of replacing the other. The field growing Co 421 at Muzaffarnagar was really magnificent and though it was quite young at the time of the author's visit, the canes were above thirteen feet high, which is rather unusual. The cane agronomist remarked that when the experiment will be complete, the variety will certainly prove of better quality and yield. It must not be forgotten that to get good results from any variety at a Government farm is no credit, as it is provided with all the facilities and costly manures; the real point is whether that variety will yield the same results in the ordinary fields of the farmer. This is the point that only experience can decide. Presumptions will be of no avail. What varieties are good for all, is a problem to be tackled by the agricultural research worker. We are interested more in the geographical than in the agricultural side of the problem and thus require a rapidly growing and rapidly maturing variety that may not be harmed by the lowering of temperature in November and December. In other words the crop should be ready for crushing before the cold weather arrives. The sowing of winter crops will require the fields to be free of sugar-cane by November, especially as wheat which constitutes a major portion of winter crops is also controlled by temperature conditions and should be grown by this time, and any delay in its sowing might be harmful. For this purpose too, we require early maturing sugar-cane varieties except in the fields where wheat does not follow sugar-cane.

Manures are also of great importance in the profitable cultivation of sugar cane. Sugar-cane requires a considerable amount of nitrogen and for this purpose nitrogenous manures should be used. The manure that an ordinary farmer uses is cattle dung and that too in small quantities. Cattle dung if used in a substantial amount forms a very good manure but the fact that a major portion of it is dried to be used as fuel does not allow the cultivator to manure his fields well. Introduction of other good manures is an immediate problem. When introducing a new manure the important point besides the utility of that manure is that the financial position of the farmer should not be forgotten. Costly artificial fertilisers cannot be applied by the farmer and their introduction in the present circumstances should never be encouraged. The

4. This is a private farm run by the Daurala Sugar Works, district Meerut.

department of Agriculture recommends the use of compost and green manuring with Sanai as efficient and cheap manures. We shall have to wait a long time if we want to see the general use of costly fertilisers.

The farmer is quite ignorant of the adequate quantity of water per watering and about the frequency of irrigation. Experiments carried out at Shahjehanpur show that the increase in yield is co-related more with the frequency of waterings than with the quantity of water used each time. Five waterings of about eighty thousand gallons per acre are supposed to be the optimum for sugar cane.[5]

Various minor experiments have been conducted to find out the most suitable space that should be allowed between the rows of sugar-cane crop. A spacing of about four feet in soils of good fertility is quite good. Flat sowing in lines three feet apart is, according to the version of the farm Superintendent of Shahjehanpur, equally good.

Pests and Diseases.—Sugar cane is considerably damaged by various pests and diseases; but varieties differ as to their susceptibility to their attacks and selections can always be made as to the type that is considerably immune.

During his tour of the area, the author was repeatedly told of the damage by a leaf-hopper called Pyrilla. Mr. Gupte, the entomologist in charge of the sugar-cane station at Muzaffarnagar, took the author to some villages and pointed out the intensity with which the insect attacks the canes. He further said that the attack is largely dependent on climatic conditions. Hot dry weather during May and June kills most of the pests. During the monsoon the multiplication of the pests is favoured by the breaks in the rainfall. To depend on weather conditions for the prevention of Pyrilla attack is like depending on rainfall for summer crops. The farmer should either devise his own methods or act on the advice given to him by the Department. The entomologist recommends the stripping and removing of the dry leaves each month from September onwards; he says that this is the only useful remedy that all his researches could find out, and it is simple to operate. He also demonstrated the spraying of some chemicals mixed with tobacco water on the affected canes but this remedy is

