

GOVERNMENT OF PAKISTAN
PLANNING COMMISSION
NATIONAL TRANSPORT RESEARCH CENTRE
ISLAMABAD

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INDUS RIVER EXPEDITION
(1987-88)

NTRC-113

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November, 1988

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1. INTRODUCTION

Pakistan has one of the largest irrigation networks in the world and some of the canals are even larger than the largest rivers in Europe. Whereas each small canal in Europe is navigable in some way, no real benefit has been derived from this great national resource so far in Pakistan. In the past, a number of efforts have been made to determine the navigational potential especially of Indus River but proved fruitless due to divergent views concerning the most critical issue i.e. the quantum of draft available below Sukkur during winter months. Those favouring the idea believe that not only sufficient draft is available to allow navigation by modern flat-bottomed crafts but alternate links to sea can also be used to serve the purpose. Those opposing the proposition remain un-convinced. Since almost all these were desk studies, unfortunately, neither side has any incontrovertible facts to present and hence the impasse.

The National Transport Research Centre however feel that given the great advantage of economics of transportation by Inland Water Transport (IWT) and the vast network, the feasible, development of IWT should be one of the major initiatives in the future.

Since the entire issue seemed to be dependent on the question of draft below Sukkur, the Centre had been making efforts to find ways and means to obtain the answer. This

obviously could only be done by actually measuring the available draft during the minimum flow period all along the river but especially below Sukkur.

Fortunately, an opportunity arose to decide the issue once for all. The originator of the idea was Dr. S. Amjad Hussain, a Pakistani expatriate living in U.S. who originally belongs to Peshawar and has learnt from the diaries of his grand-father around the turn of century, that he used to travel on a flotilla from Attock to Karachi in connection with his studies.

Dr. Hussain, in addition to being an outstanding Thoraisic Surgeon, greatly admired in his professional circles at home and abroad, is a man-for-all seasons. He is a free-lance writer (A number of his articles have appeared in PIA Magazine HAMSAFAR), photographer (one of his entries won first prize and appeared on the cover of Ohio State Medical Journal in 1982), historian (he has compiled the map of old walled city and greater Peshawar), social worker (instrumental in building the Six million \$ Toledo Muslim Centre).

Dr. Hussain offered to organize an 8-10 members expedition mainly consisting of Pakistan expatriates living in U.S. and few American citizens, to actually travel down the Indus River.

The matter was discussed with Ministries of Communications (P&S Wing), Water and Power (WAPDA), Tourism, Information and the concerned provincial departments, all of whom greatly appreciated the proposal and assured whole-hearted cooperation. The proposal was also considered by a High Level Meeting under the Chairmanship of the Minister for Planning, Development and Commerce and was unanimously endorsed. The Expedition was finally undertaken in December 1987/January 1988 with the sponsorship of NTRC.

2. INLAND WATER TRANSPORT IN PAKISTAN

There is no worth-while inland water transport system in existence in the country at the present moment. Even the 2,000 country boats operating in the private sector between Sukkur and Kalabagh are mainly concentrated in a short (150 Kms) section between Sukkur and Guddu.

The Indus is the largest river in Pakistan with substantial perennial supplies and would thus form the trunk line for the inland navigation system. Further, with river regulation provided by existing storages at Tarbela and Chashma and the one proposed at Kalabagh, it might be possible to sustain good navigable depths all the year round in most of its about 1,450 Km length from Tarbela to Kotri.

At Tarbela river Indus flows on sub-mountainous area and is controlled by a reservoir. There is no lock in Tarbela Dam. In the reach from Tarbela to Kalabagh (190 Kms) it carries all the regulated Indus flows. The river slope

is steep and navigation in this reach is hazardous. This substantial discharge is further augmented at Attock (38 Kms downstream) by Kabul river from the right. A little distance below this confluence, the Indus river is crossed by the newly constructed road bridge at Khairabad. About 7-8 Kms downstream is located the historic rail-cum-road Attock bridge. At this point, the river enters the famous Attock gorge and travels for 152 Kms to Kalabagh through rapids. In this reach the river receives from the left two main tributaries of Haro and Soan. From navigational stand point this Indus reach may not be suitable for the present. However, after construction of Kalabagh Dam this could become navigable from Kalabagh to Attock, along with the Kabul reach between Attock and Nowshehra.

Indus river segment between Kalabagh to Kotri (1,263 Kms) has not only served as an active navigational waterway till recent past (turn of the twentieth century) but is even now being used by country craft for sectoral cargo movement. Various control structures enroute i.e. barrages have been provided with navigation locks except the one at Sukkur. The lock in Kalabagh barrage is small. With regard to navigational depths, WAPDA (1976) study established year round

availability for craft upto 1.4 meter draft in the stretch from Kalabagh to Sukkur, essentially for pre-Tarbela conditions. For post-Tarbela conditions the position has significantly improved.

Indus river reach between Kotri to sea (about 152 Kms) carries significant supplies during the high run off season from June to September. This route could facilitate some local cargo movement in the high flow season to serve such places as the town of Thatta. However, a mere outlet to sea would not serve the purpose of promoting extensive use of this river reach. The river ends up in a delta and entry into open sea, without safe access to a port cannot be considered satisfactory. A connection to ports of Karachi or Qasim would require a journey of about 120 Kms in open sea for which the small river crafts are not suitable and coasters which are suitable for sea journey cannot be used in the river reach below Kotri. Any discharge escaped below Kotri in critical low flow period would be wasted to sea, when it may be otherwise required for irrigation requirements of upper canals.

In terms of the extent of dependent agriculture, Indus is one of the most important rivers of the world. The main Indus River is about 3,200 kilometers long and its principal left bank tributaries, the Jhelum, Chenab, Ravi, Beas and Sutlej Rivers have an aggregate length of more than 4,500 Kms

The source of Indus River is near Lake Mansrowar, Tibet about 5,182 metres above sea level. After running through various mountain ranges, it enters the Punjab Plain near Kalabagh at an elevation of about 244 metres and about 1,530 Kms from the sea.

Indus Tributaries:

Various tributaries enter the Indus River at regular intervals all along its length. The largest tributary is the Panjnad, or five rivers, which is made up from the confluence of Jhelum, Chenab, Ravi, Beas and Sutlej rivers. The Panjnad joins the Indus from the east above Mithankot 1,000 Kms from the sea.

The principal rivers of the Indus system are all perennial but the flow in each varies enormously during the year. Flow is at minimum during the winter, with floods occurring during the July to September monsoon season.

Canals:

Around 1880, the British started a large scale effort of diverting water from the main rivers, first with a network of canals of varying sizes and later, with barrages. The present length of the irrigation channels exceeds 56,600 Kms including main canals, branches, distributaries, minors, and water courses (See Figure - 1). Many of the main canals are quite large with widths in excess of 30 meters and hydraulic

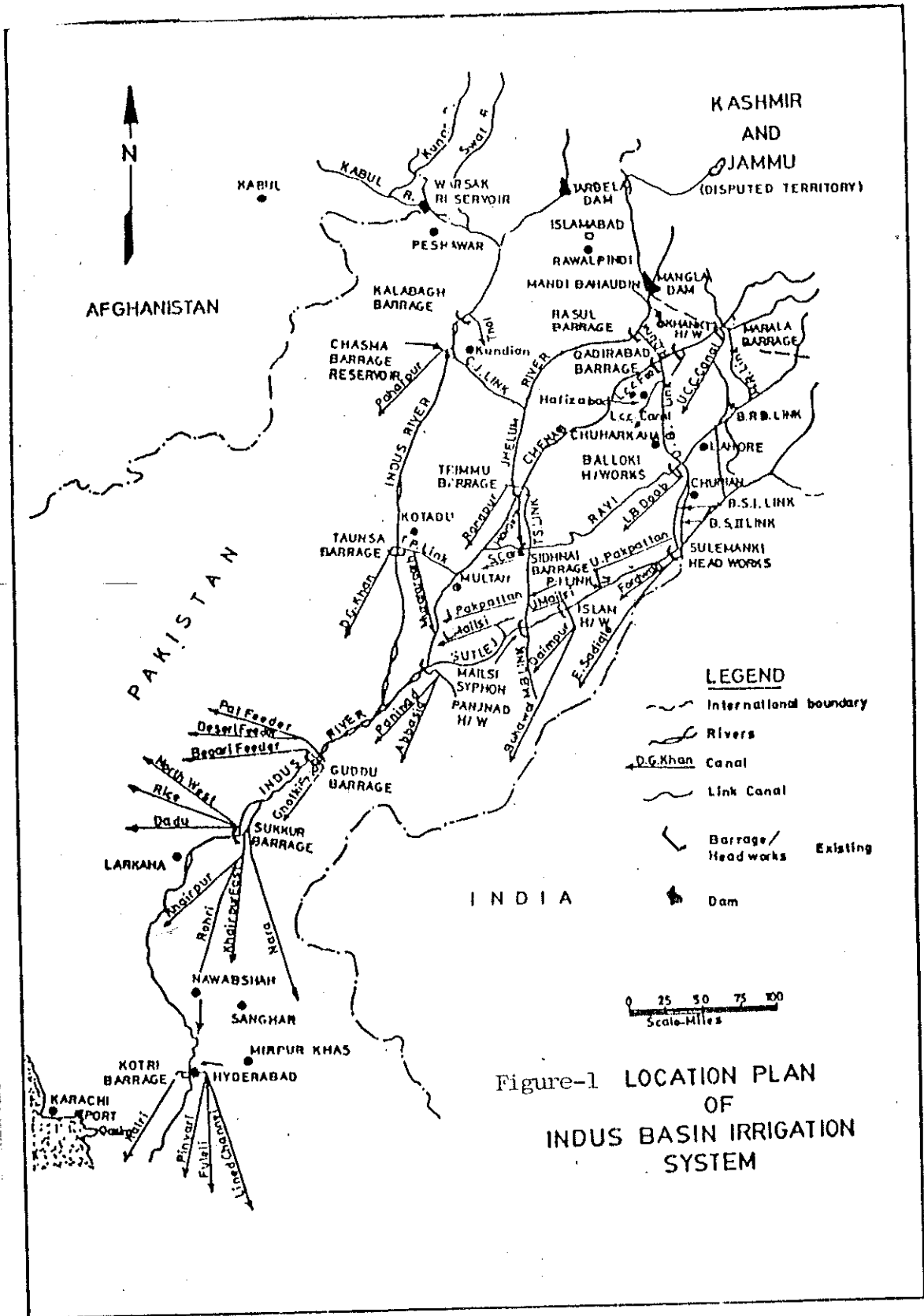


Figure-1 LOCATION PLAN OF INDUS BASIN IRRIGATION SYSTEM

capacities in excess of 15,000 cfs. The Indus barrages are essentially weirs which have a series of sluice gates between fixed piers which are spaced at intervals of 12 to 18 meters generally extending throughout the width of the waterway.

Their primary purpose is to increase the depth of water and regulate flow in the irrigation canals. Of the 14 major barrages in Pakistan, six are on the Indus River at Kalabagh, Chashma, Taunsa, Guddu, Sukkur and Kotri, others are on tributaries.

The canals were designed for irrigation purposes or diverting the water from one river to another. Hence, the bridges were constructed all along a canal for road, rail and/or pedestrian traffic. These bridges are a big hazard in the way of using the canals for inland water transport which can be an economical mode to transport goods and passengers.

3. NAVIGATION IN THE PAST

Although, presently there is no worthwhile Inland Water Transport in existence in the country, this was not always like that River Indus and its tributaries had been functioning as conduit for transport since time immemorial. The chronological detail, which date back to 2500 BC and showing rise and fall of navigation particularly on Indus are as given below:-

- 2500 B.C. The earliest evidence of navigation on River Indus is provided by a seal and potsherd graffiti of Mohenjo Daro civilization which shows a boat with a mast and yard on one of them and a boat with a cabin and a man steering it on the other.
- 327 B.C. The Greeks, under Alexander of Macedon, used River Indus in crossing Pakistan with the help of 200 river crafts.
- 718 A.D. Arabs, led by Mohammad Bin Qasim who landed somewhere in Gharo creek, one of the outfalls of Indus River, used this waterway.
- 1400 A.D. Mughal Emperors used Indus River in conquering and ruling this area.
- 1835 British Government in the sub-continent started its first steamer service on the Lower Indus.
- 1847 Government Steamer Service, known as Indus Flotilla, operated a fleet of 10 vessels and 43 barges with an aggregate capacity of 10,641 tons. The service operated between Kotri and Sukkur.

- 1857 During the War of Independence, the flotilla was effectively used to rush troops for crushing the freedom fighters. The flotilla was also being used for commercial purposes.
- 1861 The Sind Railway which started its operation between Karachi and Kotri took over Indus Flotilla in 1962. This was the beginning of the end of the water transport.
- 1862 Punjab Flotilla started operating first between Kalabagh and Mithankot and later extended to Sukkur, thus providing a direct route between Kalabagh and Karachi by water.
- 1865 The Railway line from Delhi to Lahore was extended to Multan and started taking traffic from waterways.
- 1869 Government started bearing all capital expenditure on the construction of railways thus encouraging diversion of traffic from waterways to railways to recover the cost.
- 1872 Government abolished the flotilla in favour of railway to expedite financing and recovery of investment on railway construction projects.
- 1885 The above process culminated with the purchase of railways in Sind and Punjab by the Secretary of State for the sub-continent.
- 1929 Sukkur barrage was constructed without any locks for navigation which was the last bolt in the coffin of the Inland Water Transport on River Indus.

It may thus be seen that water transport flourished in Punjab and Indus area upto the end of the last century. In fact, during that time, water was the means of transportation. The decay was started by Railway acquiring the ownership of the Inland Water Transport Flotilla and was completed with the construction of Sukkur Barrage in 1929.

