## OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.


## DISCLAIMER



## FAIR USE POLICY

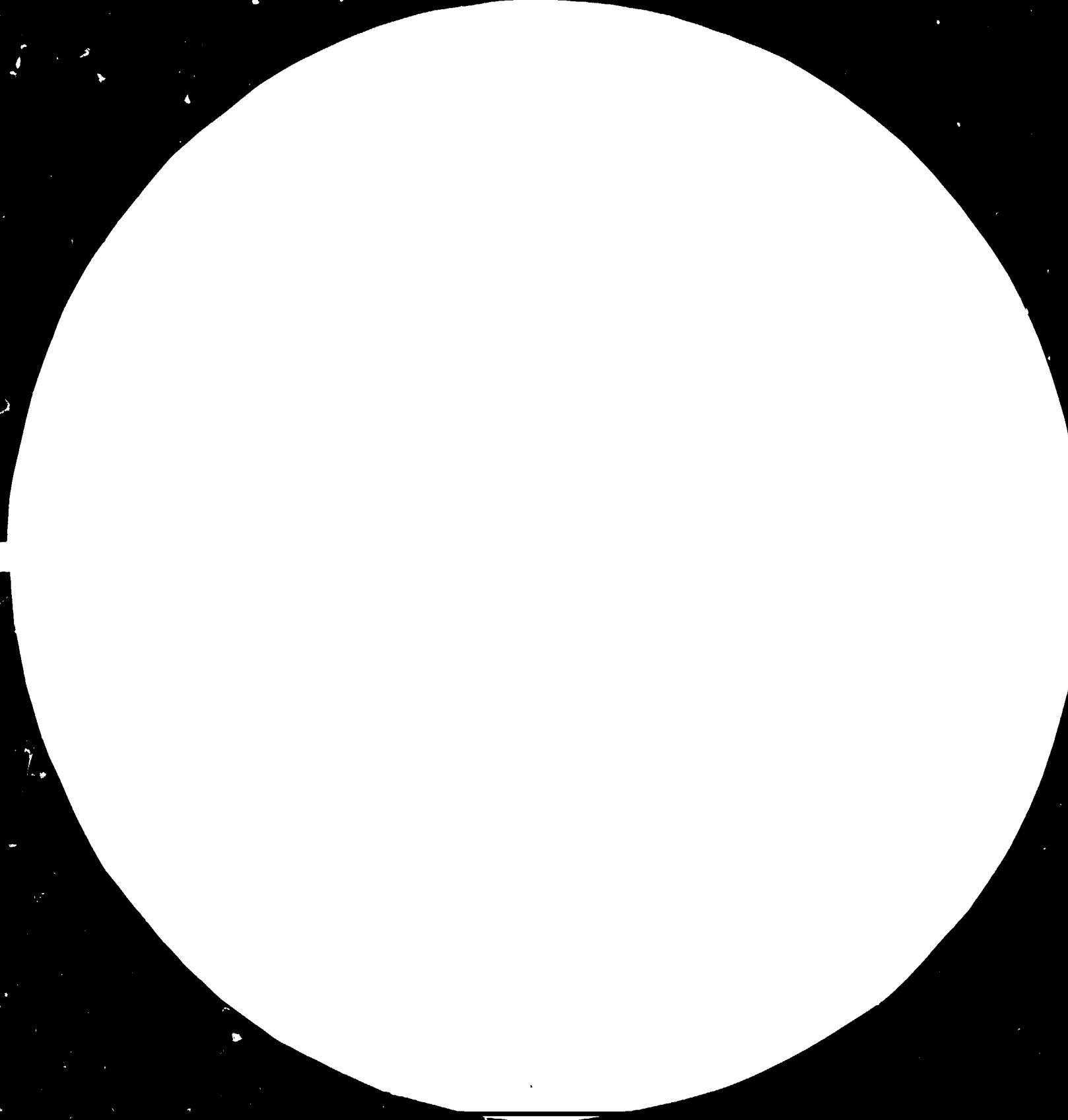


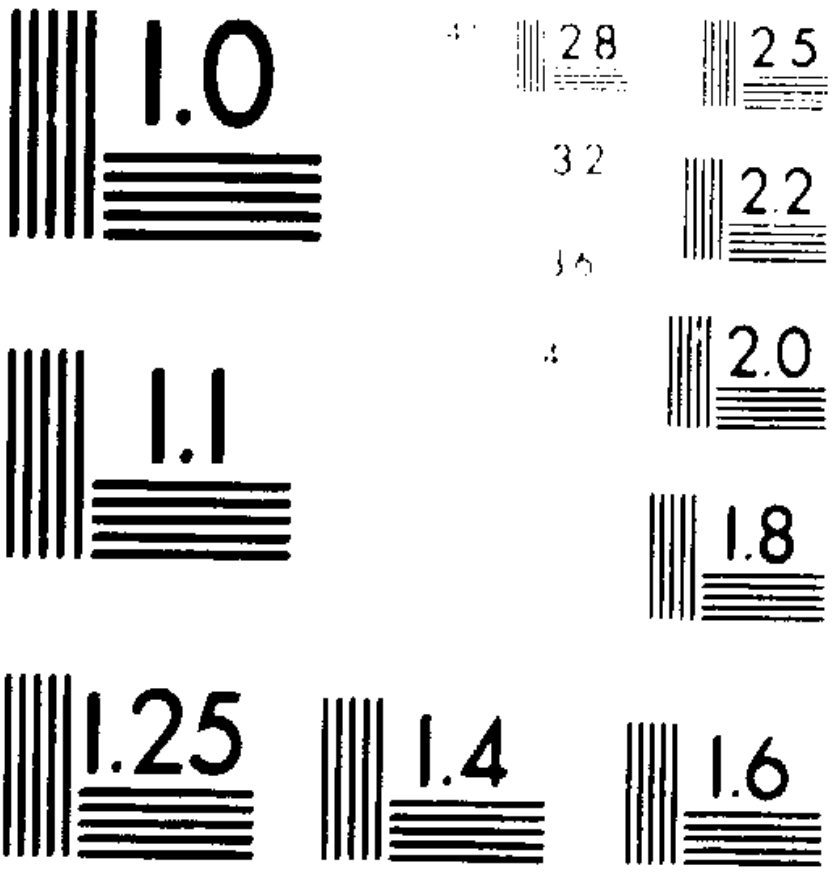
## CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org





RESTRICTED

14233

25 July 1984
English

Turks and Caicos Islands.

# DEVELOPMENT OF MOTHER-OF-PEARL PRODUCTS MANUFACTURE

SI/TCI/84/801
TURKS AND CAICOS ISLANDS

Terminal Report*

Prepared for the Government of the Turks and Caicos Islands
by the United Nations Industrial Development Organization
acting as executing agency for the United Nations Development Programme

Based on the work of R. Eder,
Consultant on Mother-of-Pearl Products Manufacture

United Nations Industrial Development Organization
Vienna

* This document has been reproduced without formal editing.

from Mr. Biering

Contents:

## 1. Executive Summary

1.1. The terms of refrence: The purpose of the mission was to identify opportunities of Turks and Caicos to develop a conch shell industry or an other shell-based industry.

1.2. Three opportunities could be identified and somewhere analysed:
- conch shell industry
- transplantation of trochus niloticus combined with the development of a mother of pearl industry
- utilization of other mother of pearl shells.

1.3. A conch shell industry could probably developed. There are large quantities of shells available, new products could probably be developed and produced with advantage.

1.4. The transplantation of the commercial trocas is probably feasible and would allow the development of a mother of pearl industry. But development would take 5 years more.

1.5. The utilization of other mother of pearl shells is economically irrelevant.

## 2. Recommendations:

2.1. It is recommended to initiate the development of a conch-shell-industry. Four steps would have to procede an investment decision:
(a) a market study
(b) design and product development
(c) a technology survey
(d) a comprehensive feasibility study (including the results of (a), (b) and (c)

2.2. The transplantation of trocas comes only second. It would be necessary to contact institutions, which are capable to implement the transplantation. The feasibility study would have to be prepared including all aspects of the transplantation.