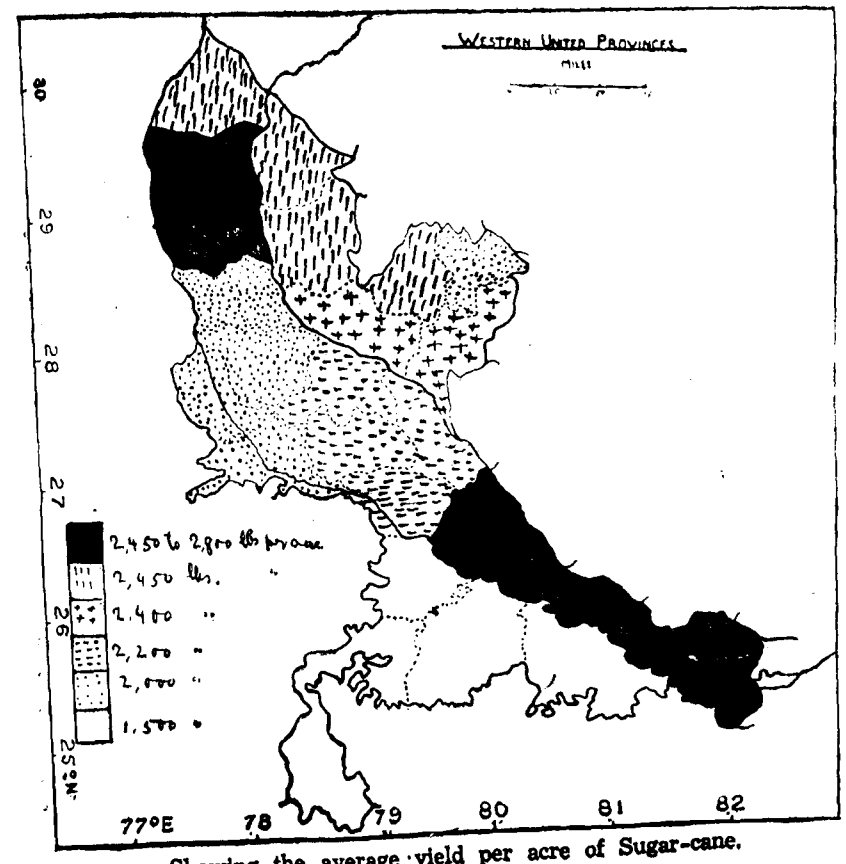
5. Triennial Report of Experiments carried out on the various agricultural stations, 1932—33, 1933—34 and 1934—35. p. 104.

applicable only for small fields and the rich farm owners. Catching of the insects in bags is ridiculously impossible and cannot profitably be used when the attack is at its highest. Here also sugar cane can be saved if early maturing varieties could be introduced. In this case the crop will not have to remain in the fields for long under Pyrilla attack and the injury may be mitigated to some extent.

The Red Rot also causes considerable damage to sugar-cane. The Plant Pathologist suggests its cure on the following lines:—

(1) by burning all dried up leaves and chumps, (2) by planting healthy sets, and (3) by discouraging ratooning. (Ratooning is the practise of cutting the sugar-cane and leaving the roots in the soil to grow again).

In 1912 the yield per acre of sugar-cane was 2055 lbs. while in the year 1935-1936 the yield was 2166 lbs. that is there has been an increase of about 111 lbs. per acre. The map shows the average yields.



Showing the average yield per acre of Sugar-cane.

Sir John Russel gives a table comparing the financial advantages to the cultivator of the new canes over the *desi* varieties.

	Per canal Bigha	
	Desi cane	Improved cane
Cost of seed, manure and cultivation.	Rs. as. ps. 51 6 0	Rs. as. ps. 55 10 0
Cost of irrigation	7 4 0	7 4 0
Rent	10 0 0	10 0 0
Total cost	68 10 0	72 14 0
Yield in maunds	250	350
Value of Gur, 10% recovery Rs. 3 per maund	75 0 0	150 0 0
Profit to the cultivator	6 0 0	32 2 0

To an observer unaware of the real conditions this table looks very attractive but this is not quite a true representation of facts. The expenses under improved varieties might be right but they are much exaggerated under Desi varieties. The average Indian farmer does not spend any extra money on seed, cultivation or manures. He uses the seed saved up from the last crop, or he borrows them on payment in kind to be made at the time of the next harvest, or he borrows seed on *sawai* system which also does not involve any cash payment. He does his work himself and he manures his fields with whatever scanty cattle dung he can get from his own cattle. A farmer does buy improved seed on cash payment system but pays back whatever he borrows in kind, and, if he cannot get it on this system, he goes without it. I have no prejudice against the utility of the improved varieties, on the other hand I would like every farmer to derive the full benefit from the improved methods. He is however, content with whatever he has got and is not very much inclined towards taking risks. Tackling the modern methods is like a game of dice for him! The less he looses the better.

Sugar Industry.—The local methods of crushing cane with crude crushing mills called 'Kohloo' and then boiling the juice into gur or jaggery are slow and wasteful. The percentage of juice crushed out is low and the sugar thus prepared is not refined. In March 1898 first efforts of improving the native sugar-industry and trade were made by the Government. Mr. S. M. Hadi of the agricultural Department of U. P. was put in charge of finding out

methods of making more, better, cheaper sugar without using any expensive or complicated operations. But it was not until after the Great War that the National importance of sugar industry was recognised.