4. PAST NAVIGATION STUDIES

The use of the interconnected network of rivers and canals of Pakistan for navigation has been the subject of extensive discussion and study. Interest in the subject was generated when large inter-river link canals were being planned following the Indus Waters Treaty of 1960. In 1959, the President of Pakistan directed that possible use for navigation of the Indus River from Kalabagh to the Sea and of the canals be examined. This and a later directive in 1966, led to studies by individuals and government agencies during the sixties. Later, in the wake of the international oil price rise and the overloading on Pakistan's rail and road systems, interest in the subject was renewed and in 1974 the federal government commissioned two studies to examine the possibility of using the Indus from Kalabagh to Sukkur and connecting Sukkur to the new Port Qasim. In early 1981 UNDP provided the services of Mr. J. M. Deplaix, IWT Expert to assess the possibility of development of inland waterways in Pakistan. In March 1984, a comprehensive desk study was completed by the Irrigation Drainage and Flood Control Council of Pakistan. In October 1984, Mr. Leonard E. Van Houten, UNDTCD Adviser on Inland Waterways visited Pakistan to investigate the potential for inland water transport. More recently in January 1987, US Department of State arranged the visit of Specialists to Pakistan

for the appraisal of prospects for Inland navigation. Subsequently, an Indus River Expedition was arranged by the NTRC in December, 1987 - January 1988 from the junction of the Kabul river to the mouth of the Indus on the Arabian sea with one of the objectives of determining the depth of water available in the main channel of the Indus during dry winter season. The JICA Study Team in their Final Report on the Pakistan National Transport Plan Study (March 1988) have recommended that a detailed techno-economic study be carried out to assess the feasibility of the inland water transport system. It may thus be seen that most of the efforts so far made are in the form of 'Desk Studies'.

5. THE INDUS RIVER EXPEDITION

Indus River Survey was carried out by Indus expedition, comprising members from United States of America and Pakistan from 23rd December 1987 to 8th January 1988. The navigational objective of this survey was to determine the depth of water available in the main river channel of the Indus from the junction of Kabul River to the mouth of the Indus on the Arabian Sea during the dry winter season and to ascertain the feasibility of using the Indus River as an inland waterway for commercial traffic-ability.

The expedition was formally launched by Begum Kalsoom Saifullah, the then Minister of State for Commerce on 23rd December, 1987 after a colourful ceremony at Kund Rest House. The expedition terminated at Port Qasim on 8th January 1988 after covering a length of 1,320 kilometers. Sonar type depth finder and lead line cum pole was used to probe the bottom of the river.

Following are the major observations made by the team:-

- (a) The survey has been carried out for dry weather (winter) when the water levels in Indus is at its lowest ebb. During summer the river can change drastically in depth, current and velocity offering new dimension to the study. Depth variation in the main channel were observed between 3 to 15 feet plus. When the depth of water is 6 to 10 feet it was bordered by a bar that came within 1 foot of the surface, which makes navigation either impossible or allow only shallow draft vessels to ply.
- (b) Localised transportation of vessels is possible for short lengths in the present condition, which is being resorted to using different type of crafts.
- (c) A large population living along the river undertake fishing by casting nets which are a hindrance to the trafficability through the channel. If the river is used for commercial trafficability the fishing being presently done will have to be either abandoned or some alternate method adopted which will seriously effect the fishing by local population.
- (d) The bridge heights and design will have to be altered to accommodate the commercial trafficability in the river.
- (e) Necessary infrastructure for transportation of vessels does not exist, which will have to be created if the river is to be used for trafficability.

On the whole it was observed that no major obstructions exist along the Indus River which is navigable, more or unless, through-out the year using atleast 4½ feet barges.

Larger craft can be plied for more than 9 months of a year. In the time and the resources available a comprehensive reconnaissance/study could not be accomplished. The main aim of this survey was to provide a broad-base for a comprehensive technical study which will require longer time and more resources. This study should investigate the shallow depth area more thoroughly including cross-sectional studies of the channel on the basis of this report. Certain reaches like Sukkur to Guddu may require detailed investigations during a detailed survey to be conducted as part of the proposed engineering study. This study should not only establish the channel, suggest plans/designs for improving it but also include the location of river ports along the entire route. The data may have to be collected over many years to cover the prospects of navigation from Attock to Karachi/Qasim Port. Till then engineering studies can be carried out for smaller stretches to plan navigation to carry passengers and goods locally where possible.

A comprehensive account of the Indus River Expedition covering the events in chronological order including the planning, design and implementation phases is given as Annexure to this report.

DETAILS OF INDUS RIVER EXPEDITION — CHRONOLOGICAL EVENTS

The idea of undertaking an expedition from Nowshehra in NWFP Province to Karachi was mooted by Dr. S. Amjad Hussain M.D., Clinical Professor of Surgery of US in 1986.

In Pakistan the idea was floated by Mr. M. Sadiq Swati, Chief NTRC, Planning Commission and the planning of the expedition started in full swings. The salient features of the proposal were as under:-

- (1) The trip shall start from Attock and end at Karachi is expected to take about three weeks.
- (2) The expedition shall consist of at least two historians, two photographers, one Naturalist, one free-lance writer and one expert on river transportation.
- (3) Rubber rafts, outboard motors, camping equipment and photographic gadgetar shall be provided by the expedition.
- (4) The expedition will study and photograph the archaeological sites and other tourist attraction along Indus Valley.
- (5) The suitability of Indus River for inland navigation shall be determined by measuring water depth with the help of sonar and other equipment.
- (6) The story of the trip shall be gotton printed in major U.S. published media and T.V.
- (7) The local hospitality in terms of ground transportation, boarding, loding, guides and help in clearing the equipment through the customs is to be provided by the Government of Pakistan.

Dr. M. Tahir Masood, on joining NTRC on 2nd August, 1987 was assigned the task of planning and coordinating the expedition under the overall supervision of the Centre's Chief. Because of technical and administrative reasons the expedition was to be undertaken in December 1987/January 1988. It is during this time of the year that the River Indus

has minimal flow which is an important consideration during any navigational study. Also, the Expedition members from US wanted to come to Pakistan by availing the Cristmass break in business/schools in USA.

After October 1987 the planning activity really became very hectic and the NTRC planning team had to put in long hours in this project. Ministries of Communications (P&S Wing), Tourism, Information, Water and Power, Central Board of Revenue, Directorate of ISI, and Adventure Foundation, Pakistan (AFP) went out of their way to help us in giving this Expedition a final shape. A brief office report dated 29.11.1987 is enclosed as Appendix-I, which gives a good idea of our efforts during the planning stage. This report also includes some useful information required to plan an Expedition like this one.

The route plan and the time table of the Indus River Expedition was finalized in early December. The same is given at Appendix-II. At this stage, it was decided to include two members of Adventure Foundation Pakistan, one representative of Port Qasim Authority and a team of Pakistan Navy with their own rafts. The complete list of expedition members is given at Appendix-III. Following equipment was imported by Dr. Hussain and his team who arrived in Pakistan on 13th December, 1987 and 20th December, 1987. respectively.

Equipment ListFrom USA

- | | | |
|-----|---|----|
| (1) | Rubber Inflatable Rafts - Achilles SD-124 | 2 |
| (2) | Mariner outboard boat engine 15 H.P. | 2 |
| (3) | Hummingbird Depth Finder 400 G | 2 |
| (4) | Extra petrol containers for outboard motors | 2 |
| (5) | Video Recorder/Camera | 2 |
| (6) | Video Recorder Cassettes | 10 |
| (7) | Walkie Talkies | 2 |

By NTRC

- (1) Two vehicles (Toyota Hilux and Car) for logistics and act as chase vehicle.
- (2) Dry/tinned ration.
- (3) Petrol and lubricants for the vehicles and outboard motors.
- (4) Items needed for inaugural ceremony.
- (5) Two outboard motors.
- (6) Signals sets to set wireless communication (courtesy M/s Micro-Link, Lahore).

By Pakistan Navy

- (1) Two rafts, outboard motors, and allied equipment for the Naval members.

Before launching the Expedition Mr. Shamsuddin Qureshi, Assistant Chief, National Transport Research Centre

was sent to various places along Indus River to finalize the arrangements of local hospitality and security with local authorities like Commissioners, Deputy Commissioners, Assistant Commissioners, Tehsildar, DIGs, SSPs, Chief Engineers of Barrages and the Local Councillor of the areas along the route.

a. Launching of the Expedition

On 23rd December 1987 the equipment was transported to the site and Dr. Hussain and Major Azam started from Nowshehra to carry out a trial run to find the depth of water available in River Kabul. It was found that the draft was not enough to start the Expedition from Nowshehra as planned. Hence, it was decided to shift the start point to Kund Rest House on Grand Trunck road near the meeting point of Kabul and Indus Rivers. NTRC with the help of PTDC made arrangements for the inaugural ceremony of this Expedition on the morning of the 23rd December 1987. Begum Kalsoom Saifullah, Minister of State for Commerce was gracious to be the Chief Guest for the inaugural ceremony. Dr. M. Tahir Masood introduced the stage fellows and requested Mr. M. Sadiq Swati, Chief NTRC to deliver the welcome address. In his address (refer Appen.IV) Mr. Swati briefly stated the background of the Expedition. He emphasised on the need for such Expeditions which can provide useful information for inland water transport planning studies. He thanked the guests in general and the Expedition members from USA in particular for their presence in the ceremony. He also thanked the Honourable

Minister for her presence which proved the importance attached by the Government to such Expeditions.

Mr. Malik Muhammad Saeed Khan, Chief (T&C), Planning Commission delivered the Key Note address. He laid emphasise on the importance of inland water transport and confirmed the keen desire of the Federal Government to take steps to develop the inland water transport system which had been neglected in the past.

After the Key Note address, Dr. S. Amjad Hussain, MD explained salient features of the planning and objectives of the Indus Expedition. He also introduced the members of the team, both from US and Pakistan. At the end he thanked the Honourable Minister and various agencies who contributed towards the planning and execution of this Expedition, particularly the National Transport Research Centre.

At the end, the Chief Guest delivered the inaugural address (refer Appendix-V). She emphasised on the need for such expeditions in future and brought out the importance of developing our inland water ways which could result in enormous energy saving as a result of cheap transport for our goods and passengers. She praised the efforts of Dr. Hussain and his team, Mr. M. Sadiq Swati and his NTRC team and other organizations who helped in organizing the said Expedition.

After a cup of tea, the Expedition was formally launched by Begum Kalsoom Saifullah into the Kabul River. The chase and the administration team under Mr. Shamsuddin Qureshi, the Liaison Officer left Kund to travel along the river bank. They were supposed to reach the first camping station i.e. Khushalghar before the rafts, make necessary arrangements for night's stay and go to the river bank to locate the rafts and bring the team members to the camp site. This procedure was followed all along till the completion of the Expedition. Where-ever the Expedition team went they were looked after by the local people and the authorities.

The Press and PTV gave a white coverage before, during and after the Expedition.

b. The Expedition:

Communication between the rafts and with NTRC (Expedition Control Office) through wireless control station at Lahore was extremely important. The communication diagram explaining the network is given at Appendix-VI. An efficient communication system was essential for safety and security of the Expedition members travelling in the River and on the bank. On the whole the system worked pretty well except for few hours break-down here and there. Mr. M. Sadiq Swati alongwith Mr. Abdul Majeed, Deputy Chief NTRC went to Karachi by road to carry out road reconnaissance/feasibility study of road along Indus River as a part of another project. This team met the Expedition members at a few places

enroute and Mr. Swati's presence proved of great help in sorting out various technical and administrative matters on the way.

The Expedition went fairly well except for a bad-luck. Hummingbird Depth Finder went defective hence for some lengths the Expedition had to use poles/bamboos to determine the water depth. After reaching Guddu Barrage the Expedition team had to take out their rafts from the River because of the security problems and low draft. They transported the rafts by road upto Hyderabad from where the voyage started once again. From there onward the Expedition continued through the River and they reached Port Qasim on 8th January 1988 where Rear Admiral Walliullah, Chairman, Port Qasim Authority, had laid a great reception for them. In his speech the Chairman appreciated the great venture and hoped that the information provided by the Expedition would go a long way in preparing the IWT feasibility and planning studies. On the next day, the Expedition members reached Karachi from where they dispersed for their destinations. On return to Islamabad Dr. Hussain and other members from US were taken by Mr. Swati to meet Secretaries of Ministry of Communications and Planning & Development. Dr. S. Amjad Hussain, Mr. Ronald Euton and Mr. Anthony Glinke were interviewed by Pakistan Television in their programme entitled "Visitors' Book" which was shown all over Pakistan

a few days later. Finally, the expedition members left for US in the second week of January 1988. As a noble gesture the expedition team from US decided to donate the two Rubber Inflatable Rafts, two outboard engines, Hummingbird Depth Finder to the Adventure Foundation, Pakistan for future use by NTRC and the foundation members.

c. Conclusions

On return to US Dr. S. Amjad Hussain wrote articles on this Expedition which were published in the US newspapers/magazines. A copy of his article in Toledo Magazine is attached at Appendix-VII. Later Dr. Hussain and Mr. Euton wrote a useful report, copy of which is attached at Appendix-VIII. The report contains very useful survey observations and recommendations.

INDUS RIVER EXPEDITION — BRIEF PAPER/OFFICE REPORT
29.11.1987

(Dr. M. Tahir Masood)

INTRODUCTION

A voyage down the River Indus is planned from Attock (NWFP Province) to Karachi. The Expedition is proposed to start on 23rd December 1987. The expedition Team comprises of six U.S. citizens lead by Dr. Amjad and will be joined by two Pakistanis (Dr. Amjad's friends) and member(s) nominated by National transport Research Centre (NTRC), Planning Commission, Government of Pakistan, Islamabad. NTRC has sponsored the Expedition and helped in completion of formalities like clearance from relevant Government Agencies, etc and shall be responsible for the co-ordination.

PREVIOUS VOYAGES:

Some of the known Pakistani expeditions in the recent past are:-

- 1954, Squadron Leader Z. A. Chaudhry and Flt. Lt. Zulfiqar Khan of PAF along with three others sailed from Attock to Sukkur.
- 1957, Late Colonel Saeed Afzal Durrani and Raja Bashir, Advocate sailed from Nowshehra/Attock to probably Kotri/Hyderabad.
- 1978, Engineer K.M. Ali, hamid Omer and Naeem Omer of Adventure Foundation of Pakistan (AFP) navigated the Indus (Tarbela to Karachi) in 35 days and made a historical record.
- 1981, Swat White Water Expedition.
- 1985, River Indus-Chenab Expedition, upto Karachi Major Azam and others (with a portage between Sukkur and Karachi).