## 2. Introduction and Background information

### 2.1. The terms of reference

The Senior Industrial Development Field Advisor for the Turks and Caicos, M. Sergio Dello Strologo, who has large experience in developing new industries on small islands etc., recommended a short mission to look into the industrial opportunities of Turks and Caicos based on Conch Shells and perhaps on other shells. He recommended to look also into the market aspects of the conch shell products.

### 2.2. The obvious alternatives

The Industrial Advisor arrived at Grand Turk from Kingston on Wednesday, March 14th, 1984. The same day the UNDP Depucy Resident Representative, Rolf STEFANSON, introduced him to Government Officials and Cynthia Artwood, Administration Officer of UNDP. The next day he had conversations with the Governor, His Exellency, Mr. Christopher Turner, the Chief Minister, Hon. Norman Saunders, the Minister of Commerce and Development, Hon. Stafiord Missich and more Government Officials. On Friday, March 16th, he went to South Caicos and was met at the airport by Mr. O.STANLEY BROOKS, District Commissioner, and Mr. Ed. HANCHELL, an enterpreneur of South Caicos, with whom he visited the place, a small work shop, where conch shells are processed, and discussed various aspects of economic life at South Caicos.

Back at Grand Turk he met the President and the Vice President of the Chamber of Commerce, M. John W. HOUSEMAN, to discuss various ideas on industrial opportunities.

In the afternoon he visited together with the Deputy Resident Representative, Mr. Rolf Stefanson, a project of the Smithonien Institute on breeding of king crabs and top shells.

At the end of the mission three alternatives for the development of an industry using renewable local raw materials from the sea, could be distinguished:

- conch shell-industry, producing jewelry and accessory for high fashion;
- transplantation of trochus niloticus as raw material of mother of pearl buttons and jewelry ;
- utilization of other mother of pearl shells.

It seems to be important to take into consideration the three alternatives, to find out their potentials and to set priorities in order to allow the Government some planning in this respect.

## 2.3. Acknowledgement

The expert is indebted to a number of people whose comments and/or assistance were most helpful. Among these are:

His Excellency, Mr. Christopher Turner, Governor,
Hon. Norman Saunders, Chief Minister,
Hon. Stafford Missick, Minister of Commerce and Development,
Mr. O. Stanley Brooks, District Commissioner,
Mr. Edward Hanchell,
Mr. John W. Houseman,
Mr. Rolf Stefanson, Dep.Res. Representative of UNDP

## 3. Industrial exploitation of conch shells

### 3.1. The availability of raw material

At present, between one and four million conchs are harvested each year in the waters of the islands of Turks and Caicos. The meat is cleaned, packed and frozen in plants on South Caicos, Middle Caicos and Providenciales and air freighted to markets in North America. The shells are dumped on the shore. A negligeable quantity only is used to make souvenirs of low standard. Conchs represent a renewable ressource of raw material. Taking into account the large breeding grounds of conchs, there is little risk of overfishing and the lasting availability of this raw material may be taken for granted. In addition, the research done by PRIDE (Foundation for Protection of Reefs and Islands from Degradation and Exploitation) and others has made possible hatchery rearing of Queen Conch from the eggs. PRIDE has entered into a joint venture project with "Trade Wind Industries, Ltd." to set up and operate a production size hatchery in 1984. The project will require capital of about US $ 650.000.-.

By 1987 the hatchery expects to produce millions of juvenile conch for planting on the companies subsea "ranches" or sale to reseed overfished areas.

The development of hatcheries and conch ranches will help the Caicos fishermen transition from being a hit-or-miss gather to a sea farmer providing regular income for people employed in the processing and transport of marine products and continuous availability of a constant amount of conchs.

3.2. The products of conch

It is somehow surprising that up to now conch has not been used very much. It is said that in the early part of this century, conch shells were shipped to Italy where craftsmen made cameos. But there is no substential demand for couch shells now. To a certain extent, it is difficult to explain that no businessman from the USA or elsewhere has had the idea of using the abundant raw material, if it is of any use.

Nevertheless, there is great evidence that conch shell can be used for many products.