In the year 1932 the Legislature passed the Sugar Industry Act. Since then several sugar factories have been opened in our area. The latest figures show that there are about thirty sugar factories in our area. However, no systematic plan has been adopted in the distribution of the factories. At places, they are overcrowded while in others, they are entirely absent. Its effects on the cultivator are imminent. In places where there are many factories the supply of cane from the neighbouring cultivators is not sufficient for the running of the factories with the result that cane has to be transported from other districts by railway and the carriage charges that the cultivators of those districts have to pay, bring down the anticipated profits to nil, while in the districts where there is an insufficient number of factories, there is a congestion of sugar-cane loaded carts in the neighbourhood of the factories and there is a super abundance of cane supply, which the factories are incapable of employing. In the districts where there are no sugar factories the cane is still crushed by Kohloo and the juice boiled into Gur and Jaggery.

The above mentioned facts are to a great extent responsible for the diverse development in our area. The factories pay the same amount for good or bad cane. No distinction is made whatsoever between the improved varieties, which essentially involve a much higher cultivation cost, and local varieties, with the result that the cultivator does not feel tempted towards using new varieties.

If we want to see the development of new varieties in our area these facts require modifications. Before a new sugar factory is opened the fact whether it is really needed in a particular area, should be ascertained. Instead of overcrowding of factories in one particular place, if the areas having none or a small number of factories be supplied, we can expect better results.

Utilization of molasses.—Closely connected with the sugar problem is the problem of utilization of molasses. Generally the farmer converts his molasses into low grade gur and some of the factory molasses are converted into alcohol. Dr. Dhar recommends

the use of molasses for reclaiming alkaline land. Molasses are also used for surfacing metalled roads. Molasses can best be used for preparation of cattle food. Sir John Russel emphatically suggests that molasses should only be used as cattle food as India is very poor in the matter of grazing lands and fodder crops; he suggests that molasses can be converted into yeast or added to grass or other green fodder. It improves the quality of animal food. Molasses are also used for making cheap confectionery in the villages.

Utilization of bagasses.—Bagasse is the residue of fibrous matter remaining after the cane has been crushed. Most of it obtained in the factories is burnt as fuel.

Investigations indicate that bagasse could be profitably used for the production of paper, purified cellulose and fibre boards.

Prospects of Fisheries and Fishing in Sind

By

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and

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Introduction.—In these days when "Grow More Food" is a common cry Sind can give its share in national planning. This new province lies between the 24°–0′ and 28°–30′ degrees of North Latitude and the 66th and 72nd degrees of East Longitude and covers an area of 52,994 sq. miles, including the Khairpur State. Sind forms the lower Indus basin, being in continuation of the Upper Indus valley, the Punjab and Kashmir. The River Indus flows through a length of over 300 miles of its course in Sind from north to south. Prior to the construction of the Lloyd Barrage, the entire low-lying countryside used to be flooded in the *'abkalani'* (inundation) season. The natural *'dhoroes'* (depressions) and *'dhandhs'* (lakes) used to be filled with *'char'* (spil) water which provided rich fisheries. But since the year 1933, when the Sukkur Barrage came into operation, the natural *'dhoroes'* and *'dhandhs'* within the Barrage zone do not receive *'char'* water, thus impairing the inland fisheries seriously.

Nature of fishing Ground.—There are certain natural physical conditions very congenial to the geographical distribution and ecology of fish in Sind:

1. There are comparatively shallow waters on the submarine bank, which is only about five fathoms deep and which is broader than even the Bombay or Madras coast, as it forms part of a continental shelf after the subsidence of the Indus Gorge.

2. The delta of the Indus which covers the greater part of the coast, is a growing one, which makes it very shallow so that at

high tide it is submerged and the sea water rushes several miles inland, the outlets of the river are practically the inlets of the sea, thus producing a regular alteration of fresh and salt water.

3. In the monsoon season, the river is in great floods and the whole delta is inundated for several miles. But when the waters are withdrawn again, mud banks, lagoons and mangrove swamps are produced in many of the creeks. These become very suitable breeding ground.

4. The silt brought down by the river is enormous again and is mostly dropped near its mouths, which are changing. The extensive drainage from the land into the sea near by, makes the waters very muddy and also rich in minerals. These help the growth of weeds which supply ample food and shelter for the fish living in them.

