This paper is written at a stage (March, 1987) when the debate on nuclear power as the answer to Sri Lanka's energy demands appears to have subsided. Undoubtedly the Chernobyl Disaster of April 1986 helped to expose some of the serious dangers that occur in case of such accidents, whether it be due to human error, or otherwise. Several lessons can be learned even from the discussions that took place internationally and locally before and after the event. One thing we should not forget is that due to our scarce financial resources, industrial nations have been willing to provide assistance under exceptionally generous terms, to assist their manufacturers in establishing a position in the nuclear power export market. Undoubtedly if manufacturer of machinery are to stay in business and retain their highly skilled multi-disciplinary teams of experts, they must get orders at least for small reactors acceptable in small grids.

In Sri Lanka today the three prominent sources of energy are fuel wood, (including vegetable waste), petroleum products, and hydro power. According to knowledgeable sources (Dr. Mohan Munasinghe, Institution of Engineers, 198)

1. The energy supply pattern for 1983 showed that 67% of the gross energy supply had come from fuel wood, whereas 28% and 5% had come from import oil (including thermal power generation) and hydro-electricity respectively.

2. The principal user sectors of energy generated from oil and electricity were Transport (54%) and industrial/commercial (28%).

3. The anticipated electricity requirement will roughly double between 198 and 1990 (growth rate of about 10% per annum), there will be a 5% p.a. growth rate for oil imports up to 1989, and 1.7% p.a. growth rate for fuel wood requirements (without taking conservation efforts into account).

And so the debate on other conventional sources of power production goes. The proposal to import coal from Australia and worse still, to locate the power plant at Trincomalee, and the recent discussions on a 'Master Plan for Forestry' have added more fuel to the fire. The news media in particular is rendering a valuable service in more ways than one, by giving publicity to such proposals, which would other wise have been confined to a team of bureaucrats, the minister concerned and of course the cabinet. The questions, answers and comments on the 'Forestry Master - Plan' have been an eye-open in many ways. According to a report appearing in a government controlled newspaper dated 12th March, 1987, the Minister in charge of Forestry speaking at a seminar organised by the Department of Forest Conservation had recently said: 'Forest Conservation is essential today as natural forests are diminishing rapidly due to illicit felling of trees by certain business racketeers. The wealth we can preserve for future generations is the natural environment'. He had added that, 'racketeers who destroy the environment by felling trees on a mass scale should be brought to the Galle Face Green and whipped in public'. Excellent! why not extend such punishment to racketeers in other nefarious business as well?. For example on 11th March, 1987 according to front page news of a leading

Mr. A.T.G.A. Wickramasuriya, BSc(London), BE(Madras), FIE( SL), CEng, hold a Post Graduate Certificate in Land Drainage from the International Agricultural Centre, Netherlands. Retired from the Department of Irrigation as Senior Deputy Director (Drainage & Reclamation). Has worked as Assistant Director, Federal Ministry of Water Resources, Nigeria and is at present a Special Engineering Consultant to the Sri Lanka Land Reclamation & Development Corporation. Has participated in several International Conferences on Irrigation & Drainage and presented papers relating to Coastal Engineering.
newspaper, a large number of industrialists reprimanded for the discharge of untreated chemicals and effluents had threatened to close down their industries, and withdraw investments if the Central Environmental Authority proceeds with legal action against them. Among them are the multinational industrialists who not only enjoy tax concessions etc., but for whom we have to burn imported oil, and the public too have to bear the fuel adjustment charge.

At this stage let me quote the following excerpt from an article on 'A solution to the power problem' by the late Mr. R. Kahawita, an eminent engineer in the field of land and water resources development (Tribune of 1st August 1981). It reads: "Hydro-power should be our main stay, but unfortunately our thinking is not in keeping with our financial and natural resources. Our terms of reference are for massive hydral projects where the rich nations can practise charity. So we are today engaged in multi-billion rupee projects, Kotmale, Victoria, Samanalawwa, Randenigala, where abundant rainfall and its storage is the sine qua non to success. Whereas there are several minor schemes more certain of water resources than the above and within our own financial resources for execution and to meet the power needs of a region than at a national level. Our first hydral project was on such a scale thanks to Wimalasurendra". Perhaps one may not agree with all of what is contained in this remark, but nevertheless there are several noteworthy points.