The original idea was, to make buttons. But such a product will need product development. At present, there is no developed market for conch buttons like there is for "mother-of-pearl" buttons. Conch is very much different in colour and texture from mother-of pearl. But, being chemically very much the same, it may be assumed that the beautiful pink shine appearance may be stabilized by an acid-treatment with polishing, as it is done in finishing mother-of-pearl.

If this is the case, there should not be any doubt, that conch products, like large buttons, bucles, etc. could be of great interest to High Fashion and there should be a considerable potential market.

Apart from being used for accessory in High Fashion, conch may be used to make jewelry. The possibility of making cameo comes first. It would depend to a large extent on the designs if such products sell well and where they could be sold.

Other jewelry items like necklaces, bracelets, pendents, etc. should be possible products. In fact, there is no limit

to the inspiration of a good designer to create new conch products. The only constraint may be seen in the fact that every such product would require appropriate product development: design, production of samples, market tests, large scale production.

3.3. Manufacturing process and equipment

The production process is similar to mother-of-pearl processing and should be determined in a pilot project before any investment decision is made. In general, production will comprise the following steps: grading shells by size and eventually colour, cutting blanks, grinding and/or turning shapes , engraving, drilling, etc. wet-polishing, washing, bleaching, washing, polishing with acids, washing, dry-polishing, grading, assembling, packing, storage, dispatching...

Depending on the design, the necessary steps will vary and accordingly the required equipment will vary too. Certain designs would be more appropriate for labour intesive, others for capital intensive production. A labour intensive factory would require higher skilled labour. A capital intensive factory could employ unskilled labour and would probably guarantee a high standard from the beginning. But, as the machinery would be very specialized, it would imply large scale production of a few products only, and it would be more difficult to switch over from one product to another.This in turn would require a guaranteed market, which could absorbe relative large quantities of very few products. Consequently, more emphasis would have to be put on the market study and product development. On the other hand, a labour intensive factory could produce any kind of product, but productivity would be low and skilled labour only could achieve a high standard of quality.

This foundamental strategic choice will have to be made right at the beginning of the development of the project.

Factors determining the choice are:

- availability of skilled labour and unskilled labour;
- wages;
- demande by product;
- design;
- number of designs etc.

At the moment it can be said that unskilled labour only is available and that wages are relatively high. Therefore, it is recommended to investigate in details on all economic aspects of capital intensive production of conch shell products.

In order to get an idea of how much capital could be required the capital cost for a hypothetical production line is estimated. It is assumed to need:

| | |
|---|---|
| 1. one diamond-saw or one blank boring machine | US $ 3000.- - 4.000.- |
| 2. one grinding unit | 7.000.- - 10.000.- |
| 3. one drilling machine | 2.000.- - 3.000.- |
| 4. one engraving machine | 20.000.- - 25.000.- |
| 5. one exhauster | 1.500.- - 2.000.- |
| 6. one polishing unit | 2.500.- - 3.500.- |
| 7. Accessoirs and tools | 10.000.- - 15.000.- |
| | 46.000.- - 62.500.- |
| 8. Transport | 8.000.- - 12.000.- |
| 9. Installation | 20.000.- - 30.000.- |
| Small unit-capital requirement in US $ without building, infrastructure, working capital. | 74.000.- -104.500.- |

3.4. Time schedule for the development of a conch shell industry

The crucial point in the development of a conch shell industry is product development.
A thorough market study is expected to provide information on

(a) all actual products of conch shell, (pictures)
(b) products, which could be substituted by conch-shell-products;

Information should compri e prices,quantities of demand and supply, suppliers, quality standards, projections, distribution systems, customes, etc.

Taking into account the results of the market study, designs should be made, prototypes should be produced and tested on the market. The feedback should lead to new designs etc. Besides, intuition should help to create new products, which again would have to be tested on the market.

Specific marketing activities should help to establish business relationships in an early stage and to obtain advance orders.

Production of prototypes could be done in existing factories or by potential suppliers of machinery. A survey of such suppliers and of their production programme should be made. In co-operation with potential suppliers the production flow should be determined. Subsequently, the layout could be drawn the organization and manning table could be proposed and an investment study could be done.

The nature of the project hardly allows an other approach. The following GANTT-chart may give an idea of the time and human ressources necessary to develop a conch shell industry.