PROPOSED EXPEDITIONS

- 1987, Dr. Amjad and his Team in collaboration with NTRC, proposed for 23rd December 1987, from attock to Karachi.
- 1988, Kabul-indus Expedition starting from Khyber is planned to be the longest travelled journey on any River in Pakistan. It is a venture of AFP, Engineer K.M. Ali and Major Azam are expected to be member of the Team.
- 1988, Silk Route Expedition, planned from Peking to Karachi via Shanghai, Engineer K.M. Ali, Major Azam and others are the Team members.

RECENT MEETINGS

- On 11th November 1987 a meeting was called to discuss the arrangements connected with the Indus River Expedition. Representatives from Ministry of Tourism, Central Board of revenue, PTDC, and Ports and Shipping attended. Next meeting is proposed for the second week of December 1987 (i.e. after Dr. Amjad's arrival).
- With a view to collecting maximum information for the proposed Expedition, NTRC looked for some members of the previous expeditions. On 25th November 1987, Engineer K.M. Ali from PIA and Major Azam from GHQ, Rawalpindi were invited for a meeting with Mr. Sadiq Swati, Chief, National Transport Research Centre at NTRC. Following points were discussed:-
 1. Discussion:
 - a) A brief for previous expedition was presented and discussed. Related documents distributed.
 - b) Dr. Amjad's Expedition, outline/plan was discussed.
 - c) Adventure Foundation Pakistan (AFP), assistance in any form was offered.
 - d) The possible camping sites and lengths of each days journey were noted.
 - e) Historical, Archaeological, Cultural interest items were discussed.
 - f) Security arrangements were sorted out.
 - g) Inland navigation possibilities and possible bottlenecks.

2. Open Points:

- a) Sind Barrage opening/closing schedule
- b) Letter to VCOAS for Maj. Azam's permission to join the Expedition.
- c) Letter to PIA for meeting again on 15th December to get permission for Ali.
- d) Letter to AFP for coordination and help.
- e) Extra Boat/Engine/Life jackets from AFP as well.
- f) Meeting on 15th December, 1987, NTRC to arrange.
- g) AFP membership forms were given to NTRC to encourage membership.

3. Miscellaneous:

- a) Terms of reference for "Low Cost Roads in China" study - to be provided to Silk Route expedition by NTRC.
- b) Terms of reference for possible study of use of howercraft for inland navigation to be provided.
- c) Truck fuel saving Aerodynamic spoilers, NLC to be contacted (and possibility of tax exemption investigated by NTRC).

-- The above meeting was followed by a detailed discussion on 26th November 1987, evening amongst Dr. M. Tahir Masood, Engineer K.M. Ali and Major Azam. All aspects of the Expedition were thoroughly discussed. The discussion covered points like number of persons in the Team, equipment being imported by US Members and make-up of shortfall through the courtesy of AFP, itinerary, administrative and chase vehicles, security, nomination of members from Pakistan to represent NTRC, designation of Co-leader-cum-Liaison Officer and his duties and matters connected with the local hospitality, etc.

SUGGESTED ROUTE PLAN:

Day :	From	To	KMs.	REMARKS
1 :	Attock Khurd	Khushalghar	72	
2 :	Khushalghar	Kalabagh	90	
3 :	Kalabagh	Chashma Barrage	78	
4 :	Chashma Barrage	Dera Ismail Khan	102	
5 :				REST DAY/-

Day :	From	To	KMs.	REMARKS
6	: Dera Ismail Khan	Leiah	108	FC
7	: Leiah	Taunsa Barrage	70	
8	: Taunsa Barrage	Jampur	115	FC
9	: Jampur	Mithankot	102	FC
10	: Mithankot	Guddu Barrage	122	
11	:			REST DAY
12	: Guddu Barrage	Sukkur	165	
13	: Sukkur	Dokhri	118	
14	: Dokhri	Dadu	95	
15	: Dadu	Mihrabpur	82	
16	: Mihrabpur	Kotri	110	
17	:			REST DAY
18	: Kotri	Thatta	112	
19	: Thatta	Kati Bunder	104	
20	: Kati Bunder	Port Qasim	110	
21	: Port Qasim	Karachi	60	

TOTAL DISTANCE:

1,815 KMS APPROX.

FC Means : FERRY CROSSING

IMPORTANT POINTS:

- (1) Dr. Amjad is expected to arrive in Islamabad on 10th December 1987. Other members with equipment are expected to arrive from US by 20th December 1987.
- (2) It is important to get the services of Maj. Azam who shall be member of the expedition. CGS/VCOA need to be requested to make him available from Dec. 15, 1987 to Jan. 4, 1988 i.e. for a period of one month. So, a request is to be made immediately by NTRC.
- (3) It is also proposed that two members (Naseem Zafar Iqbal and Ahsan Imran) from AFP be included in the Team. One of them will be in the Chase Vehicle and the other will be in the raft. The job of the member in the Chase Vehicle is not very important but also very tiring. So they will keep switching during in the voyage.

- (4) Wireless communication between the rafts and with the Chase Vehicle is important.
- (5) AFP should be requested to show the equipment to make up the deficiency in the equipment received from US and also to make provisions needed as a result of addition of Pakistani members to represent NTRC.
- (6) As understood from the detailed discussion with Ali and Azam, the following main aspects are to be handled and they should be the responsibility of NTRC for the success of their expedition:-
 - (a) Coordination;
 - (b) Planning;
 - (c) Logistic Support; and
 - (d) Security.
- (7) The Expedition involves a lot of logistic and Administrative support including information on the River and dealings with locals/local governments/government officials/police/WAPDA/Tourism/other agencies. So, it is appreciated that these main aspects require complete authority to be vested with NTRC to avoid confusion and embarrassment on part of Government of Pakistan. For a smooth working of the Expedition, it is imperative to have a Pakistani official/Team member designated as the Co-leader-cum-Liaison Officer. It is absolutely essential to lay down, in writing, the duties and authority of the Leader and Co-leader during the planning at launching, during voyage and at dispersal.
- (8) There are many expected and un-expected situations which arise during the practical execution of the expedition and these cannot be fully appreciated by the foreign participants. Friends coming from abroad might have collected a lot of information on Indus and other expeditions but assistance and coordination by NTRC and availability of AFP members who would have undertaken such expeditions earlier. River survey is essential in an Expedition like this.

CONCLUSION:

To effectively conduct the expedition, the following recommendations are made:-

- (a) As mentioned above, NTRC Representative should be designated as the Co-leader-cum-Liaison Officer with full authority on items 2(a) to 2(d).

- (b) All security plans and local administrative support plans are to be made well in advance, discussed and finalization for implementation.
- (c) All logistic planning is to be co-ordinated and chalked down as per the expedition schedule.
- (d) All financial implications should be finalized and put up in meeting on 15th December 1987.
- (e) Code of ethics and division of responsibility should be formulated and accepted by all members before the launching.
- (f) A Recce Survey (on land) along the River by at least two members of the Team is very important. In the absence of this Recce, it is essential to have at least two members from AFP who have been on an expedition before. AFP should be approached to loan two members who have wide experience. It requires a lot of planning and spade work before the team from US arrives.
- (g) Expected problems are as follows:-
 - (1) portage/Abandoning decisions
 - (2) Food/water logistics
 - (3) Chase Vehicle Co-ordination
 - (4) Security agencies' coordination
 - (5) Cultural conflicts during voyage.
- (h) Early determination of equipment details is necessary for effective planning.
- (i) Association of AFP can help for providing camping equipment shortages.
- (j) I recommend 2 x 4 x 4 vehicles to provide logistic support. We require an experienced person from AFP to man the Chase Vehicle.
- (k) All the nominees of NTRC and AFP should be considered equal team members of the expedition.
- (l) Barrage opening dates to be determined and re-scheduled in-line with expedition dates or expedition has to fall in line with these Barrage Opening Dates. Otherwise there will be no water beyond Sukkur for any rafting i.e. Expedition will end there.

- (m) Between Guddu and Kotri the services of police personnel will be required as security is not safe in that area. An additional boat may be required for which AFP may be approached.
- (n) Wireless equipment is needed between rafts and vehicles (Boat to Boat + Boat to Vehicle).
- (o) Barrage Negotiation is a technical drill because at the Canal outlets, the suction is very dangerous and we require a proper negotiation procedure which is controlled and co-ordinated by the member in Chase Vehicle. The Guide in the raft also renders some help.
- (p) PIA Tour Promoters should be contacted, as it can provide historical data/information and movies/slides on landing.
- (q) Local Guides for each leg will be need. Maj. Azam has all the coordination details on the subject.
- (r) Mr. K.M. Ali can coordinate all the details from Keti Bunder to Port Qasim and Expedition should be planned to terminate at Karachi for better reception.
- (s) At dispersal/landing in Karachi, Engineer Ali can help in arranging publicity/videos, etc. through PIA. At the end of the Expe, equipment donation to AFP is suggested. Also, members of the expedition be requested to fill forms for the membership of AFP.
- (t) Engineer Ali can help in local hospitality at Karachi through PIA.

Appendix-II to Annex.

INDUS EXPEDITION - ROUTE PLAN AND TIME TABLE

S.No.	Places		Distance in Kms.	Time in Hours	Camping Stations	Dates	Boarding	R e m a r k s
	From	To						
1.	Attock	Khushalgarh	72	5	Kushalgarh	23-12-87	Police Guard Rooms at Bridge	Self Arrangement
2.	Khushalgarh	Kalabagh	90	5	Kalabagh	24-12-87	Highways Rest Hou- se Beside the River	Local Authorities
3.	Kalabagh	Chashma	78	5	Chashma	25-12-87	Wapda lodge at Chashma Barrage Colony	Local Authorities
4.	Chashma	River Bank	70	5	Near D.I.Khan	26-12-87	River Bank	Self Arrangement
5.	River Bank	D.I.Khan	32	5	D.I.Khan	27-12-87	C&W Rest House	Local Authorities
6.	D.I.Khan	Leiah	108	10	Near Leiah	28-12-87	River Bank	Self Arrangement
7.	Leiah	Taunsa Barrage	70	4	Taunsa	29-12-87	Barrage Rest House	Local Authorities
8.	Taunsa	Gazi Ghat	65	4:30	D.C.Khan	30-12-87	Building Rest House	Local Authorities
9.	Ghazi Ghat	River Bank	75	6	Near Jampur	31-12-87	River Bank	Self Arrangement
10.	River Bank	Mathankot	68	5	Mithankot	01-01-88	Forest Rest House	Local Authorities
11.	Mithankot	Guddu Barrage	122	6	Guddu Barrage	02-01-88	Barrage Rest House	Local Authorities
12.	Guddu Barrage	Kotri Barrage	450(BY Road)	-	Hyderabad	03-01-88 to 05-01-88	Inspection Banglow of Irrigation Deptt.	Local Authorities

S.No.	From	Places To	Distance in Kms	Time in Hours	Camping Stations	Dates	Boarding	Remarks
13.	Kotri Barrage	Thatta	112	7	Thatta	06-01-88	i)Thatta Sugar Mill Rest House ii)Archological Rest House.	Local Authorities
14.	Thatta	Kati Bander	104	11	Kati Bander	07-01-88	Union Council Off.	Local Authorities
15.	Kati Bander	Port Qasim	110	4:30	Karachi	08-01-88	Hotel Plaza International	Port Qasim Authorities
16.	Karachi	-	-	-	Karachi	09-01-88	-do-	-do-

Indus River Expedition
1987-88

Planning and Supervision of Project

1. Mr. M. Sadiq Swati, Chief, NTRC, Planning Commission, Islamabad — Overall Incharge.
2. Dr. M. Tahir Masood, Consultant NTRC, Planning Commission, Islamabad — Chief Planner and Coordinator.

Members of the Expedition

From USA

1. Dr. S. Amjad Hussain, S/o Late Syed Gul Badshah, age 50 born Peshawar. USA citizen. Surgeon and freelance writer living in Toledo Ohio. Expedition Leader.
2. S. Waqaar Hussain, S/o Dr. Amjad Hussain, age 17, US citizen, Senior Student Maumee Valley Country Day School, Special interest in anthropology.
3. Dr. Bahu Sultan Shaikh, age 40, born Karachi. US citizen. Cancer Specialist. Interest Archeology, Indus Valley civilization.
4. Mr. Anthony Glinke, S/o George Glinke, age 30, born Michigan. US Citizen. Mechanical Engineer. Currently student MBA, University of Michigan. Special interest: Pakistan and its culture.
5. Mr. Ronald Euton, age 45, born Ohio. US citizen. Teacher Maumee Valley Country Day School, Toledo. Special interest: History, anthropology.

From Pakistan

6. Mr. Sardar Hussain, (Peshawar) Retired Director of Agriculture Frontier Province, knows the Indus in frontier province very well, has contacts in the area, great marksman and hunter.
7. Mr. Azhar Ali Shah, (Peshawar) Engineer, "can fix" guy, No.#3 amateur cyclist of Pakistan (#1 Frontier Province).
8. Dr. Najam-ud-Din, (Lahore) Radiologist, outdoorsman.

From Pakistan Army

8. Major Syed Azam Jaffar, ADM Section, GHQ, Rawalpindi — Deputy Expedition Leader. Member of Adventure Foundation (Pakistan). Took part in Chenab-Indus River Expedition.