The engineering and environmental problems that we have already experienced at Kotmale testifies to the wisdom of such thinking. Time will show to what extent the construction of high dams can alter or degrade the soil and ground water characteristics in this region (Wickramasuriya, SLAAS Mahaweli Seminar, 1986), and the penalties future generations will have to pay for the conversion of large extents of our natural forests, whether it be for tea plantation during the British Period, or potato or tobacco during our period.

More recently Mr. M.G.K. Manon, F.R.S., who was the Chief Guest at the 1984 Annual Session of the SLAAS, stated in his address that: "Over the past few decades we have learnt many lessons. The most important of these is undoubtedly that development has to come about primarily through indigenous efforts. The early theory of development based on massive capital inputs from outside is now no longer regarded as meaningful. Such capital inputs judiciously employed can certainly be a useful catalytic force. Even technology from abroad becomes relevant for development only if it is assessed from the viewpoint of its appropriateness to the local situation, but it has to be absorbed, utilised and modified by a group in the country, capable of doing so. The prime task therefore is to build up such capability'.

On the one hand these relate to government policy; and on the other, how can we build up such capability unless and until we first weed out so called experts, and 'sycophants' and what not? No wonder the Minister of Finance and Planning recently spoke of the dismay he experienced after setting up a 'Think Tank' in 1978. He was not to derive much benefit or independent thinking.

Non Traditional Sources

Delivering the R.H. Paul commemoration lecture of the Institution of Engineers on 26th July 1984, Prof. K.K.Y.W. Perera, Secretary, Ministry of Power & Energy, referred to the Non Traditional Energy Sources for Sri Lanka and expressed the view that: "Under this category a variety of sources can be classified. Examples are bio-gas, paddy husks, sawdust, wood waste, wind energy, some solar heating applications, solar cells and ocean thermal energy conversion. Most of the above sources, except the first four suffer from highly dilute form of energy available. Hence the extraction of the energy requires large structures, surfaces, etc. and is associated with heavy capital cost. Except for sawdust, paddy husk, wood waste, and agro waste, a large scale utilisation of others in the next ten years would be extremely difficult'. He went on to add that: "It is worthwhile mentioning here that the possibility of solar cell electricity for rural domestic lighting may become a reality. Solar cell technology for producing electricity is highly advanced'.

Wave Energy

The learned Professor will no doubt agree that a very obvious source of energy that nature continuously dissipates at our door step is in the waves of the sea that surround our Island. Considering the geography of Sri Lanka one may even call this a potential source of hydro-power. But what have we done
about harnessing this energy?.  Sad to say. Nothing!  On the contrary we continue to blast tons of rock and dump it in the sea as we have been doing during the past fifty years or more to dissipate the wave energy or divert it away from our coast, in frantic attempts to protect our beaches, particularly along the west and south - west coast.  Further to the south from Weligama to Tangalla, the predominant geomorphological features along the coast are the outcrops of rocks and headlands. If not for these natural fortifications, where would our southern coast be under the growing impact of the waves which build up and travel across the Indian Ocean?  We have so far failed even to do a preliminary scientific investigation of the subject.  Worse still, foreign agencies and their local counterparts have at times suppressed even the presentation of papers related to it, at international conferences held in our own country.  The International Conference on 'Coastal and Port Engineering in Developing Countries' held in Colombo in March 1983 is one instance on record (vide I.E.S.L. Transactions 1983 62-65).

On the other hand harnessing of wave energy in some of the developed countries of the world has now passed the stage of investigation and experimentation, consequent to work done in those countries during the past ten years or so. Many different proposals have been put forward by them to harness wave power.  Basically these devices exploit one or more of the following characteristics of waves:-

a)  The oscillating vertical motion of the wave.
b)  The circular motion of the water particles within each wave.
c)  The varying height between water surface and the sea floor and the corresponding changes in pressure.
d)  The breaking of waves on the shore or breakwaters.

The earliest attempt to harness wave energy has been in 1909 when Hunting Beach, California Wave Power Company, is reported to have produced electricity for lamps on the wharf.  Between 1952 and 1978 twelve devices had been patented in U.S. alone.  Oscillating water column devices are reported to be already in use in Japan, according to an article appearing in 'World Water' March 1985 issue, under the title 'Wave Power' :-  'At the end of 1985, Norway was to have made considerable progress towards completion of two pilot wave power hydroelectric projects, both backed by the Department of Oil and Energy'.  One is based on the concept of the oscillating water column, the other on a tapered channel design.  The former operated an air turbine.  The latter a conventional hydroelectric turbine.