Chart 3.4.:

Time schedule for the development of a conch shell industry

| Month<br>Activities | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Briefing - UNIDO, preparation | ●○○○○ | ○○○○○ | ○○○○○ | ○○○○○ | ○○○○○ |
| Study of secondary inf. | ○●○○● | ○○○○○ | ○○○○○ | ○○○○○ | ○○○○○ |
| Market study: | ○○○○● | ●●●●● | ●●●○○ | ○○○○○ | ○○○○○ |
| Conch-products and substitutes: | ○○○○○ | ○○○○○ | ○○○○○ | ○○○○○ | ○○○○○ |
| Vienna -Austria | ○○○○○ | ●○○○○ | ○○○○○ | ○○○○○ | ○○○○○ |
| Paris - France | ○○○○○ | ○●○○○ | ○○○○○ | ○○○○○ | ○○○○○ |
| Rome - Italy | ○○○○○ | ○○●○○ | ○○○○○ | ○○○○○ | ○○○○○ |
| London - UK | ○○○○○ | ○○○●○ | ○○○○○ | ○○○○○ | ○○○○○ |
| Germany | ○○○○○ | ○○○○● | ○○○○○ | ○○○○○ | ○○○○○ |
| USA | ○○○○○ | ○○○○○ | ●●○○○ | ○○○○○ | ○○○○○ |
| Summary-Analysis | ○○○○○ | ○○○○○ | ○○●○○ | ○○○○○ | ○○○○○ |
| Design and product development | ○○○○○ | ○○○○○ | ○○○●● | ●●○○○ | ○○○○○ |
| Design various prod. | ○○○○○ | ○○○○○ | ○○○●● | ○○○○○ | ○○○○○ |
| Produce proto types | ○○○○○ | ○○○○○ | ○○○○○ | ●●○○○ | ○○○○○ |
| Market test | ○○○○○ | ○○○○○ | ○○○○○ | ○●●●● | ○○○○○ |
| Redisign | ○○○○○ | ○○○○○ | ○○○○○ | ○○○○○ | ●○○○○ |
| Produce new proto types | ○○○○○ | ○○○○○ | ○○○○○ | ○○○○○ | ○●○○○ |
| Market test | ○○○○○ | ○○○○○ | ○○○○○ | ○○○○○ | ○○●○○ |
| Technology survey | ○○○○● | ●●●●● | ●●●○○ | ○○○○○ | ○○○○○ |
| Survey potential suppliers of machinery | ○○○○○ | ○○○○○ | ○○○○○ | ○○○○○ | ○○○○○ |
| Germany | ○○○○○ | ○○○○● | ○○○○○ | ○○○○○ | ○○○○○ |
| Italy | ○○○○○ | ○○●○○ | ○○○○○ | ○○○○○ | ○○○○○ |
| Visit potential suppliers (discuss proto types) | ○○○○○ | ○○●○● | ○○○○○ | ○○●○○ | ○○○○○ |
| Summarize technology | ○○○○○ | ○○○○○ | ○○○○○ | ○○○●● | ○○○○○ |
| Feasibility study | ○○○○○ | ○○○○○ | ○○○○○ | ○○○○○ | ●●●●● |

## 4. Transplantation of TROCHUS NILOTICUS

### 4.1. The need of industries of Turks and Caicos.

The economy of the Turks and Caicos is mainly based on inshore fishing for conch and crawfish as well as on tourism.

Other than the processing of fish products for export, industry is of negligeable importance on the Turks and Caicos Islands.

It is a matter of fact, that the islands have no comparative advantages for whatsoever industry: energy has to be imported; labour is unskilled and relatively expensive, the local market is extremely small (8000 inhabitants) and there are practically no industrial linkages. Nevertheless, there is an interest to diversify economic activities and to make the best use of available ressources.

### 4.2. Possibilities to diversify economic activities:

The availability of a large quantity of conch shells may be considered as a major reason to investigate the industrial utilization of the raw material , which is considered as a waste now (see chapter 3). There is still an other potential ressource: the islands are surrounded by extensive areas of the type of shallow waters which could be particularly suitable for the breeding of trochus niloticus. The mother-of-pearl of this shell is very beautiful and mainly used to make buttons and jewelry. Its meat is similarly good as the one of conch.