From Pakistan Navy

10. Lt. Mian Mohammad
11. Lt. A. Hussain
12. Mr. K. Khan, TO CD-1
13. Mr. T. Mohammad, Leading Chef.
14. Mr. Hazoor Bukhsh, Leading Seaman
15. Mr. M. Kerial, Leading Seaman
16. Mr. S. Hussain, AB CD-III
17. Mr. M. Saeed, ME-1

From Adventure Foundation (Pakistan)

18. Mr. Naseem Zafar Iqbal ; Already taken part in Chenab-Ravi-
Indus Expedition in 1985.
19. Mr. Shahzad Nazir ;

From Port Qasim Authority

20. Mr. Tanweer Haider, Hydrographic Officer

From National Transport Research Centre, Planning Commission

21. Mr. M. Shamsuddin Qureshi, Assistant Chief (NTRC), Liaison Officer.
 22. Mr. Nazar Mohammad, Driver (NTRC)
 23. Mr. Hameedullah, Driver (NTRC).
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WELCOME ADDRESSAppendix-IV to Annex

(by Mr. M. Sadiq Swati, Chief NTRC)

Honourable Minister of State for Commerce

Mr. Malik M. Saeed Khan, Chief (T&C), Planning Commission

Mr. Pervaiz Butt, Managing Director, PTDC

Dr. Amjad Hussain, Leader of the Expedition

Ladies and Gentlemen

It gives me great pleasure to welcome to this auspicious occasion of the Launching Ceremony of Indus Expedition. Honourable Minister we are particularly grateful to you for finding time from your busy schedule. Your presence here today is a great source of encouragement for all of us and we hope that you would continue to lend your support for the efforts that we are making.

Excellency, I would briefly give the background of the Expedition. As you are aware, Pakistan has one of the largest irrigation networks in the world and some of the canals are even larger than the largest rivers in Europe. Whereas each small canal in Europe is navigable. In some way, no real benefit has been derived from this great national resource so far in Pakistan. In the past, a number of studies have been carried out to determine the navigational potential in the country especially of Indus River but all these efforts proved fruitless due to divergent views concerning the most critical issue i.e. the quantum of draft available below Sukkur during winter months. Those favouring the idea believe that not only sufficient draft is available to allow navigation by modern plat-bottomed crafts but alternate links to sea can also serve

the purpose. Those opposing the proposition remain un-convinced. Unfortunately, almost all these being desk studies, neither side has any incontrovertible facts to present and hence the impasse.

We in the Centre feel that given the great advantage of economics of transportation by inland water transport and the vast network, the navigation potential must be fully explored and if proved feasible, development of inland water transport should be one of the major initiatives during seventh plan.

Since the entire issue seems to be dependent on the question of draft below Sukkur, the Centre has been making efforts to find ways and means to obtain the answer by actually measuring the available draft during the minimum flow period all along the River but especially below Sukkur.

After many years of waiting, an opportunity finally arose in June 1986 when, during an informal chat, Dr. Amjad Hussain, who hails from Peshawar, disclosed that he had learnt from the diaries of his grand-father that around the turn of the century Indus was navigable from Attock to Karachi and he actually travelled by this to Karachi where he was studying and he would love to re-trace the foot-steps of his grand-father. He offered to investigate the possibility of raising an Expedition from U.S. to travel down Indus.

Dr. Hussain, in addition to being an outstanding thoracic surgeon, greatly admired in his professional circles at home and

abroad, is a man-for-all seasons. He is free-lance writer, photographer, historian, social worker among other things instrumental in getting the six million \$ Toledo Muslim Centre built. Organizing and leading an Expedition on River Indus is one more feather in his cap.

The offer of Dr. Amjad was discussed with Ministries of Communications, Tourism, Information, Water and Power and Provincial Governments, who greatly appreciated the idea and assured whole-hearted cooperation. As a result, in addition to members of Dr. Amjad Hussain Team, the Expedition is represented by Pakistan Army, Navy, Port Qasim Authority and Adventure Foundation of Pakistan. Without the cooperation given by the various concerned agencies, it would not have been possible to reach this stage. The extent of the cooperation of these agencies is obvious from the fact that today's function has been sponsored by P.T.D.C. and some friends from Peshawar have also chipped in. M/S Waljis, Sitara and Karakorum Travels have provided tin food. The District Administrations in all the three provinces have agreed to provide boarding, lodging and security for the team. The communication network, which would keep the team in constant touch with the base station from Attock to Karachi, has been provided with the courtesy of Micro-Link Lahore. P.T.V., Press and Provincial Information Departments shall cover the team at various points all along the route. The team is expected to arrive at Port Qasim on 11th January and proper arrangements shall be made for their reception.

In closing, I would once again like to express my gratitude to Begum Sahiba for graving the occasion with her presence. I am also thankful to Dr. Amjad, M.D. PTDC, and C&W Department of Government of NWFP and private tour operators for the help.

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INAUGURAL ADDRESS

(by Begum Kalsoom Saifullah, Minister of State for Commerce)

Mr. M. Sadiq Swati, Chief, National Transport Research Centre

Mr. Malik Muhammad Saeed Khan, Chief, Transport and Communications, Planning Commission.

Mr. Pervaiz Butt, Managing Director, Pakistan Tourism Development Corporation.

Dr. Amjad Hussain, Leader of the Expedition

Members of the Expedition

Ladies and Gentlemen

It gives me great pleasure to be here today amongst you on this auspicious occasion of launching of Indus Expedition. I am particularly happy to note that on this project a number of federal and provincial agencies are collaborating with a group of private individuals. This is something which does not happen very often in developing country like Pakistan. I hope that other government agencies will try and emulate the example set by this Expedition. I am particularly happy to note that a major part of the cost of the Expedition is being borne by Pakistani Expatriates living in US, which shows their love and affection for their motherland. I would like to place on record our appreciation to Dr. Amjad Hussain and his team for their help.

In addition to the historical, social and cultural aspects which would be explored in this trip, the Expedition would also provide a definite answer to one of the most vexing questions of suitability of Indus for navigation purposes. Even a cursory look at the history of the evolution of major urban centres all over the world reveals that those lying on the coast or on an

inland waterway channel had a definite edge over those without such an access. Since time immemorial, water transportation has played a significant role in the development of civilizations and their contribution to trade and commerce is above any question.

In the present era, the importance of water transportation has increased even more. The important elements in support of waterway transport is that of cost. Waterways are especially suited for the movement of bulk and semi-bulk goods over comparatively long distances. Other commodities can also be moved deficiently and cheaply by this mode.

Operating costs per ton (labour and fuel) are much lower than for road. Moreover, a road vehicle will come to the end of its life in seven years or less. The serviceable life of a barge is very much in excess of that.

Inland waterways are more friendly to the environment than other modes of transport. It is an inherently safe mode of transport. Modern society is increasingly dependent on the movement of goods and chemicals with corrosive, explosive, flameable, toxic or radioactive properties. The distance between vessel and shore, and the size, stability and relatively low speed of craft make the waterway relatively better mode for transport of these hazardous and dangerous substances.

Energy saving is one of the most important benefits of inland water transport. In the developed world, transport accounts for about 18% of total energy consumption. The results

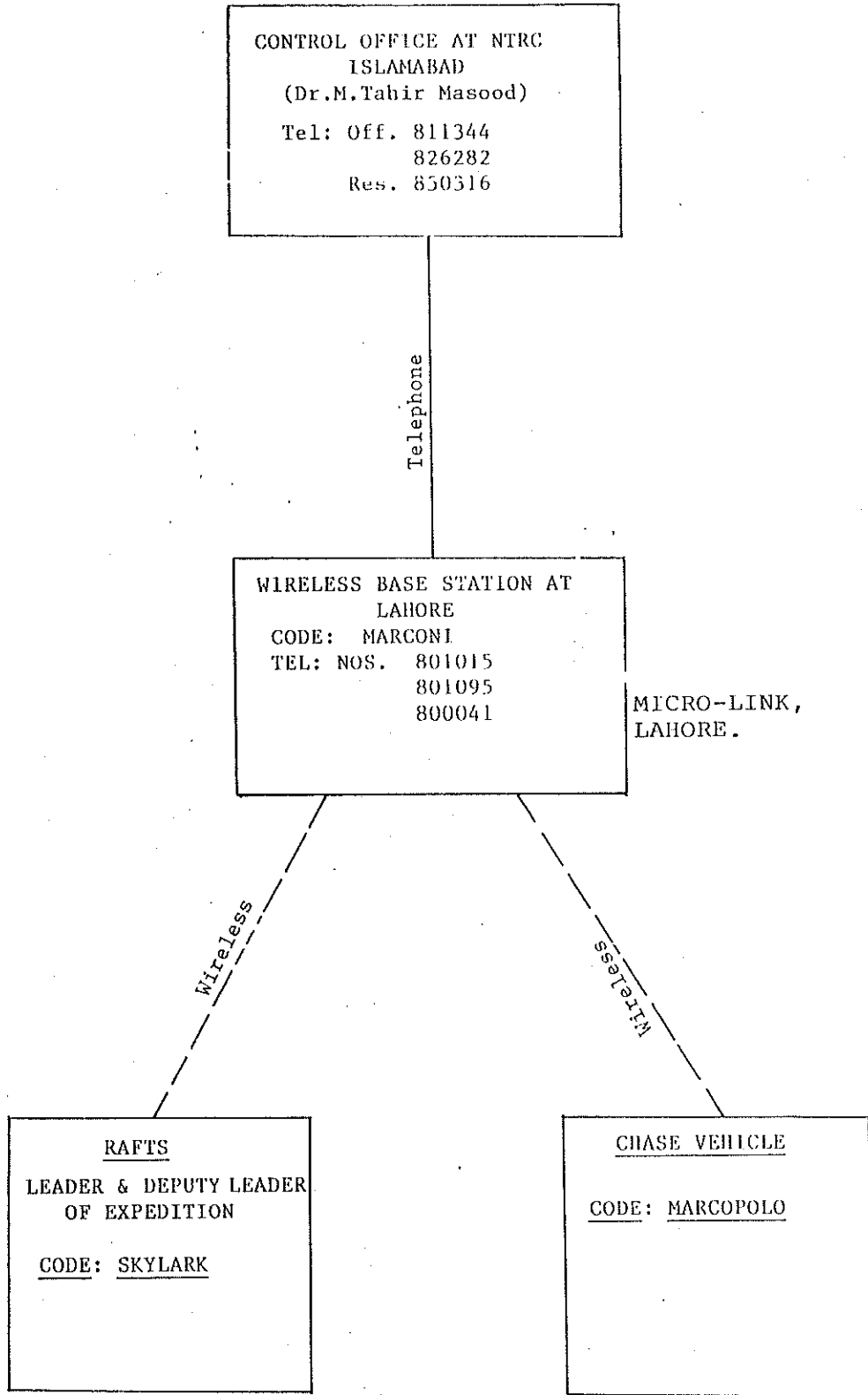
of studies invariably show that water transport is 30% more energy efficient than rail and lot more so than road transport. It is, therefore, sensible to maximize the use of waterways for transport.

Consuming all these positive points of water transport and the advantages that it offers, every effort needs to be made to develop navigation in Indus River and if found feasible, it should be given major thrust during seventh plan.

In closing, I wish the members of the expedition best of luck and a most enjoyable and safe trip. Given the degree of devotion by all the parties involved, I have no doubt that the Expedition would be successful and achieve its objectives. I pray to God Almighty that the outcome of the trip is positive.

With these words, I formally launch the Expedition.

INDUS EXPEDITION — COMMUNICATION DIAGRAM



NOTE: BASE STATION WILL STAY AT LAHORE. IN CASE IT SHIFTS TO KARACHI AFTER A FEW DAYS, TEL. NOS. AT KARACHI WILL BE: 441429, 441439.

Toledo Magazine

WEEK OF APRIL 3-9, 1988



PESH

TAUNSA BARRAGE

Adventure On The Indus

Toledoans Explore A Great River In Pakistan

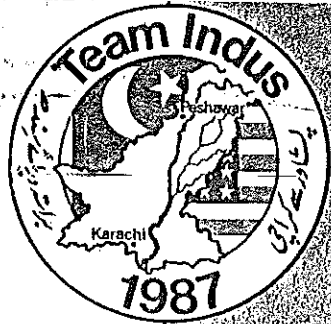
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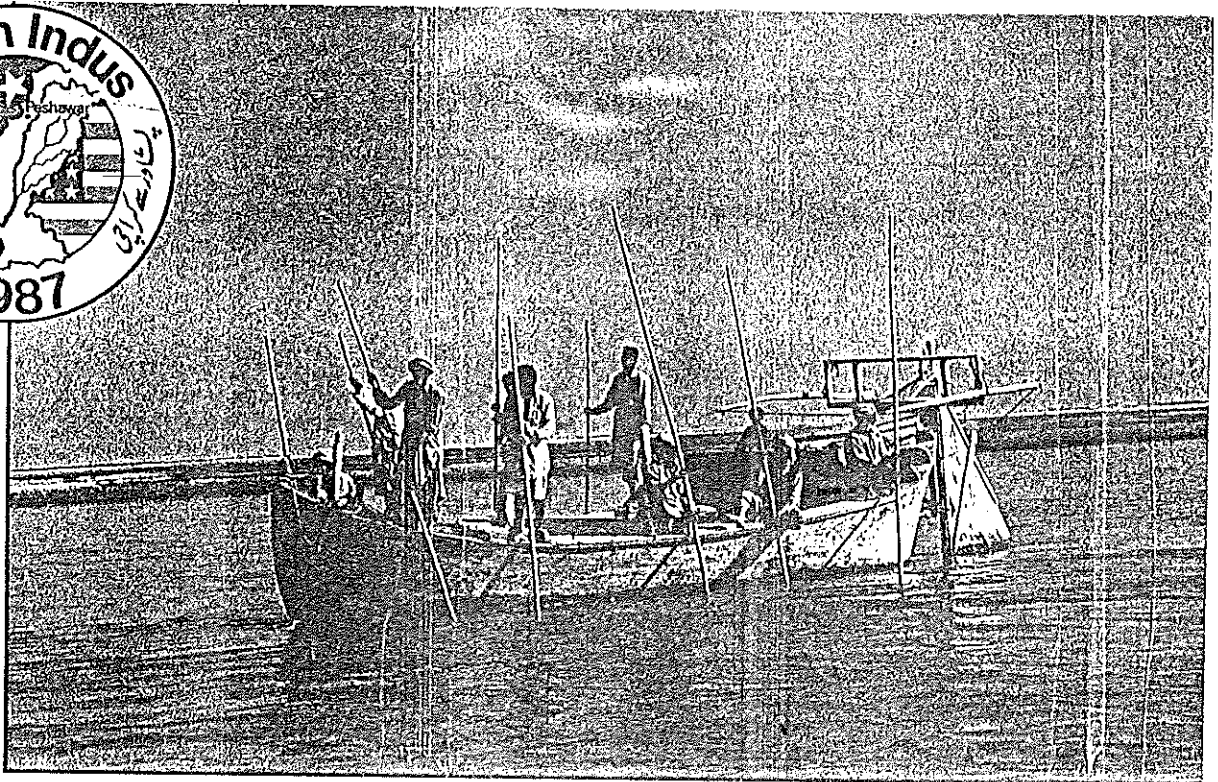
KARACHI



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The expedition team's logo, above. At right, native fishermen hunt for turtles with spears.