5. The cold season, particularly in these latitudes, help to keep the waters near the coast heated in summer to a great extent, cool for nearly four months of the year. This combination of hot and cold currents also exerts some healthy influence on the fish.

6. The bed of the river is generally higher than the surrounding country, as the Indus valley in Sind is an aggraded one, so that when the river is in flood twice a year, the waters run into low ground forming shallow lakes and pools all over the valley. These become excellent breeding ground for fishes.

Classification of Fisheries.—The fisheries of Sind may therefore be classified as under:—

(A) Marine Fisheries, e.g., Sea Coast and inlets.

(B) Fresh-water Fisheries:

i. Running water, e.g., River Indus, canals, etc.,

ii. Standing water, e.g. Lakes, ponds, tanks, etc.

The Arabian sea, the river Indus and the lake Manchar are the most important areas of fisheries of the province.

(A) *Marine Fisheries.*—Karachi dominates the marine fisheries, extending over a length of about 150 miles of the littoral area from the Karachi port to the Sir mouth of the River. But sea fishing on the Sind coast is still in its primitive stage, the annual catch per fisherman being 1·5 to 2 tons, whereas the Madras figure

for the Malabar coast is 7 to 10 tons per fisherman per year. The average income per fisherman per annum is estimated at Rs. 225 to Rs. 350 and about 3883 '*muhanas*' and '*nakhuas*' are engaged in this industry. They own about 300 country boats in all and go to the sea for about 10 to 15 miles from the coast and rarely beyond 20 miles' range. The total catch of the fishermen has been estimated at 5,000 tons in a year, about 2,000 tons of which is consumed locally in Karachi. The rest forms a large export trade from Karachi port to various parts in all the kinds of fish and its products.

The following are the important fishing grounds and fish curing yards on the Sind coast in the Karachi district:—

1. Ibrahim Hydri.
2. Reri.
3. Phuti.
4. Khudi.
5. Dabo.
6. Patiani.
7. Wan.
8. Chan.
9. Khobar.
10. Hajamro.
11. Tursian.
12. Mulh.
13. Shah Bunder.
14. Hub.
15. Shamspir.
16. Babo and Bhit islands.

Most varieties of fish of tropical climate abound in the sea near Karachi. The most important of them are: 1. Sardines (Clupea Sp:); 2. Gole (Sciaena miles and S. sina) 3. Surmai (Cybium Sp:); 4. Bombay duck (Harpodon nehereus); 5. Singala (Macrones gulio); 6. Boi (Mugil Sp:); 7. Trout (Barilius bendelisis); 8. Rawas (Polynemus Sp:); 9. Lady fish (Chela Sp:); 10. Pomfraets (Stormateus cinereus); 11. Pala (Clupea Sp:); 12. Prawns (Peneus and Metapeneus Sp:); 13. Sharks (Carcharias mustelus); 14. Sole (Cynoglossus Sp).

How fish is disposed of.—All the sea fish is brought to Karachi for disposal by local sale or export. The best fish catches are got from the month of November to the month of March and fairly good ones from April to June. During the monsoon season, fishing is suspended, because the country craft and nets are not efficient enough for monsoon fishing in the sea, which of course is not so rough as near Bombay. The surplus of fish and prawns is cured, dried and exported to different places. Thus the fresh fish and prawns, after meeting with local requirements are converted into dry salt fish and fish products of greater commercial value.

Fish export trade.—This trade consists of exports of salt fish, dried prawns, prawn shells and fish manure. The salt fish are exported to Gujerat, Bombay coastal ports, Colombo and Rangoon. Very small fresh fish only are packed in ice chests and booked to up-country places in Sind, the Punjab, and Baluchistan. Dry prawns are exported to Bombay, Rangoon, Singapore and Hong-kong. Prawn shells are sent to Germany, Ceylon and Rangoon as cattle food. Fish manure, which has no local market, is exported to Germany and Colombo for tea and rubber plantations. Isinglass is exported chiefly to London and China.

It may, however, be mentioned here that this kind of sea-borne trade is paralysed on accout of the present war.