**Sri Lanka's Coastal Zone**

From time to time since 1942 I have been involved in the investigation of land reclamation and drainage schemes in the coastal zone of Sri Lanka, particularly those in the North West, West and South.  An item of great relevance to this work was the behaviour of the coast under the growing impact of the sea, especially at the sea out-falls of the canals, streams, and rivers.  I have found that a good many of the theories that appear in text books and journals on the subject of Coastal Engineering were of little or no value either to the solution of coastal engineering problems or the development of the coastal or marine resources of Sri Lanka.  Some of my findings based on field observations and on Hydraulic research models appear in several papers presented by me and discussed both at national and international scientific conferences.  One of these was at the annual sessions of the Institution of Engineers, Sri Lanka as far back as 1964.  The title was 'A New View of Land Formation and Erosion along the coast of Ceylon'.  The following is an excerpt from that paper:-

'The forces of the sea that are responsible for the damages to our coast land, are directly responsible for the damages to the national wealth available over approximately 8,400 nautical square miles of the continental shelf surrounding the Island.  This is also accompanied with the breakdown of the reefs that nature built up at one stage to promote the breeding and growth of marine life'....  'The extent of the oyster banks are on the decrease.  There is reason to believe that at the south east end of the Island under the protection of the little and Great Basses with a reef and sand bank extending to it from the mainland (much larger than what is known to exist today), there did exist pearl banks similar to those of Mannar.  But all that remains today are thick deposits of shells inside the caves and tunnels in these rock outcrops, as were actually found during a recent investigation at the two Basses.  A fair crop of live coral exists to the west of the rocks'.  (Source Dr. Sena Wickramasinghe) during a discussion
he had with me in 1964, when I was Divisional Irrigation Engineer in charge of the southern division of the Irrigation Department at that time. The following excerpt from an article titled :- "Diving about the Little Basses by Rodney Jonklaas (source Sunday Times, 6th March 1966) provides more information which is first hand, and of value to the present paper :- "We had started off in the early morning from Kirinde, Dr. Sana Wickramasuriya, Eric Lonway, Sumandesa Perera, Tiddy de Silva, Wimaladasa (proud owner of the 'Anonymous') Upali Singho, 'Edwin (both crewmen) and myself, we had with us provisions for several days, plus the basic equipment required to do the little basses underwater survey work".

"Sometime afternoon we saw three motorised boats from Pattanagala at anchor, fishing on a submerged reef which stretched several miles under water and culminated in the Little Basses Reef which we could just spot because of the towering light house on it. To shoreward occasional swells caused a few breakers to pinpoint the shallower parts of this vast reef". "In the water were Sana, Tiddy de Silva, Sumanadasa and myself, and three of us carried spear guns. Beneath us was a vast, almost city reef teeming with fish, but oh, in such a compelling curtail, we were forced to swim with the current or at best try and keep in one spot by kicking vigorously".

"The crevices and caves of this fabulous reef teemed with Thick Lips, Snappers, Parrot Fishes and Groupers. Over them were shoals of Bait and weaving their way amongst the Bait were the giant Caranxes we hunted, together with an occasional Seer and once a large Barracuda. Spear guns spanged and thudded and although we could not take any monsters we soon had enough fishes for us to eat and also to present to our light house keeper friends". "It was now time to get to work and so we started our survey operations. Once again we went through the old routine, we had evolved on the great Basses and found that we could work faster and more easily here where it was shallower free of caves and caverns and with the fierce current behind us, pusing us along our way".

Reports of surveys carried out, off the coast of Sri Lanka jointly by the Institute of Marine Research, Bergen, and the Fisheries Research station, Colombo, during August-Sept., 1978; April-June 1979; and January-February 1980 to investigate the coastal fish resources of Sri Lanka provide data of value to this paper. This includes information not only on fish resources but also on the physical features of the Continental shelf, water quality, and currents.

We are all aware of the problem of coast erosion. It has a long history of causing damage to private and public property year after year, and at times, causing loss of life. The waves of disaster are now becoming more frequent, and their impact in certain localities has been more like that of Tidal Waves.