— Photos by Amjad Hussain

By AMJAD HUSSAIN

IT WAS A DREAM almost 30 years in the making — to travel down the Indus River from Peshawar in northern Pakistan to the Arabian Sea in the south, a voyage of 1,400 miles. Last December, the dream came true.

The Indus, one of the longest rivers in the world, arises in Tibet, and after coursing in a northwesterly direction in Kashmir, it enters and flows through Pakistan for 1,800 miles, until it empties into the Arabian Sea. It has twice the annual flow of the Nile, and three times the flow of the Tigris and Euphrates combined. And like those great rivers, it has played a pivotal role in history.

Five thousand years ago, the Indus River cradled along its banks a civilization as old and as rich as the river civilizations of Nile and Mesopotamia. Barbarians of Central Asia swept down the western mountains, looting and killing the Indus inhabitants. Hindu kings reigned and built cities along its banks. Buddhist monks built huge monasteries, and Buddhist missionaries from the north took the Indus to the sea and beyond. Chinese pilgrims tracked the steep cliffs along its course to visit their out of the way shrines. Three hundred years before Christ died, Alexander the Great swept across Indus to fight fierce battles in its plains. Part of his returning army took the Indus to the sea on their way back to Greece. A thousand years later, Arabs brought their new religion Islam to its banks. The Mughals crossed it in the 16th century on their way to Delhi, and established a dynasty which ruled the subcontinent for three centuries. Last in the string

Amjad Hussain is a Toledo surgeon and freelance writer. He was born in Peshawar, Pakistan.

Adventure On The Indus

of foreign invaders were the English, who in the 19th century fought their way in the plains and ruled the Indus Valley for 200 years, until their departure in 1947.

Its name is derived from a Sanskrit word, Sindhu, meaning divider, keeper, or defender. The name gradually changed to Indus (India). It is called the Lion River in Tibet, where it is believed to arise from the mouth of a lion. Lower down in the gorges, it is the Abasin.

MY FASCINATION with the river started during my childhood, when I hunted and fished with my brothers on the Kabul River, a tributary of the Indus. The Pushtu word, Abasin, that means "father of the rivers," always took new meaning when I listened to the tales of my ancestors farming along its banks 300 years ago, or of my grandfather taking his family by river boat 250 miles to the southern districts, where he was a country doctor in the 1870s. As I grew older, this childhood fascination with the Indus grew into an adulthood obsession. I had to do the Indus.

Not counting the adventurous travelers of the remote past, there have been very few attempts of long-distance travel on the river. No hard data is available on river conditions in certain times of the year. The

only accounts available are those of the Alexander the Great, or more recently, in 1830, of an English adventurer, Alexander Burnes. Fascinating reading, but not very useful when you need present river conditions. In the beginning of this century there was regular river traffic as native boats moved cargo up and down the river, but this traffic has all but disappeared. The construction of many dams across the river and the availability of more efficient, but expensive, road transportation have brought an end to an era.

Preparations for our trip began about two years ago, but reached a feverish pitch in the last six months of 1987.

Two rubber rafts, two outboard motors, lifejackets and miscellaneous equipment were selected and bought in Toledo and tested on the Maumee River. The list of members kept changing up to the last month. From a long list of candidates, eight were finally selected. Members from the United States included Dr. Bahu Sultan Shaikh, a Toledo physician; Ron Epton, a teacher at Maumee Valley Country Day School; Tony Glinke, an engineer from Ann Arbor, and Qarie Hussain, my son, a senior at Maumee Valley Country Day School. From Pakistan we included Sardar Hussain, my older brother, an agriculturist who had introduced me to Indus; Azhar Ali Shah, a top



The inhabitants of the Indus in the plains of the Punjab.

amateur cyclist from Pakistan, and Dr. Najam-U-Din, a young radiologist from Lahore. The number had to be kept small because it would be difficult to arrange logistic support for a large party. As it turned out, we added three more members from Pakistan on the recommendation of the government of Pakistan. Maj. Sayed Azam, a young army officer, joined us and we designated him deputy leader. The other two, Nasim Zafar, a bank executive from Lahore, and Shahzad Nazir, an electronics engineer and a mechanical wizard, had done part of the Indus from Lahore to the sea a few years ago with Major Azam. The U.S. members paid for most of the equipment, and the government of Pakistan supplied the chase vehicle and logistic support; in return, we conducted a depth survey of the river. Pakistan International Airline helped transport the equipment to Pakistan.

By Dec. 11, 1987, when I reached Pakistan, it seemed that the expedition was finally ready. Originally I had planned to start the expedition on the Kabul River near Peshawar, but had to choose the confluence of Kabul with the Indus, 50 miles east, because of very low water levels in the Kabul River. Another snag — the 15-horsepower engines we brought from Toledo were not powerful enough for the Indus. We needed 25 horsepower, which were available but too expensive. In the next 36 hours we located two used engines in Lahore and had them overhauled and brought to the base camp the night before our departure.

At the base camp on the Kabul River near its confluence with the Indus, another surprise awaited us. An eight-member team of the Pakistan Navy had been sent to the camp to join our expedition. They had brought two rafts and two small outboard motors, and assured me that they would not be a burden on our team. Reluctantly, I permitted them to join us.

We gathered in the rest house (government-owned bungalows for officials' use, the kind we would use along the way) built on a cliff overlooking the Kabul River. We checked the equipment, distributed the waterproof bags, went over the ground rules and, above all, got acquainted with each other — many of the members had not met before. We also met our guide, Toli Khan, a wiry man of 60 years who had spent most of his life on the river, hunting, fishing, and delivering boats to customers in its southern reaches.

Early in the morning of Dec. 23, 1987, the day of the

launch, I stole away for an hour of quiet time on the river. Watching from the cliffs in the early morning fog, the river appeared mysterious and magical. I could imagine Alexander the Great crossing the river just a few miles upstream to enter the plains of India, or the Buddhist missionaries passing under the shadow of these very cliffs, on their way to the sea almost 1,400 miles away. Or my grandmother and her daughters huddled in a tiny cabin in the rear of a native boat, making the southward journey under the watchful eye of the stern patriarch sitting in the bow.

After the launching ceremony attended by 200 guests, and the obligatory speeches by the chief guest, a minister of the federal government, and others, and the ubiquitous tea, we finally sailed on our long-awaited expedition.

We had skipped the most northern reaches of the Indus, for we were not equipped to risk the pure white water. Instead, we started at a point where the river, still in the mountains, had few rapids downstream and could be navigated with outboard motors.

LIKE THE DIVERSE people who inhabit various parts of the river, the river itself takes on a different character in different places. In the most northern areas it thunders down the Karakoram Mountains and enters the mountain gorges, where, confined by the unyielding rocky formations, it flows level but fast, and has many grade 1 and grade 2 rapids. Thereafter, it stretches into the sandy plains of Punjab and Sindh, where it meanders, and after almost 1,000 miles enters the delta before ending in the Arabian Sea.

Within a few miles of our launching we came to the junction of the Kabul River with the Indus. Here the muddy waters of the Kabul join the crystal-clear icy waters of the Indus, and for miles, the two waters flow as two streams in one bed. That is where our first mishap occurred. Just past the imposing Attock Fort, built in the 17th century by the Mughul Emperor Akbar, we hit strong currents and rapids. Ron Eaton, an avid videographer, lost his balance and was thrown overboard into the icy waters. Except for a few bruises and a chill, he was fine; however, the video camera was damaged and for the rest of the journey we relied on borrowed equipment.

As we went through the mountains, every turn brought new vistas. The raw beauty of the mountains casting a near perfect reflection in the slow-moving water was breathtaking. In many places we slowed

down to enjoy the surroundings. Little children ran to the riverbanks to wave and giggle, but the women stayed at a distance and, in keeping with tradition, did not wave.

We came across small villages, some built on high ground near the banks, others built on rock cliffs to safeguard against summer floods. We saw huge rock formations rising in the middle of the stream. Many looked like gigantic reptiles sunning their backs. Sparsely populated, this stretch of the river could match any river in beauty and grandeur.

At 2 in the afternoon we stopped for lunch and to make radio contact with the ground crew. A four-wheel pickup truck with a few members of the expedition carried our excess equipment and backpacks. The vehicle would rendezvous with the boats every day at predetermined points to replenish supplies and fuel. We communicated with the ground crew at prearranged time, through a base camp at Lahore, 300 miles away. We called the boat *Scylax*, after the Greek adventurer who was the first person to survey the river in 500 B.C., at the request of Darius the Great of Persia. Our chase vehicle was named *Marco Polo*, after the famous traveler who had passed the silk route in the upper reaches of the Indus. The base station was called *Marconi*, after the inventor of the wireless. But on this first day, *Scylax*, *Marco Polo*, and *Marconi* couldn't connect. There was just too much static. And we couldn't find the lunch bag — it had been left behind in the confusion at the launching ceremony. Needless to say, Azhar, our expedition member in charge of food, took some ribbing for the rest of the journey, and we didn't go hungry again.

WE REACHED OUR destination, the Khushalgarh Bridge, before sunset. The steel span built at the turn of the century connects Punjab and the Northwest Frontier, and carries train and road traffic. As is customary, a contingent of civilian police guards the bridge. There are no settlements or towns within 15 miles of it. The policeman provided us with a most welcome cup of tea.

Our chase vehicle had not arrived. They were to have come on a particularly bad stretch of road, passing through the hilly terrain frequented by bandits and outlaws. As the time passed, we became more concerned. Two members and a few policemen were dispatched to hire a vehicle from the nearest town to go looking for the ground crew. Late in the evening, they finally arrived. Because of very bad roads, they couldn't travel more than 4 or 5 miles an hour. It took more than 10 hours to do the 50-mile stretch.

The guards on the bridge vacated two tiny rooms at the entrance of the bridge for us. We sat around a big pot of cooked vegetables and ate with our hands, scooping vegetables with pieces of flat bread. It was our first meal of the day, and it tasted very good. We unrolled our sleeping bags on the cement floor and tried to sleep. With the rumbling of the trains overhead, and the noise of the trucks and busses passing outside the room, it was a fretful sleep. We called it the Khushalgarh Hilton.

The next day took us through more mountainous terrain and beautiful scenes — a lonely fishing boat casting a perfect reflection with the backdrop of dozens of mountain peaks, or two young boys, perhaps 14 years old, piloting a full loaded cargo boat across the river, their forms and the boat appearing as silhouettes in the hazy sunlight. On this stretch, we also passed the nomadic gold diggers, panning gold from the Indus sand.

About 10 miles upstream from the town of Kalabagh we passed through a mountain gorge, a site being considered for construction of a dam across the river to produce electricity and to irrigate the arid land. It is estimated that the resulting lake will extend for

hundreds of miles upstream, and submerge some of the choicest agricultural land in the Peshawar Valley. A political battle is being fought in Pakistan over the future of the dam, which while improving the lot of people in one part, will definitely bring calamity to others.

At Kalabagh, we came across the first irrigation dam, called a barrage, one of the six on the river built to divert the waters for irrigation. Although barrages are provided with locks, we found them to be cumbersome and in many places out of order. We portaged the boats on these spots, and carried the boats, and equipment by truck, van, or a tractor, downstream from the barrage.

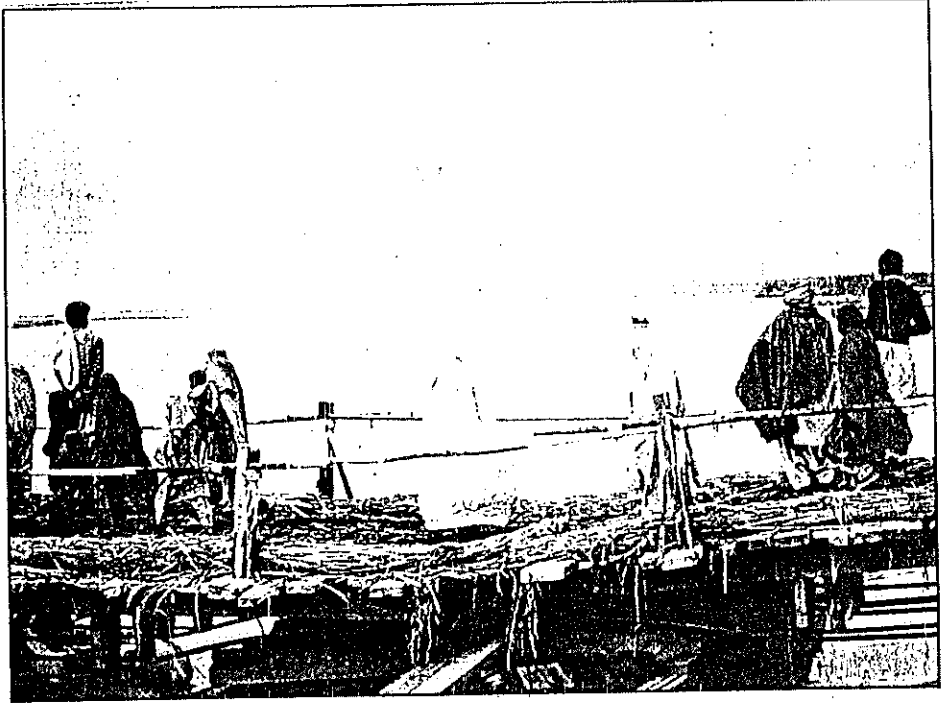
Barrages were put into use by the British. The first was built at the turn of the century by Sukkur, in the southern reaches of the river. It held not only enough water for the side canals, but it also functioned as a bridge for traffic across the river. These barrages and the irrigation system, one of the most extensive in the world, transformed Punjab into the breadbasket of the subcontinent. Even today, Pakistani Punjab produces enough grain to feed the whole country. Progress has a price, and with the widespread use of water through unpaved canals in the past century, the water table has risen dangerously. The salt from the deeper layers of the land has risen to the surface, and has made millions of acres of agricultural land useless. The same water which brought a boom is causing devastation in some parts of the plains.