Scope for fish curing and canning industry.—It would be seen that the city of Karachi is supplied with fresh sea fish in excess of its requirements and as the inland fresh-water fisheries of the province provide a good deal of fresh-water fish in the interior of the region, Karachi does not possess a favourable market for sea fish in the other parts of Sind. But still there is some demand for sea fish in some towns of Upper Sind, where fresh-water fish cannot be had. Even enough fish do not reach the Punjab, Baluchistan, Afghanistan and the Makran coast. Besides, the local sea fish supply of Bombay is practically non-existent during the monsoon season due to the handicaps of the inclement weather. There is, therefore, great scope for the fish export trade, if fish curing industry can be developed scientifically by carrying out efficient methods of marketing, refrigeration and transport simultaneously. By providing refrigeration facilities on the steamers and over the rail and cold storage plants at important fish markets, it is very possible to extend the present meagre fresh fish exports to various up-country places in the north and to the coastal ports in south India.

Oyster and Pearl Fisheries.—The pearl fisheries in Karachi harbour and neighbouring creeks were flourishing during the rule of the Ameers of Sind. Mr. John Mcleod, Collector of Customs at Kurrachee, in a memorandum submitted to Government on the 31st December 1847 says: "In the salt water inlets along the entire sea coast of Sind, a thin-shelled variety of the oyster exists, producing a seed pearl. It is most frequently found on mud banks left

dry at low tides. The pearl is of very little value compared with that produced by the Ceylon and Persian Gulf Fisheries, the price of the latter varying from Rs. 1,000 to Rs. 1,500 per tola. From the supposition that it possesses invigorating powers, it is used here chiefly as medicine. The larger grains are occasionally made use of as personal ornaments, the smaller ones to intermix with the valuable Bahre in pearls in which manner they are kept in bags by the Bombay merchants, as means of preserving their lustre".

The oysters were gathered from the Bairi, Hain Rocks Dubba, Pitiani, Maurypur, Phity, Khajar, Kudi, Karanji and the Hub river. For want of scientific care and due to overfishing, a depletion of the oyster bed of Sind has resulted. But there is great scope for the beds to yield much bigger crops of good oysters, for which the demand is certainly much more than the actual supply.

(B) *Inland fresh water fisheries.*—i. Running Water—River Indus, canals etc., Valuable fisheries are provided by the River Indus and almost every small village or hamlet on its banks is an important fishing village. The canal fisheries are not very important, inasmuch as the canals are inaccessible and do not, therefore, form convenient fishing grounds on account of their high vertical berms and *'bunds'*.

The important fishes of the River are: 1. Pala, Indian Shad (Clupea ilisha); 2. Khago (Rita buchanaui); 3. Dambhro (Labeo rohita); 4. Gandan (Notopterus chitala); 5. Moraki (Cirrhuia mirgala); 6. Singari (Macrones aor); 7. Gangat (Palaemon carcinus); 9. Kuriro (Risobra domiconis and Ophiocephalus Sp.).

All the above kinds of fish of the River Indus are naturally available in canals, *dhandhs* and *dhoroes* also, since they receive spill water containing spawn and larva from the River. But *'pala'* is the most important river fish which survives and thrives in the river water of high gauge and great velocity of flow in the *abkalani* season from March to September. Male *'pala'* is called *'khidara'* and female *'pala'* is called *'aniara'*. The latter is bigger in size and weight than the former. An average *'pala'* measures 1½ ft. long, 6″ to 8″ wide and 2½″ thick in the centre and weighs about 4 to 6 lbs. The other kinds of fish are, therefore, available in the river and canals only in winter, when the guage falls and the velocity decreases; or if they are available in summer, they are always in very small numbers and near the banks, where water is shallow and slow.

The *'pala'* is exclusively available in the river and is non-existant in the canals and lakes, since it emerges from the Arabian Sea on attaining maturity and migrates upstream in the centre of the river course, to Zinda Pir (near Rohri) where, according to the old myths, it goes "to offer prayers"; but the scientific truth behind it is that while it travels against the current for laying eggs, it is exhausted as soon as it reaches Zinda Pir and is not able to go higher up, excepting a few sturdy variety.

It lays eggs in water which are dragged down into the sea where they take about 2 years to attain the marketable size. Some suppose that spawning grounds of *'pala'* are higher up in the river bed near Sukkur and it is the larva which is washed down into the sea. But its correct breeding, spawning, development, life history, rate of growth, feeding habits and wanderings need to be investigated scientifically for the proper conservation and exploitation of the fishery.