From what I have observed particularly along the west, south-west, and south coast of the island for over forty years, I have evidence to show that neither the prevention of coral mining nor the prevention of sand-mining is going to solve the problem of erosion. I wish to repeat the question I have often asked from my fellow scientists and engineers :- where does all that soil, including valuable minerals washed down our rivers, and the sand from our eroding beaches finally go? Is it not drifting away perhaps even from our territorial boundaries? Where to and why? The answers lie not in the establishment of sophisticated coastal engineering laboratories and switching responsibility from one organisation to another, as has happened in the case of the laboratory at Katunbedda, but in meaningful field investigations and research relevant to our problems and needs.

According to a news report (Lloyd Timbrelake, London, vide C.D.N. of 1st September 1982). There is a buried mineral treasure beneath the world oceans which may make the new U.N. law of the Sea treaty a much more important document and may also threaten the economies of many mining nations. Earlier it was the "nODULES" of manganese, cobalt, nickel and copper which got all the attention, later other Deposits of so called "polymetallic Sulphides" of even greater value have been found in the East Pacific Rise. From desk studies of satellite photographs etc., suspect the presence of valuable minerals roughly within 200 miles off the S.W. of Dondra headland.

According to Rodney Jonklaas "In the super salty 'lewawsy' off Palavi and Hambantota not only salt can be the revenue earner for the government, if recent investigations and experiments by a team of dedicated Indian scientists are followed up. The diminutive brine-shrimp, Artemia to be precise, has been found in the saltlars and its ova, or cysts,
if correctly harvested, cleaned and processed can be a multi-million dollar business. The economics of artemia has caught the questing eye of the Ministry of Fisheries and its formidable propaganda machine (Ref: Weekend 4, 11, 1984 'Sayonara to shrimps'). There are several other thought provoking observations which open new avenues for exploration, research, and development, in and around our coastal zone. These relate not only to energy and fisheries, but also to salts and minerals, including precious stones.

New thinking

For over fifty years our line of thinking has been directed towards either breaking the impact of the waves in frenzied attempts to protect the beaches, or to prevent sand bar formation at the sea out-falls of rivers and streams and canals and lagoons to drain and reclaim low lying lands, and to construct barrages to prevent the entry of sea water, and thus develop the land for agriculture.

Foreign consultants have advised us to go a step further and to PUMP in sand to nourish eroding beaches; and to PUMP out water to reclaim land. I have produced evidence earlier, at the Institution of Engineers and elsewhere, to establish the absurdity of the first, and to doubt the wisdom of the second in most instances. Apart from this, the very idea of using, whatever energy we now have, in any prolonged or continual attempt to destroy or dissipate the energy of the sea, seems unscientific and unreasonable. No doubt it is one more instance of the type of expertise and charity, extended by rich nations to poor countries.

Based on observations in the field, maps, aerial photographs and studies on hydraulic models relating to wave behaviour, I find that there are several sites particularly along the south west and south coast of Sri Lanka, where there is evidence of obviously high variation in the concentration of wave energy. This in my view is brought about by the unique position of Sri Lanka in relation to the shape, and form, and other oceanographic aspects of the Indian Ocean in general (Fig. 1-a, 1-b) on the one hand, and the geomorphological features of these sites on the other.

In this paper the potentialities of three of such sites are briefly indicated under (A), (B) and (C) below. A more comprehensive description of how energy and marine resources available at the respective sites is proposed to be harnessed will be given during the author's address which will be illustrated with slides.

(A) Kudawella Project

The proposed project is located around the promontories bordering the coast about four miles before reaching Tangalle on the main road from Colombo. Figure 2. A special feature which continues to draw visitors to the site is what the people of the locality call 'HUMANAYA'. This is a spout of sea water which continually keeps gushing upwards with an explosive sound, through a gorge situated on the eastern side of the headland B, shown in the figure. This phenomenon is active throughout the year. The jet of water rises as much as thirty feet above sea level at interval of about two of three minutes during the south west monsoon, and to a lesser height and at longer intervals during the months of February and March when the sea is relatively calm.

From a reconnaissance survey of the coast on either side of this headland, I infer that there is a wave energy difference, high enough to be tapped as hydro-power. Site conditions appear to be favourable for sea water to force its way into Mawella Kalapuwa, through specially designed conduits with inlets around C. The water from the Kalapuwa will be let down along a water way into the bay (situated west of the headland) where the wave energy potential is comparatively low. The power plant can be located at a suitable site between the Kalapuwa and sea outfall in the bay just mentioned.

An additional benefit of the scheme is that the Kalapuwa itself will be enriched with a continual supply of sea water which will not only contain nutrients but also the fish fry. These will enable the development of the Kalapuwa for inland marine fisheries, with cheap source of electricity for refrigeration etc.