AFTER KALABAGH, the river enters the plains. No longer confined to the unyielding mountains, it stretches and breaks up into channels. At places the riverbed measures 10 miles or more. In the low season it flows into many channels, but in summer, after the snow melts in the mountains, and the monsoons sweep the plains, it changes course, overflows its banks, and becomes an unpredictable force.

Unlike the mountains, the plains are well-irrigated and green. People grow wheat, barley and cotton. There are fruit orchards, where keeno — a cross between an orange and a tangerine — and bananas and guava are grown. The farmers have learned to live with the river. Living in houses made of Indus sand and straw, they live off the land. Their clothes are homespun, they grow their own food and sell the surplus. Except for the occasional sound of a tractor or a radio, one could be in another time. If the surging river threatens their dwellings, the people move farther out and rebuild. We saw many abandoned houses crumbling into the river.

Christmas was spent traveling the 70 miles between Kalabagh and Chashma. Tony Glinke and Ron Euton were in a contemplative mood. It was perhaps the first time they had been away from their families on Christmas. But a surprise awaited us as we reached Chashma — Sadiq Swati and his family were waiting for us.

Sadiq Swati heads the National Transportation Research Center of the government of Pakistan, and has been keenly interested in developing the Indus for inland water transportation. He is a graduate of Ohio State University, and he visits the United States often. A year ago, during a visit to Toledo, he wondered if we could undertake a depth survey of the river for his center. In return, he promised to provide us with a chase vehicle and to make all logistic arrangements. It was through his efforts that the foreign members of the team were permitted by the government of



The boat bridge at Mittunkot.

Pakistan to go down the Indus — permission which had not been granted in the past. Sadiq, his Columbus-born wife, Louise, and their two children had driven almost 40 miles to meet us at Chashma. Baskets of food were brought into the rest house and spread on a large dining table — meats, chicken, fish, breads, cakes, candies, spirits, and whatnot. We festooned the room with Christmas decorations. Louise had brought beautifully wrapped gifts of books and handicrafts for the guests. The evening was topped off by a fireworks display and singing of Christmas songs. It was a beautiful surprise for all of us, but especially for the two "real" foreigners among us.

Because of the very dry season — there had been no rains — the barrage at Chashma was closed off to divert the available water for irrigation. As a result, our journey after Chashma was painstakingly slow. We got stuck in the sandbars on every turn, and had to free the boat by jumping out and pulling. Here we also ran the danger of stepping into spots where the bottom is soft and, like quicksand, can engulf a person. For long stretches we couldn't use the outboard motors, and instead rowed the rafts. As if low water levels were not enough, we also had to contend with innumerable fishing nets across the entire width of the channel. At each net crossing we had to shut off the engine, pull the engine back, and restart it, only to repeat these steps 100 yards downstream, again and again. Naturally, we couldn't make it to our next stop in time, and had to camp on the river.

Our most consistent reference points on the meandering river in the plains were the paltans, the ferry crossings. One could see the flat-bottom, wooden boats with rounded bows from a distance. These boats are used to carry people, animals, and commodities across the river. The keepers of the ferries are paid a yearly quota of grain by the surrounding villages. These ferry crossings are well-marked on maps and were of great help in assessing our progress on the river. Many times, we stopped to chat and to share food. In some places, we treated the sick using our emergency medical supplies.

BOAT BRIDGES have a long history on the Indus. Alexander the Great built a boat bridge near Hund, in the north, to cross the river. Since then, all invaders coming down the Hindukush Mountains to enter Indian subcontinent built boat bridges to cross the river. The Mughal Emperors maintained a boat bridge near the Attock Fort, and collected tolls from the passengers. The English ushered in the modern era by building the first dual-purpose steel span on the river at Attock in 1883. Even though there is a new concrete bridge, the old bridge is still used by road traffic, as well as by trains on overhead tracks. In all there are 11 permanent bridges, including 6 barrages, on the 2,000 miles of the river — and many more are needed.

In the summer months, when the boat bridges are dismantled at few places, steamers carry people and commodities across the river in areas with heavy traffic. There is one steamer beached in the lower Punjab, near the village of Rujhan. Built in England in 1860, the steamer was commissioned on the Indus in 1919. Originally, it ran on wood, but since then, has been converted to oil. It takes six hours to make the trip across the river. With great skill, the pilot takes the boat upstream and downstream, negotiating the sandbars between deep channels. The revenues pay only 60 per cent of the cost and the government pays the difference. Elsewhere, these vintage steamers would have been scrapped long ago, but on the Indus, they still perform like trusted friends.

Hitting a sandbar or a submerged rock was always a danger. We had to change damaged propellers a few times. It was on one of those occasions that the pilot of our lead boat didn't pay attention to hand signals of our guide. We hit a sandbar and damaged the cotter pin, which holds the propeller in place. And, as luck would have it, extra cotter pins were in the ground vehicle. Shahzad and Major Azam, our expert mechan-

ies, tried to fix the pin, but to no avail. Loosing a propeller would have meant towing the disabled boat the next 80 miles. We towed the boat up to the next ferry crossing, where we found the ferry docked on the bank, with no one in attendance. We climbed aboard the ferry and extracted a few nails from the boat. One nail fit nicely as a cotter pin. I saw Major Azam, ever a proper, fair, and upright officer, sheepishly leaving a 10-rupee bill in a crack in the door of the tiny cabin. Whether the owner found the money or not, Major Azam's conscious was satisfied. The rusty nail held the propeller the rest of the way to the sea.

On the ninth day, still passing through the plains of Punjab, we came to the first boat bridge on the Indus, near Jampur. In the winter months, when the river is low and breaks into many channels, temporary boat bridges are constructed for the light traffic. Cars and pickup trucks can cross loaded, but buses must cross the bridge empty, with passengers trailing on foot. A nominal fee is charged for such crossings. Come spring, the bridges are dismantled and the boats hauled to high ground, for the river swells and flows in the miles-wide bed. Some of the boats, we learned, were built in the last century. The boats are constructed of deodar, a soft wood and each one costs up to \$20,000. Maintaining a bridge with up to 50 or 60 boats is an expensive proposition.

We spent the last day of 1987 navigating the meandering river between Dera Ghazi Khan and Jampur, and set up our camp about 15 miles below the boat bridge. By this time we had become rather expert in setting up tents, gathering firewood and dried camel dung for the fire, cleaning the boats, and cooking the meal, all before darkness set in. Tony Glinke, our friend from Ann Arbor, surprised us by producing a half-bottle of vodka from his pack. Mixed with mango juice, this skewed screwdriver was served to those who partook and the New Year was heralded at 9 p.m. We were just too tired to wait for midnight.

Mithunkot, a small town on the right bank, sits on the confluence of Cheneb with the Indus. Cheneb, or Acesines, as the Greeks called it, brings the combined waters of the five rivers of the Punjab. It is on this river that Alexander's army came down from Jehlum and went down to the sea. We could imagine the bewilderment of the local people who saw the great flotilla of 2,000 boats entering the Indus, their coxswains crying "in-out, in-out," for every oar stroke, and could imagine them running along the banks, following the flotilla's progress for miles.

Mithunkot, located at these crossroads, at one time was large and prosperous. A permanent bridge 90 miles downstream at Guddu has taken much of the commerce away. But the shrine of a mystic poet of the last century has kept Mithunkot from sliding further down in obscurity. We visited the shrine, where the chief custodian tied turbans around a few of us, as is the custom when dignitaries or high officials visit the shrine. Without telling us, our deputy leader, Major Azam, had paid a visit to the shrine earlier in the day, and had given them exaggerated accounts of our importance. We were pleased by the VIP treatment even though it was given on false information — I was sure Baba Ghulam Farid, the saint, did not mind. The custodian told us of many miracles attributed to the saint. He told us the story of a ruler of the princely state who had married an English lady and was about to lose the state to his wife, whom he had divorced. It was through the divine intervention of the saint that the ruler was able to keep his state. It is therefore very important, the custodian said, "that a decent Muslim should never marry a foreign woman." I was glad Dotie, my American-born wife, was not there. It could have created an international incident.

JUST OUTSIDE the shrine, in a dirt field, a game of smash volleyball was in progress. Ron Euton, the schoolteacher and a volleyball coach, couldn't resist. A match was played between Pakistanis and the foreigners, and the Pakistanis were sure winners. Then they played with Ron's regulation-size ball. It didn't take the native boys long to get used to the bigger ball and different rules, and again they won. Ron was so impressed he presented his regulation volleyball to the natives.

At dinner, Muhammad Anwar, the deputy commissioner of Mithunkot, and his party joined us. Deputy commissioners are officers of the elite civil service and hold enormous judicial and administrative powers in their districts — a visit by such a high official is considered to be an honor. Muhammad Anwar was a highly educated and polished man of 35. During the conversation, I mentioned that we were fed up with the deep-fried flat bread-called paratha. With a few exceptions, we had eaten the bread three times a day, and even though it is considered a delicacy, one does get tired of eating even a delicacy so often. After the sumptuous dinner that evening, including the parathas, I overheard the deputy commissioner instructing the cook to prepare the best and greasiest parathas for breakfast the next morning so that "the honored guests will always remember Mithunkot." But the next morning we insisted on having plain bread, eggs, and tea. I am sure the poor cook didn't cherish the idea of disobeying such a mighty official.

In the next few days we were in the desert plains of Sind, the southernmost province of Pakistan. We saw many Persian wheels and diesel pumps lifting water from the river to the elevated banks for irrigation. Except for occasional green spots, the landscape was sandy, with growth of tamarisk and wild reed. Due to extensive irrigation systems by canals and by the indigenous Persian wheels, large areas of desert have been cultivated. But in many places the terrain probably is the same as that seen by the returning army of Alexander the Great, or by the English adventurer Alexander Burnes. Burnes, as a young army officer in the British Indian Army, sailed upstream from the sea in 1832 to deliver a gift of five dray horses from the King of England to the Sikh ruler of Punjab. He was attacked by armed badits at many points. In some parts, things have not changed in the past 150 years, as we would soon learn.

AT THE GUDDU barrage in Sind, we were advised by the local officials not to continue our journey down river, because of, as they put it, "poor law and order conditions." This 150-mile stretch of the river passes through some dense jungle and invariably the river pirates or

bandits take pot shots at anything that moves without their consent. It was a painful and difficult decision, but I decided to abandon this particular section of the river. We sent boats and equipment by truck to Hyderabad and the team took off in a van on a side trip to Moenjodaro, the City of the Dead.

On the way to Moenjodaro, we passed the ancient city of Sukkur, on the right bank of the river. Here, I had a chance to look at the Island of Bukkur, located in the middle of the river opposite Sukkur. This island, a fortress now, was cultivated by my ancestors when they settled down in Sind after a long migration from Northern Iraq in the 18th century.

Moenjodaro, or the Mound of the Dead, is the archaeological site of a city which flourished on the right bank of the Indus 5,000 years ago and was the southern capital of the Indus Valley Civilization. This civilization, which paralleled the great river civilization of Mesopotamia and the Nile, extended from the foothills of the Himalayas in the north, to the coast of the Arabian Sea in the south. To date, more than 70 ancient towns had been identified in this 1,000-mile long, 300-mile wide "valley" along the Indus and its tributaries.

We do not know much about the origin of the inhabitants of the Indus Valley. They were, perhaps, Dravidians. In a few hundred years they built well-planned towns and cities. Moenjodaro, like its sister city, Harappa, in the north near present-day Lahore, was built with the symmetry of a chessboard. Houses were made of baked bricks and were well-ventilated; there were extensive sewer and drainage systems. The people farmed wheat, barley, and cotton, and appeared to have extensive contacts with not only the towns of the Indus Valley, but as far away as Euphrates and Tigris.

The decline and end of this great civilization is as obscure as its beginning. The changing course of the Indus, unprecedented floods, and/or Aryan invasion from the west could have played a role in its demise. By the time the Buddhist monks arrived to build their stupa on top of the hill in 200 A.D., the Moenjodaro had been dead for more than 2,000 years. Their seals, terra cotta toys, gold jewelry, colorful pottery, board games, and weights and measures remained buried until 1926, when the first excavation at the site was performed.

Our stay in the rest house by the ruins was most enjoyable, partly because of Sindi hospitality, and partly because of our expedition member, Toledoan Dr. Bahu Shaikh. His brother, Justice Abdul Kadir Shaikh, is chairman of Moenjodaro Commission, which is trying to save the site from salinity, water-logging, and the destructive elements of nature. A first-class chemistry lab, run by Mr. Samad Khan, a chemist, has been conducting experiments and analyzing soil. Nearly a small museum houses various artifacts excavated from the site, and a large painted mural portrays the city life of Moenjodaro.

By chance we met Thor Heyerdahl, author of "Kon-Tiki" and well-known experimental archaeologist — he was filming the site with a Swedish crew. "Kon-Tiki" is the absorbing account of his sea journey from South America to the Polynesian islands in a balsam wood boat. Dr. Heyerdahl was interested in our expedition and, ignoring the impatience of his crew, talked to us for some time. Compared to what this great man had accomplished, our trek down the Indus was a Sunday afternoon picnic. He asked questions about the river, the water levels, particular archaeological sites along the river, and our equipment. He was a pleasing and engaging man.

On the way to Hyderabad from Moenjodaro, we stopped in Sewan to visit the mausoleum of a Muslim saint. Like so many Muslim saints of the subcontinent who had come from outside, Lal Shahbaz Qalandar had come from Khorasan in the 13th century to preach Islam. The shrine rests in the center of the town of Sewan, under a large dome. The walls and ceilings are

ornately decorated with multicolored tiles and hand-painted geometric designs. Pilgrims from all over the country come to pray at the shrine, and at times beg the saint for favors, a sacrilegious act according to strict monotheistic teachings of the religion. Food is distributed free to the needy and travelers twice a day, and the whole affair is run with donations and charity. Three hundred years ago, a ruler of Sind donated a silver gate to the shrine. Not to be outdone, Bhutto, the executed prime minister of Pakistan, gave a gate of gold to the shrine as a token of his dedication. It is said that the Indus is subject to his command and no traveler dares to pass his shrine without making an offering. We made the offering and continued on.