The 'pala' is caught by 'muhanas' in 'bhans' or with 'sindha' while floating on a 'mati' or 'tunba'. The 'bhans' are long nets cast in the river in which the 'pala' fish are caught while migrating upstream and are gathered in the morning or in the evening. It is a popular belief that the longer the 'pala' remains in water after it is killed, the more fat it loses from its body; consequently,it becomes less tasty, whereas a 'muhana' floating on a 'mati' kills the 'pala' fish and puts it inside the 'mati' where it does not remain in contact with water. It is, therefore, the most tasty. And while floating on a 'tunba' he kills the 'pala' and ties it round his waist till he swims down the fishing section to catch more fish and comes out of water. This 'pala' is, therefore, less tasty than that of 'mati' and more tasty than that of 'bhan'.

For similar reasons, the 'pala' in the lower reaches of the river near the sea contains more fat and is, therefore, more tasty than the 'pala' of the upper reaches, as it is supposed that the 'pala' while migrating upstream loses much of its body fat on account of physical exertion. Consistent with this hypothesis, the Kotri 'pala' which is the most reputed and favourite fish in Sind for its delicate taste and flavour, contains more fat than that caught near Larkana or Sukkur.

How the fish is disposed of.—The Kotri 'pala' is very delicious as it is the most putrescible commodity, and can only be consumed

locally or despatched safely to nearby markets. There is a very great demand for this fish on account of its delicious taste and delicate flavour in Upper Sind, the Punjab, Baluchistan and Afghanistan. This fishing industry has, therefore, great scope for development if quick and efficient transport, scientific curing and cold storage facilities can be provided during transit and at destination.

(B) *Inland fresh water fisheries.*—ii. Standing water—Lakes, ponds, tanks etc. Before the Lloyd Barrage works came into operation in the year 1933, the river and the inundation canals used to swell up with seasonal flood water during the *'abkalani'* period and *'char'* (spill) water used to fill up the *'kachas'* (low lying areas) and *'dhoroes'* (depression). This flood water contained fish spawn and larvae and these natural lakes served as very useful breeding and playing grounds of the fish. But the rapid improvement of perennial irrigation system in the Punjab and the consequent fear that very little *rabi* water would be available in Sind led to the construction of the Lloyd Barrage across the River Indus at Sukkur. On account of the subsequent controlled and regulated supply of perennial irrigation, the canals as well as the River do not overflow and the *'dhoroes'* and *'kachas'* do not collect the spill water. These fisheries, therefore, have been utterly ruined and the rural *'mirbahars'* and *'muhanas'* who were sustained by this industry, have been deprived of the means of earning their livelihood.

At present, the Lake Manchar, having the capacity of holding about 5,000 cusecs of water normally, is the only important inland fresh water fishery. It yields all the kinds of fish above mentioned excepting the *'pala'* fish. But its most popular fish is *'dambhro'* or *'kuriro'*. The fish is available all the year round but the catch is very large in the cold season. No scientific investigations have so far been carried out with a view to improve and conserve this most important fishery of Sind.

The *'muhanas'* set up a long net in a loop called *'pithro'* and from a distance the fish is led into it by beating of tin plates and making noise thereby. When the fish is caught in the *'pithro'*, the catch is gathered by means of *'kurhis'* which is a conical net of handy size, placed over the fish to encompass them. It is needless, therefore, to point out that fishing in the Lake Manchar is unrestricted and indiscriminate.

How the fish is disposed of.—Formerly the fish caught from the *'dhoroes'* and the *'dhands'* all over the province used to meet with the local demands in the interior; but since the functioning of the Lloyd Barrage as the *'dhorones'* and *'dhandhs* remain dry, the demand for the Manchar Lake fish has consequently increased. But like the marine and the river fishing industry, this also suffers from the handicaps of lack of quick and efficient transport, want of scientific curing and preservation. The fish as such are either locally consumed or are sent out only to very nearby markets. There is, therefore, urgent need of scientifically improving and developing the Lake fishery also. There is great scope for expanding fisheries of this kind at important places and in big fish markets by filling the principal lakes with water through regular channels from the perennial canals periodically, for fish breeding by means of fish culture and hatcheries.

Scientific improvement of fisheries and development of fishing industry.—The role of fish in solving the vital problem of shortage of food and nutrition has of late been recognised with increasing emphasis. The fish contains almost all the essential nutritive ingredients in a readily digestible form and the fish oils contain vast vitamin potentialities according to the latest bio-chemical researches. There is, therefore, urgent need of popularising Sind fish for regular daily diet especially at the present time of food crisis due to war and scientific methods for developing the fisheries and improving the fishing industry in Sind must be adopted on the following lines:—

1. Fishery laws and regulations should be framed against indiscriminate fishing and the size of mesh of nets should be licensed to prevent undersize catches.