(B) Kalametiya/Lunama Multipurpose Project

The proposed project is located about ten to fourteen miles beyond Tangalle. Fig. 3.

Kachigal Aru has a catchment of 86 sq.kms. and flows into Kalametiya and Lunama Kalapuwa.
The sand banks that form along the coast, have in the past continued to block the free flow of water from the Kalapuwa to the sea. Consequently large extents of rice fields in the lower basin of the Aru were subject to problems of flood and drainage. Twenty years back when the author was the Divisional Irrigation Engineer in charge of the then Southern Division of the Irrigation Department, an experimental sea-outfall was opened across the out-crop of rocks, in an attempt to divert the Kalapuwa water to a location of the foreshore where there was evidence that the force of the waves was comparatively less than along the stretch of the coast right in front of the Kalapuwa. The experiment proved to be a success, and is functioning even today.

Consequent to investigations carried out at two other sites, viz, Crow Island at Colombo North, and at Muthurajawela, the suggestion is now made for a multipurpose plan of development of the two Kalapuwas. The project will include not only flood protection and drainage for agriculture, but also the development of a marine fisheries industry, based on the inputs available from the natural resources of the site. These consist of wave energy, nutrients and organisms for fisheries, minerals (cockels) etc. The technology is based on the inflow and or infiltration of sea water that continually takes places across the narrow but high sand bar into the Kalapuwa. Fig. 6 illustrates the findings at 'Crow Island' investigations.

(C) Development of Hambantota Lewayas

To the north east of Hambantota town is Mahalawaya and about half mile beyond it is Koholankala lewaya. A little within and to the west of the town is Kargan lewaya (Fig. 4). As far as I am aware the first two lewayas have been developed as salterns. Sea water is admitted during high tide or is pumped into the lewayas.

A recent proposal to develop Kargan lewaya also as a saltern, appears to have come to a standstill due to certain questions that have been raised by those concerned with environment. Those questions arise from the Coast Conservation Act. The fact that the Act has several controversial technical matters was expressed even at a public Seminar on 'Coast Conservation' held at the Institution of Engineers Sri Lanka on 25th May 1982 (Reference: Institution Transactions 1983 page 64). I do not propose to review these in this paper.

From what I know in general, about this part of Sri Lanka, I am of the view that as in the case of, Kelameiya, the prospects of directly or indirectly harnessing wave energy should also be investigated. Considering the close relationships that exist between the three lewayas, it is necessary that development should neither be done in isolation, nor limited in scope. However, I have no doubt that the most favourable sectors of development are the production of common salt, as well as other salts of commercial value, and the harvesting of brine-shrimp. Hambantota has marine resource potentialities to make it an industrial city.

South East Coastal Zone Development Scheme

The Wildlife and Nature Protection Society of Ceylon has in a Memorandum on 'Conservation in Sri Lanka indicated that the Ruhunu National Park be extended to the Little Basses (Source: Sri Lanka Wildlife Bulletin 41).

I am not only in agreement with this view but based on what was said earlier in this paper, I suggest that the project area should cover Great Basses as well, and the scope of development should include harnessing of wave energy and marine resources. The two reefs could be a major advantages. (Fig. 5)

I foresee the scope of a major scheme of development, which might be taken up in stages. Investigations and construction works involved are of a specialised type. Studies will have to begin with a reconnaissance survey. This will include oceanography in and around the area. These and the other field investigations might take us to the beginning of the next century. But considering the rather delicate location of Sri Lanka in the Indian Ocean and the growing imbalance between the land and the sea, the data that can be collected will be of national value. This I believe is the type of 'FUNDAMENTAL STUDIES' we have to undertake, at least to ensure the conservation of Sri Lanka's coastal zone.

Conclusion

Two decades have passed since the presentation of my paper at the Institution of Engineers in 1964, wherein I have said that :-

"Science and Technology have advanced to a stage when we have gone beyond the earth and
come closer and closer to the planets that surround us......... On the other hand it is shocking to realise the comparatively little we yet know of the large wealth that is hidden under the seas, and the immense stock piles of sediment that nature has deposited right round our continents in the form of continental shelves. Perhaps providence intended that man might some day harness the vast volume of energy that is continually transmitted to earth by the moon's gravitational pull of the waters round the earth....... It is noted that a start was made by the United Nations Organisation in 1960*

Since then, there have been several international conferences in which Sri Lanka too participated, the latest being the one on "Economic Scientific and Technical Co-operation". In August 1986 we heard about the release in Colombo and other world capitals of a eleven-member Energy Research Group Report. The message given therein was that Energy will never be cheap, conservation, and alternate sources have to go on. (Source: Dr. Mohan Munasinghe, C.D.N. August 86).