OUR EQUIPMENT was waiting for us at Hyderabad, from where we were to start our river journey. Hyderabad was, at one time, the seat of government of the rulers of Sind. Now a large provincial city, it boasts a large university and a fine medical school. It is an oasis in a desert, for except for the irrigated land around the city, the desert prevails, and continues southward on both banks of the river. We shopped for provisions, made obligatory phone calls to our families, and took off next morning in our southward journey to the sea. The barrage at Kotri, near Hyderabad, had been opened a few days earlier, and we were lucky to have enough water downstream to ride on the crest of a swollen river. We were 300 miles short of the sea.

Dolphins, which we had seen above Hyderabad, became more abundant. Called "the blind dolphins of Indus," they are listed as endangered species. We enjoyed watching them playfully jump near our boats.

We looked for a type of crocodile called gharial in this stretch of the river, but did not see any. These fresh-water creatures are common on the Indus and its tributaries, and have been observed by many travelers.

Situated at the crossroads where the Indus traffic connected with the old caravan routes from the coast of the Arabian Sea is Thatta. At one time a thriving city, it reached its glory from the 14th to the 18th century as a center of Muslim power and as a seat of learning. Today it is little more than a large dilapidated village standing six miles from the river, on its right bank. It is a town where the dead outnumber the living. The large cemetery, the largest of its kind in Pakistan, attests to its historic past. Red brick graves and colorful mausoleums of blue and white tile tell a story spanning four centuries. There is a mausoleum of a Mughal governor, an ornate grave of an Afghan general, and the graves of other functionaries, inscribed with verses of the holy Koran written in calligraphy. The town itself is perhaps half the size of the cemetery, but twice as dead.

Our next destination was a small fishing village in the delta, a hundred miles away. The river breaks into numerous creeks in the delta, and to locate the proper channel without the help of a delta guide, is an impossibility. The Indus delta is a 3,000-

square-mile area through which the river meanders at will, changing constantly. The two mighty branches noted by Alexander the Great are now many small and large channels. As one writer noted, it is a battleground where the river, wind, and sea endlessly contend. With the daily deposit of a million tons of silt that the Indus brings with it, the coastal shoreline has been pushed back almost 100 miles in the past few thousand years. Thatta, now 100 miles from the sea, was at one time near the coast.

We hired a guide from Thatta and embarked upon our journey into the delta. Within 30 miles, we encountered rough waters, because of incoming tide. Unlike Toti Khan, our guide up to the Guddu barrage, this guide was vague about the distance we had to cover. Every inquiry was answered with "a little further down." Sensing his uncertainty about the distance, we stopped at a fishing hamlet, hired a pickup truck to get extra fuel from a depot 15 miles away, and resumed our journey. By this time we were riding the receding tide in the fast-disappearing daylight. We saw and enjoyed the last sunset on the delta, with the copper-red disc of sun splashing its gold on the calm waters and slowly inching down at the horizon. In the distance, a sailboat passed and the flying seagulls made pencil-sharp silhouettes against the sun.

We had underestimated the distance to our destination by at least 50 miles. We were in the creeks and the guide was as lost as the rest of us, but he kept saying "a little further down." I couldn't help but recall that it was in the delta that the returning armies of Alexander lost many of their boats to the tides and the elements. He pressed local pilots into service, slaughtered bulls as a sacrifice to Poseidon, and offered a libation from a golden cup, then tossed the bulls and the cup into the water, and prayed for a safe journey through the delta.

We traveled another 20 miles in darkness under the canopy of stars, looking at the white foam in the wake of our boats created by bioluminescent marine organisms. Upon seeing a moored fishing boat, we stopped and asked the two men about the distance we still had to cover. It is only five miles, we were informed, but since the tide has gone out, the shortest connecting creek will be too low for safe passage. We will have to make a longer loop of perhaps 15 miles.

Will one of the men come with us? After some bargaining and the promise of a handsome reward, one of the men jumped on board and led us towards Keti Bunder. How he guided us in complete darkness through the maze of creeks, I will never know.

Suddenly, our walkie-talkie crackled, "Scylax, Scylax, can you read me?" It was the ground crew wondering what had happened to us. Azam, ever an optimist, informed us that he would fire a flare to show us his location. He did, but in the confusion, the only flare that he possessed was a smoke flare! For another hour, we couldn't make visual contact with our ground crew. And then, we saw the dim flickering flashes of our chase vehicle at a distance. It had been a long day.

KETI BUNDER, a god-forsaken place, exists only because of fishing. At one time, it supplied fresh vegetables to surrounding areas within a hundred-mile radius. With the building of the barrages upstream, the river water decreased and the salt water moved upstream, destroying all fresh-water vegetation and reducing a thriving agricultural village to a filthy fishing hamlet. It is said that at one time, in the not too distant past, the Indus carried fresh water for miles into the sea. Not anymore!

We were housed in a three-room brick-and-cement dwelling for the night — no electricity, no running water, no nothing. We called it the Keti Bunder Hyatt. The hospitality of the local chieftain made up for most of the shortcomings. We had a well-deserved and much needed rest. This was our last night on the river. We hired a new guide for the last leg of our journey to the sea. For we still had to navigate the maze of creeks to reach our finish line at Port Qasim, 50 miles away.

Like the mountain gorges of the north, the delta of the Indus has its own beauty and grandeur. Like the Florida Everglades, the whole area teems with vegetation and marine life. Luxuriant mangroves cover the jigsaw-shaped chunks of land between sparkling blue creeks. The mangrove, a rather beautiful tree, assumes an umbrella-like shape and grows in a natural symmetry. In some places the neat symmetrical trees and the creeks give appearance of a manicured Japanese garden.

Three motor launches of the Port Qasim authority met us at the mouth of the harbor. As we entered the harbor, escorted by the launches, all the ships anchored there blew their horns. A group of a hundred or so people waited at the docks with large banners. Admiral Waliullah, in charge of Port Qasim, welcomed us ashore. It was our 18th day on the river, and we had finally made it.

There followed a round of official and private receptions, and radio, newspaper, and television interviews. We returned to the docks the next day to dismantle our equipment. We cleaned the boats and every member autographed them. Boats and engines were packed and donated to Adventure Foundation of Pakistan, a foundation dedicated to promoting adventurous activities in Pakistan. Brigadier Jan Nadir Khan, president of the foundation, had been most helpful to us. We flew to Peshawar to say good-bye to my family, and then it was time to return to the States.

Early one morning, on the way from Peshawar to Islamabad, we stopped at the Kund rest house. Abdul Qayum, the keeper, prepared a simple breakfast for us (including the ever-present parathas). The place which three weeks ago was a madhouse, was quiet and serene today. We took a walk down to the river, watched the misty fog enveloping and clouding the river. We could see in the distance, the Attack Fort and the steel span of the Attack Bridge. And beyond that, the mountain ranges.

Yes, we had done the Indus.

(Many individuals and institutions helped with the expedition. I am grateful to Mr. Sadiq Swati and Dr. Tahir Masood of the National Transportation research center, Islamabad for logistic support and supply of chase vehicles and Mr. Shamsuddin Qureshi of the same department for being an excellent liaison officer on the expedition. Special thanks to Gen. Safdar Butt, former chairman of the Pakistan Water and Power Development Authority, for taking personal interest in the expedition.

I am also grateful to Charles Scharte and Chuck Halldober for supporting the expedition, and G. Robert McLean, map librarian University of Toledo, for supplying the maps for the expedition. Lastly, my very personal gratitude to my wife, Dottie, who had been an enthusiastic supporter and spent much time helping in the planning.)

REPORT BY MR. RONALD EUTON AND DR. A. AMJAD HUSSAIN M.DI. PURPOSE

The team Indus expedition had a number of objectives, included in these was to conduct a survey of the Indus River from the junction of the Kabul River to the mouth of Indus on the Arabian Sea. The purpose of this survey was to determine the depth of water available in the main channel of the Indus during the dry winter season. Ultimately this data would be useful to ascertain the feasibility of using the Indus River as an inland waterway for commercial traffic.

There is documentation of the use of the Indus as a means of commercial transportation, certainly during the period of British occupation and earlier. Obviously the use of small, shallow draft, steam propelled craft is a different matter from the demands for a modern, diversified transportation system designed to supplement and in some cases replace existing surface transportation.

The economic advantages of water transportation are well known. Lower cost per ton mile, more efficient use of resources both in terms of fuel expenditures and cost of construction for equivalent carrying capacity, make water transportation a very desirable option for a nation as energy and resource conscious as Pakistan.

The obvious limitations of water transport are also factors. The relative speed precludes the rapid movement

of perishable materials (at least without refrigeration), the need to transship materials, means that materials need to be handled more than once in many cases, thus increasing energy consumption, time requirements, and cost. Also specialized handling facilities may be necessary depending on the character of the goods transported and the containerization available.

II. METHODS

Initially the team planned to use a sonar type depth finder to ascertain the channel configuration along the route. Unfortunately the equipment went out of service on the third day and provided only meager information. This still remains the recommended method for studying channel characteristics. The team simply lacked the means to service the equipment in the field.

Most measurements were made physically by the use of lead line and pole to probe the bottom. In many areas, during the winter season, the water is shallow enough to be surveyed very accurately by this method. One serious limitation to the data collected on this expedition was that careful cross-sectional studies of the channel were not feasible in the time available. These observations are essential for a true picture of the feasibility of use of the river for commercial purposes. There were numerous occasions when, due to the relatively shallow water, the

team was able to take frequent soundings with line or pole (the craft usually required a minimum of 2-3 feet of draft because of the size of the outboard engines used).

The objective of the team was to maintain an unencumbered passage in the deepest part of the channel. To that end an experienced guide was employed who was generally successful in directing the team's boats into water deep enough to run safely at full speed. This also suggests that there is suitable local expertise available to provide initial skilled guidance for shallow draft commercial barge traffic. This would need to be supplemented by regular surveys of shifting bars and hinderances to navigation such as slumped trees, especially during the dry winter season with critically low water levels.

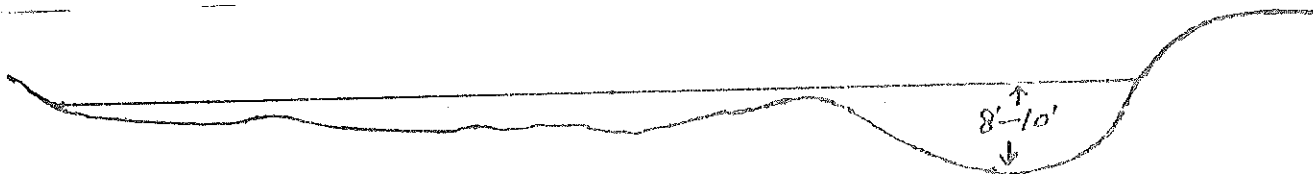
Another indirect observation was based on the movement of existing barge and ferry traffic on the river. Some of these are motorized and others are poled. The depth of the water in many cases near the ferry crossings was more than sufficient to provide for shallow draft traffic (in excess of 8-10 feet in many places).

III. OBSERVATIONS

Since this study was conducted during the winter season, the driest period of the year, and the fact that the past two seasons had been particularly dry, the channel was probably at its minimum throughout much of the course investigated. The broad meandering even in the more northern areas may not typically be a factor during more "normal years"

and especially during the wetter seasons. Shallow draft vessels might travel a more direct route when there was sufficient water depth to accommodate them outside of the normal "channel".

One characteristic of the channel, that was observed frequently, was the development of a deposit adjacent to the main channel requiring that our boats either maintain position in the main channel carefully or approach the main channel from the side very carefully. In places where the main channel was 6 to 10 feet deep, it was frequently bordered by a bar that came within 1 foot of the surface. Adjacent to the bar the water was frequently 2-3 feet deep (see Figure 2). This configuration demands that vessels maintain their position in the main channel very precisely during the driest season. There are also many areas where the channel seems to distribute itself in a vague series of meandering sub-channels, again making it difficult to follow a "main" channel. This was observed south of Kalabagh and downstream of the barrages where the water flow interrupted and sediment load may exceed the carrying capacity of the water volume. Under these conditions the river tends to produce a very broad, shallow channel with deposition over much of the area. As a consequence the channel is not clearly defined and would require maintenance to permit river traffic of much draft.



Another observation involved the existing boat traffic on the river. There are not only ferries that provide essential transportation of people, livestock and goods across the river, but also a surprising amount of traffic along the river. There were numerous local vessels observed moving goods several kilometers along the river. Many of these were motorized but there were many that were under sail or were being poled in protected channels. Obviously there is a need, locally, to move goods and there is already a limited response to this need. This, coupled with the scarcity of bridge crossings, speaks to the need to further encourage development of this resource.

There are a number of problems that would hinder the further development of inland water transport. One of these is the obvious need to maintain a navigational system to provide current channel information. This would necessitate the establishment of a survey and beacon/buoy system that was up dated regularly. This would permit deeper draft vessels to successfully navigate the river where currently only the local ferrymen and fishermen are familiar with the water conditions.

It will be necessary to maintain part of the channel if the river is to be used on a year round basis. During the summer months the channel may be deep enough to preclude significant channel maintainence, however, the winter season would necessitate frequent "service" in some parts of the

river particularly in the northern sections. One side benefit of this type of maintenance is that it might be possible to exercise some control over the character of the channel in such a manner as to begin to prevent some of the current erosional problems that are constantly reshaping the agricultural land along the Indus. It was observed that a number of populated areas are currently being undercut, and homes, irrigation systems and plantations are continually being lost to the river. Some minor channelization (if there is such a thing as minor channelization in a project of this scope) to facilitate navigation might also help maintain existing channels to the benefit of the adjacent population.