2. Fish culture on scientific lines should be introduced for stocking of principal lakes and ponds with quick-growing kinds of fish.

3. The catches may be increased by providing facilities for more intensive fish with more efficient means and methods of fishing.

4. Fishermen's Co-operative Societies should be formed to help them with the State aid to buy fishing gear and craft.

5. Arrangements for efficient, quick and cheap transport

should be made by the State by rail or over roads, to ensure regular supply of fish to important fish markets.

6. Scientific fish curing, canning preserving experiments may be conducted and cold storage facilities provided at the fish market places and during the transport.

Development of other Allied Industries.—The scientific development of fisheries and economic reorganisation of the fishing industry will not only alleviate poverty if the rural population; which will be sustained by this industry and augment the food supply but will also give a fillip to various other industries allied to the fishing industry and relieve thereby unemployment. For example, for curing and preserving fish, more of salt and ice will have to be manufactured. Similarly, cottage industries like manufacture of boats, rope making, sails building, net manufacture, mat knitting, etc., will be revived. The subsidiary factory industries allied to the fish commodity such as fish canning, fish manure, fish oil, fish meal and guano, isinglass and fish maws, smoking and picking, fish pastes, the shell fish, oyster shells, sea weed, bone for gelatin, fish leather for commercial use, can be established on commercial basis.

Thus the fishing industry in Sind has great economic possibilities. They need a sound Government policy and a proper department of energetic and capable leaders.

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The Classification of Cold Temperate Climates

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While the boundaries of the various types of climates have been fixed more or less, there seems to be some difference of opinion in the determination of the boundaries between the cool temperate climates and the cold temperate climates. This is quite evident from the treatment of these climates in the various text books of Geography.

Kendrew in his book "the climates of the continents" has included the whole of central Europe from northern Italy to the extreme northern part of Sweden, under the central European type of climate while under the north-western European type of climate he has included the north-western Europe from northern Spain to the extreme northern part of Norway. Russia and Finland have been included in the eastern European type of climate with very cold winters. It is apparent that in such a division, no attempt has been made to differentiate between the cool temperate and the cold temperate climates.

On the other hand, Dudley Stamp in his book on "the natural regions of the world" has certainly tried to differentiate the regions where the cool temperate and the cold temperate climates occur. Thus under the cold temperate climates, northern and central Norway, Sweden, Finland and northern Russia south of the Arctic circle, have been included. The rest of Europe north of the Mediterranean regions and south of the cold temperate climates, has been included under the cool temperate climates. But the cold temperate climates have not been divided into the cold maritime type and the cold continental type as it has been done by De Martonne. Besides, the division between the cold temperate and the cool temperate climates, is rather vague. Dudley Stamp

has cited Barnaul as an example of the cool temperate continental type of climate and Härnösand as an example of the cold temperate climates. The mean monthly temperature in degrees F of these stations are given below:—

Stations.	Jan.	Feb.	Mar.	Apr.	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean annual.
Barnaul °F ..	0	2	13	34	52	63	67	62	51	35	17	6	33
Härnösand °F ..	21	20	25	34	43	54	59	57	50	39	30	22	38

No doubt at Barnaul in Siberia the mean monthly temperature in the summer season is higher than it is at Härnösand in Sweden. But if the mean monthly temperature during the winter season of these stations are compared it is at once evident that at Barnaul the mean monthly temperatures during the winter season are far lower than they are at Härnösand. Thus at Härnösand the mean monthly temperature never falls below 20 F whereas at Barnaul in the month of January the mean monthly temperature is 0°F. Even the mean annual temperature at Barnaul is lower than it is at Härnösand and yet Härnösand is considered to have a cold temperate climate while Barnaul is considered to have a cool temperate continental type of climate.

In a like manner Dudley Stamp has divided Canada into the cool temperate and the cold temperate types of climates. The Prairie region has been classified under the cool temperate continental type of climate, while the regions towards the east and west of this region have been included under the cold temperate climates. But if the mean monthly temperatures of certain stations within the prairie region are compared with the mean monthly temperatures of stations further east and west of this region, it will be noticed that there is hardly any difference.