During the past ten years several countries have gone ahead with exploring alternate forms of energy appropriate to their resources and needs. India is about to commence construction of a barrage to harness the tides. They have progressed with investigations to mine minerals in the Indian Ocean, and also planned to open up a shipping canal across Palk Strait. Apart from strategic considerations relating to the last, this is of concern to us in oceanography as well. This was pointed out by me a couple of years back to the highest authorities of the Government. I am not aware of its outcome.

Some time about 1986, NARA had the services of a research vessel. This should be most welcome. We look forward to the publication of the data so far collected, as a matter of urgency. For a long time we have been hearing about the preparation of 'Master Plan for Coast Conservation' but when this will be available to the public, we do not yet know. These are all relevant to the present topic. We know that a multi-million rupee fisheries harbour at Kirinda, constructed with foreign expertise and no doubt with the approval of the Department of Coast Conservation and their foreign experts in 1986, has proved to be a total failure. But yet we rely on such experts to guide us in the Master Plans for the coastal zone.

Research and Development Policies

We have not failed to hold national conferences, seminars and workshops. The 'research colloquia' of the I.F.S. being one of the latest innovations. Arising from a question from the audience at a colloquium of the I.F.S. held on 2nd October 1985 the views expressed by two leading scientists is worthy of note by the other scientists and also by Institutions of science and or technology in Sri Lanka.

Question : "Have University agriculture researches offered their opinions to the policy makers and planners on agricultural policy and projects.

Prof. S : "We have never been invited to participate in agricultural planning. We are just across the river but our views have not been sought. Uninvited we don't want to force our way in."

Prof. P : "Scientists should not wait to be invited. They must force their way in. Scientists should proclaim their views to the country. That is a duty they owe the nation. Once they convince the people, the planners will seek out the scientists". (Source: C.D.N. of 8.10.1985, 'Science Notes')

A third view : As (expressed at the I.F.S. at its inception)

"Let us then pause for a moment to examine the purpose and methods of science. Science is knowledge gained and verified by exact observation. You as scientists are those who search for that knowledge. You seek it I presume, as your distinguished predecessors have done in the past, for the sake of humanity. It is in the second purpose that your pursuit brings you close to the politician and the public worker, and it is that co-operation which is helping to solve the problems of hunger and poverty, the utilisation of the resources of nature for the use of man and, in a word, seeking to secure, the material happiness of Mankind throughout the world". (Expressed by His Excellency J.R. Jayawardena, President of the Democratic Socialist Republic of Sri Lanka at the I.F.S. Inaugural Seminar on 2nd December, 1982).

I hope the present Director of the I.F.S. who I believe is also the Science and Technology Policy advisor to the President is aware of the above.
In any case I do not propose to make my views on alternate sources of energy etc. attract the attention of planners, by the use of 'force' as suggested by Prof. P., or by flattery. Such suggestions may help some new comers to the country to 'leap frog' over fellow scientists. I have a record of being closely involved in land and water resources development schemes since 1941, the greater part being in Sri Lanka. I look forward to render to my country a service where among other matters, science and technology have purpose and meaning to the large majority of our people who remain while the gap between them and the rich widens. Sri Lanka is blessed with natural resources, but we lack honesty in developing them.

Acknowledgements: Dr. Sena Wickramasuriya, Rodney Jokleas.

References


9. Discriptive Regional Oceanography (Thernia 1980).


DEPTHS IN METERS

FIGURE 1(a)

THE CHARACTER OF THE BOTTOM ON THE CONTINENTAL SHELF.
HARNESWING WAVE ENERGY & MARINE
RESOURCES IN SRI LANKA

A PROPOSAL FOR KUDAWELE PILOT PROJECT

(at) A.T.G.A. WICKRAMASURIYA (30-3-1987)

SCALE: 3" to 1 mi. (app)
GROUND WATER ACROSS SAND BAR AT
CROW ISLAND
(OBSERVATION: END MARCH 1984)
KUDAWELLA PROJECT SITE