Another significant obstacle to the utilization of the river is the current dependence of the local population on fishing. There were many areas where the channel was completely blocked by fishing nets and lines. One day just south of Kalabagh, the team was forced to stop to cross approximately forty fishing nets, frequently placed as little as 50 meters apart. It was unclear whether this was a winter phenomenon or was characteristic during the summer months also. It would be necessary to reach an understanding with the fishermen about the location and distribution of their nets so as to permit their continued utilization of the river and to permit the free passage of deeper draft river vessels. It would be important both to maintain good relations with the local population and to avoid interfering with a vital livelihood, that an understanding be reached that was satisfactory to both positions.

The presence of boat bridges with low clearance would need to be resolved. It would be necessary to introduce some type of mechanism to open the bridge or construct an adjacent boat channel.

Another difficulty is related to the existing character of the local river transportation. Generally the ferrys and barges can be loaded by hand or by the use of simple ramps that permit the movement of goods or livestock directly onto the vessel. This is adequate for most of the existing traffic but is unsuitable for a great variety of goods that would be utilized in the case of development of a more extensive system. A more conventional docking system or at least a "temporary" docking facility would need to be developed that would permit the more rapid loading of a greater variety of goods, possibly including vehicles, and unloading possibly using mechanical means. The transportation of bulk goods, especially agricultural products necessitates the development of both handling and storage facilities near enough to the channel to facilitate easy handling. Also protection for the docking and storage facilities must be provided to prevent flood damage. The existing techniques of "protection" encountered near the barrages to contain the river in existing channels is more than adequate, in other words, the technology already exists and in some places the facilities certainly could be accommodated in the existing barrage complex.

One potential conflict between the existing water utilization and the accommodation of inland water transportation

is the need for adequate maintenance of sufficient water volume to accommodate shallow draft barges. Local channelization would relieve part of the dilemma as deeper channels would require less total water volume and permit a lower water level to be maintained. There would still be potential problems during the most severe winter droughts that could result in a significant conflict between the need for adequate water depth and diversion of water for irrigation purposes to interior areas. This might mean that some sections of the river might not be in service all year round or that a very careful allocation of water be made and more coordination of the total volume of water available in the country be made.

IV. SURVEY OBSERVATIONS

(A summary of the observations is included on page 70 at the end of this report).

A. Attóck to Khushalghar: This stretch included numerous Class 1 and 2 rapids. These posed no hardship for the survey rafts but would hinder conventional commercial craft. There were stretches between the shallows that could be utilized for local traffic however. The channel is well defined with relatively swift current. Although there were occasional ferrys, there was little evidence of significant movement along the river. The river is very scenic in places and would lend itself to tourism development (see recommendations).

B. Khushalghar to Kalabagh: There were still numerous rapids in the upper levels of the stretch just below Khushalghar and strong currents. In several sections lower in the gorge, the rock structure was tilted vertically and resulted in several isolated resistant layers that stood vertically in the center of the channel, splitting it. At higher water levels, e.g. in the summer months, these could pose significant navigation hazards unless they were well marked. Deep channels were common (in excess of 30 feet). Ferrys and some local goods were observed moving along the river.

This lower gorge region was very scenic and represents the best region of the entire survey for tourism development. There were numerous sites suitable for establishment of "camps" and many attractive locations for casual exploration. Raft or small boat excursions through this region could provide a very valuable addition to Pakistan's tourism development.

The channel was very deep as Kalabagh was approached. There was evidence of local utilization of the river for transportation in that area.

C. Kalabagh to Chashma Barrage: The channel began to acquire flood plain characteristics below the barrage. The channel began to meander and the channel was well defined in the meanders. There were numerous areas where the channel was very shallow, 1-2 feet. The rafts had difficulty negotiating some of the these shallows. Main channel was generally 10+ feet.

D. Chashma Barrage to Dera Ismail Khan: Chashma Barrage was closed and as a consequence the water levels were inadequate in many areas. There were frequent shallows although many of the meander loops contained good water (10+ feet). The shallows were in the 1-3 foot range and were frequently extensive. This region would require extensive dredging for commercial use at minimum water levels.

A significant problem was encountered in the form of frequent fishing nets across the entire channel. The local fishermen utilize many of the shallow stretches 4-8 feet in depth. Approximately 40 nets had to be negotiated and would pose major problems for commercial navigation. An accommodation would have to be reached on the shared utilization of many stretches of the river.

E. Dera Ismail Khan to Leiah: This is another stretch with well developed floodplain characteristics. Frequent meanders and severe undercutting on the outside of the meander loops created hazards in the form of slumped materials and fallen trees in the channels near the plantation areas. Frequent shallows of 1-3 foot depth create navigational problems throughout the northern portion of this section. Again numerous fishing nets (20+) created problems in the main channel).

F. Leiah to Taunsa Barrage: Fewer shallows in this sections. The channel was well defined in the meander loops

and maintained its character as it crossed the flood plain. Average channel depths exceeded 10 feet. Some severe undercutting, but the water velocity was lower and the channel obstruction was minimal. Frequent ferrys were noted but little evidence of transport along the river channel.

G. Taunsa Barrage to Jampur: The water level was low below the Barrage for a considerable distance, average 4-8 feet, with some shallows of 2-3 feet. The channel was elusive in places as the river spread into wide shallow stretches, averaging 3-5 feet in depth. A shipping channel would require navigational marking and some extensive channelization. The boat bridge at Jampur would create a problem for vessels traversing the river. Some mechanism for accommodating passage of larger vessels would be required.

H. Jampur to Mithankot: This section had numerous long stretches of good channel 6-12 feet in depth. There were only 3 or 4 shallow areas of 1-2 feet. The river was broad and the channel obscure in places. The presence of occasional, temporary boat bridges is an obvious complication to free navigation of the river by any sizable craft. Development in the form of some type of movable deck or semipermanent boat channel would have to be made to accept commercial craft.

I. Mithankot to Guddu Barrage: There were many good stretches of channel 10-15 feet in depth, with few shallows along the route although the channel is very broad and shallow immediately above Guddu Barrage, averaging 4-10 feet on the east side of the channel near the barrage. Again, it would be necessary to channelize and to install navigation devices in this lower region.

J. Guddu Barrage to Hyderabad: The river was considered too shallow between Guddu Barrage and Kotri due to the very dry season for the survey to be practical at that time. There were also security concerns along that stretch of river. The survey party therefore transported the equipment to Kotri to complete the survey on the lower reaches of the river.

K. Hyderabad to Thatta: Barrage at Hyderabad released water 12 hours prior to the departure of the survey team, as a consequence the channel for the first half of the section was very good, depths commonly 8-15+ feet. The channel was generally well defined but narrow in places, there is one location midway where the river is down cutting into a resistant layer of bed rock. The channel is narrow but fairly deep (10+ feet). The survey team damaged a propeller by narrowly missing the edge of the channel. Dredging and good navigational marking would be essential at that location.

This stretch would be questionable for navigation if the Barrage had not recently released a quantity of water.

It might not be possible for the system to sustain an adequate water flow that far south in the system throughout the dry season (although the winter of 1987-88 was remarkably dry). It would be advisable to survey that stretch during a more typical rainfall pattern to determine the long term feasibility for commercial navigation..

L. Thatta to Keti Bunder: Again the survey team was able to ride a small crest of water from the earlier release at Hyderabad. This carried the team into the tidal pattern lower in the delta. The channel was more difficult to follow in the delta area as the meanders became very broad and the channel broke down into a series of distributaries. There were a number of 4-6 foot shallows and 2 or 3 at 1-2 feet. There were also long sections of channel that ranged from 8-15+ feet in depth.

The low water levels and the fluctuating effects of the tide on this lower section makes it questionable for year round commercial use. Also the low gradient would result in extensive siltation and shifting bar deposits making it difficult to mark and maintain clear channels.

M. Keti Bunder to Port Qasim: The team followed a number of creeks connecting various distributaries in a relatively short route to Port Qasim. This route, however, would not be practical for bulk transportation. The creeks are narrow and winding in places. They ranged in depth from 3 feet to 20 feet in some of the major distributaries where fishing

trawlers were observed. A deeper water route would avoid the creeks and utilize the open sea. This designed for deep water navigation. The whole lower section of the Indus is a question as a practical route, especially during the low water season. There may be better access to Port Qasim and Karachi via creeks and distributaries farther to the west, or by way of existing canals.

V. RECOMMENDATIONS

A. The team strongly recommends that further study be made of the entire channel system. It is necessary to complete extensive cross-sectional analysis of the Indus channels in order to evaluate the practicality of inland navigation. Simply having adequate depths in the channel is not sufficient to permit practical navigation. Radius of channel curves, width to permit two way traffic with suitable safety margin, and stability of the bottom materials in regard to shifting bars and shallows needs to be evaluated.

B. Consideration must be given to the minimal channelization operations necessary to sustain an uninterrupted commercial season. Also the impact of the summer flooding and consequent channel alterations must be taken into consideration. Development of navigation markers and a suitable maintenance and updating procedure must be pursued.

C. The team recommends that a study be undertaken to determine the most desirable configuration for bulk commercial vessels and driving system that would be compatible with the unique characteristics of the Indus and its attendant canals. Simply modeling on the European or American transport systems might not be in the best interests of Pakistan. Utilizing smaller, shallower draft vessels that could navigate the Indus during the dry season and accommodate the narrow channels, and at the same time be compatible with the restrictions of the existing canal system might be advisable. The unique qualities of the Indus preclude simply adopting equipment designed for rivers of more consistent flow rates and uniformly deeper and straighter channels.

D. If commercial traffic seems practical, it is recommended that a serious effort be made to utilize the expertise of local fishermen, hunting guides and ferrymen as pilots, and to help establish and maintain navigational markers. These people are acquainted with the unique characteristics of each section of the river and would be invaluable resources in establishing a successful navigational system.

E. Although several of the Barrages have boat locks, not all appear to be in suitable condition to accommodate regular traffic. It might be necessary to either modify the locks to accept new vessel designs (see C above) or develop vessels compatible with the existing lock configurations.

F. The team recommends a survey of the existing canal system with the objective of incorporating them into a unified inland water transport system in conjunction with the Indus channel. The extensive canal system presents obvious possibilities of utilization for transportation.

The obvious problems include the need to modify existing bridges over many of the canals to permit passage of commercial sized vessels and the potential damage to canal channels by boat wakes and propeller wash. It is apparent that not all canals would lend themselves to this utilization, nor would the necessary modifications be economically feasible in some cases. It might be possible to consider a long term program of up grading as bridges need major repair or expansion as a consequence of the continuing increase in vehicular traffic.

G. It is recommended that the waterways connecting Port Qasim to Hyderabad, either via the Indus or creeks, canals and the Indus, be investigated with the objective of initiating commercial traffic to the interior. The increasing vehicular traffic could be alleviated if a significant portion of bulk goods could be transported by water.

H. The existing ferry traffic and local barge traffic should be studied to determine the actual amount of material being transported seasonally and to ascertain which sections of the river both support significant amounts of traffic and

have the potential for further expansion. There are regions where there was very little evidence of existing traffic and other regions where apparently a thriving barge traffic exists. Much of this traffic may be local commodities but some might be adaptable to other materials and further alleviate the vehicular congestion.

I. Any development of the river for navigation will necessitate the cooperation of existing irrigation and electrical generating programs with a developing water transportation division. Although the objectives of the different divisions might seem to be at odds, in reality they have the same goal, that of the most efficient utilization of the Indus waters. The inland transportation does not "use up" the water, but indeed, it does have specific requirements. Studies would determine the minimal water levels necessary for navigation that were compatible with the maintenance of adequate flow for the irrigation canal system. It might be determined that specific sections of the river could not meet all of the volume demands during particular drought periods. This could be integrated into an overall plan to make the best use of the available water in those sections of the "maintenance" of the channel.

J. The last recommendation and the one most strongly urged by the team is to consider the development of the region of the Indus River from Attock Khurd to Kalabagh as

a scenic river. The possibilities for tourism are great. The region has scenic grandeur that rivals that of many popular tourist attractions in the world. It is relatively accessible but at the same time gives that sense of traveling into another time. The river, vegetation and geology combine to produce a scenic area that promises new vistas with every bend of the river, dramatic rock formations that invite exploration, and numerous villages and ferry crossings that encourage interesting cultural contacts.

The river in this region is comparable with "safe" utilization for general tourist purposes and offers many opportunities for enjoyment of the scenery and contact with the local peoples. A three or four day excursion would permit groups to stop and explore along the river, particularly in the scenic gorge area to the south. Either simple shelters could be erected to provide accommodation for tourists unwilling to "rough it" or suitable areas could be designated for tent camping, access to fuel and safe water would be the only requirements.

This development would require a minimum of investment, and at the same time it would provide jobs as guides, support personnel and in administration. There would also be a positive impact on the local villages as supplies and handicrafts would be purchased by the tourists.

RIVER OBSERVATIONS

<u>River Section</u>	<u>Depth</u>		<u>Channel</u>	<u>Miscellaneous</u>
	<u>Minimum</u>	<u>Maximum</u>		
A. Attock to Khushalghar	2-3'	20'+	well defined	some rapids
B. Khushalghar to Kalabagh	3-4'	25'+	well defined.	
C. Kalabagh to Chashma Barrage	1-3'	15'+	elusive in places	frequent shallows.
D. Chashma Barrage to Dera Ismail Khan	1-2'	10-15+	frequent shallows	numerous nets
E. Dera Ismail Khan to Leiah.	1-3'	8-15'	frequent shallows	numerous nets
F. Leiah to Taunsa Barrage	1-3'	6-12' (18')	well defined in meanders.	
G. Taunsa Barrage to Jampur	4-6'	10+	few shallows (two or three)	
H. Jampur to Mithankot	1-2'	5-15' common	few shallows	severe undercutting.
I. Mithankot to Guddu Barrage	1-2'	6-10' (15'+)	obscure above Guddu Barrage.	
J. Guddu Barrage to Hyderabad.	no data	no data	(low water, bypassed by expedition).	
K. Hyderabad to Thatta.	3-4'	10-15' (20'+)	large meanders	one rock outcrop.
L. Thatta to Keti Bunder	1-2'	8-15'	large meanders	few shallows (tides a factor)
M. Keti Bunder to Port Qasim	3-6'	10-20'	narrow, twisting creeks, (tides a factor).	

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