However, Dudley Stamp has cited the mean monthly temperatures at Ottawa, throughout the year, as an example of stations with a cold temperate type of climate and has mentioned Winnipeg as an example of stations with a cool temperate continental

type of climate. The mean monthly temperatures in degrees F of both these stations are given below:—

Stations.		Jan.	Feb.	Mar.	Apr.	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Ottawa °F	..	12	14	26	43	56	65	70	67	59	47	32	17
Winnipeg °F	..	4	0	15	38	52	62	66	64	54	41	21	6

From a comparison of the mean monthly temperatures of these stations it is at once evident that in the coldest month of January, the mean monthly temperature at Ottawa is 12°F while the mean monthly temperature at Winnipeg for the same month is 4°F. Even when the altitude of Winnipeg is taken into consideration the differences in the mean monthly temperatures are considerable. In no month in the year has Winnipeg a mean monthly temperature higher than that of Ottawa and yet Ottawa is considered to have a cold temperate type of climate and Winnipeg is considered to have a cool temperate continental type of climate!

In a like manner De Martonne in his book "Shorter Physical Geography" has cited Moscow as an example of a station, with a cool temperate type of climate, where in the month of January the temperature falls down to 12·2°F. But at the same time under cold temperate climates he has quoted Moscow as an example of a station where the annual range of temperature is very great! Like wise De Martonne and Austin Miller have cited Barnaul as an example of cold temperate climates, where the annual range of temperature is even greater than it is at Moscow. On the other hand Dudley Stamp has quoted Barnaul as an example of a station with a cool temperate continental type of climate.

Austin Miller has quoted Moscow, Winnipeg and Bergen as examples of cold temperate climates. But in the map of distribution climatic types he has included the prairies of Canada, the southern part of Norway and the central part of Russia under the cool temperate climates. Likewise the region north of the Caspian Sea has been included under the cool

temperate climates in the map of climatic types. But the stations within this region have been cited as examples of cold temperate climates.

All these examples go to show that at present the climatic boundaries between the cold temperate and cool temperate climates are very vague and precision in this respect is necessary to make the subject more scientific. Somewhere a line has to be drawn between the cool temperate and the cold temperate climates. This line has been well drawn by De Martonne and in my opinion this should be uniformly adopted so that all confusion between the cold temperate and the cool temperate climates should be removed. In accordance with De Martonne in the cold temperate climates the mean annual temperature lies between 23°F and 41°F, and the mean monthly temperature during some months in the year is above 50°F.

If this test is applied to Norway it follows that the coastal region of Norway south of Trondhjem must be included under the cool temperate oceanic type of climate while the region north of Trondhjem in Norway, should be included under the cold temperate oceanic type of climate.

Similarly if this test is applied to British Columbia, it follows that the region along the coast of British Columbia has a cool temperate oceanic type of climate and not cold temperate oceanic type of climate as is mentioned in some books of Geography.

No doubt De Martonne has included the Prairie regions under the cold temperate continental type of climate and not under the cool temperate continental type of climate as has been done by Dudley Stamp. But the mere inclusion of the Prairie region under the cold temperate continental type of climate does not solve our difficulties, for this region remarkably differs from its neighbours to the east and west in its natural vegetation. However, in the case of the regions with a cool temperate climate, the cool temperate grasslands have been considered by De Martonne under the transitional type of cool temperate climate. It therefore appears that a good deal of vagueness can be avoided if the cold temperate grasslands are classified under the cold temperate transitional type of climate. Thus if this classification is adopted, the cold temperate climates may be divided into three types, namely, the cold temperate

continental type, the cold temperate maritime type and the cold temperate transitional type of climates.

In a like manner, the steppes from Orenburg in Russia to Barnaul in Siberia may be considered to have a cold temperate transitional type of climate. These cold temperate grasslands pass gradually into the cool temperate grasslands. However, the climatic conditions here are very similar to the climatic conditions in the Prairies of Canada, as it is apparent from the mean monthly temperatures of Orenburg and Semipalatinsk. The mean monthly temperatures (°F) of these stations are given below.

Stations.	Jan.	Feb.	Mar.	Apr.	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean annual.
Orenburg °F ..	4	8	19	39	59	68	72	68	55	40	24	12	39
Semipalatinsk °F ..	3	4	14	37	58	68	71	67	56	38	21	9	37

The mean monthly temperature of these stations are very similar to the mean monthly temperature of Winnipeg. Of course, at Winnipeg the winters are even colder, but there is not much difference in the mean annual temperature. The mean annual temperature at Winnipeg is 35°F while at Semipalatinsk it is 37°F.

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