The trochus could either be used to diversify the fauna and to have an other major fishing product for export (mother-of-pearl and eventually meat of trochus) or to build up a mother-of-pearl industry whith a high value added and a higher employment effect. Any reason is good. Though no reliable figures are available on the total demand for trocas products, there is great evidence that the actual share of mother-of-pearl buttons

in the toal production of buttons is rather limited by the lack of raw material than by demand. The share of mother-of-pearl buttons could be increased considerably, of there were more trocas available.

Actually only 5 % of the buttons are made of mother-of-pearl and more than 800 million buttons of mother-of-pearl are sold every year in Europe. The demand is by far not satisfied and little is done to promote mother-of-pearl products. From the point of view of the market trocas may be considered as a product which has no sales problems.

4.3. The trochus niloticus.

It is mainly found in the Golf of Bengal (Ceylon and Andamases), Indonesia, Australia, Papu New Guinea, Vanuatu, Carolines, Philippines, Loo Choo, New Caledonia, Futuna and other islands in the South Pacifique. In 1957, the trocas was transplanted to Polynesia, because the commercial value had increased considerably and supply of trocas was very limited. The trocas is feeding on small algae which grow on dead coral and on any kind of micro-organisms.

The optimum environment of trocas is the surf zone on the ocean side of the reef.

Although trocas is most abundant in the barrier reef surf zone and on the outer shelf of the seaward side of this zone, it can and does live on some lagoon reefs and even occasionally may be found on some gringing reefs.

Trocas requires, in order to survive, a high level of dissolved oxygen (2.5 ml/gm body wt/hour) in the water. While the waters in the vicinity of the outer reefs have a great deal of dissolved oxygen (5-6 ml) the waters of the lagoons are low in dissolved oxygen. Atoll lagoons on the other hand, are well ventilated.

The depth range of Trochus on the outer shelf of barrier reefs is about 12 to 2o feet of water. In deeper waters the number of trocas decreases. There are practically no trocas beyond a depth of 4o feet. The reason for this depth limitation is not positively known but the indications are that the plant food is limited in depth and that this limit is due to the fact that sunlight is filtered out in the deeper zones and that the plants are unable to survive.

Trocas may also be found in the very shallow water of the boulder and cobble area near the outer edge of the top of the reef, but again, they are not as abundant here as in the slightly deeper water.

The feeding habits of Trochus have been studied by Moorehouse, Asano and John A. McGowan. They all say, Trochus feed on the brown or greenish-brown vegetable matter (filimentous algae and diatoms) that grows abundantly on the surface of rocks, boulders and dead coral. They are primarily nocturnal feeders.

The growth in diameter of the shell slows down markedly after the animal reaches an age of 4 1/2 to 5 years, but the shell continuous to get heavier. The continued increase in weight is due to the fact that the walls of the shell thicken and calcium carbonate is deposited in the upper terminal portions of the inside of the shell. The sexes in TRochus are separate and there is an equal percentage of mals and femals. They cannot be determined externally by the shape, size or coulour. Internally, however, the male has a creamy white gonad while the ovaries of the female are dark brown. Males mature at a smaller size than females. The older the animal, the larger the ovary and the more eggs it produces.

Both the male and female eject their gametes into the water and the eggs are fertilized there.

Then follows development through a free floating larval stage.

This planktonic larva has never been identified but it almost certainly exists. This stage is shorter than two weeks and may last as little as two days. The smallest Trochus are found in the cobble and rock zone of the reef. The young Trochus moove seaward trough the boulder zone and down to deeper waters on the shelf, but never they are found in the deep water of the outer shelf zone.

There are a few predators on Trochus which prey on the juvenile and adult: sting rays and large trigger fish. They are capable of crushing small shells. An other is the large red hermit crab, which is able to kill and eat a 4-inch-Trochus.

Trochus is an Indo-Pacific species, and limited to the waters of Indo-Australian Archipelago.

## 4.4. Transplantation

Some spectacular successes in transplanting Trochus prove that it is practicable and that it can be highly profitable.

However, it is obvious that some care and planning are necessary to carry out a successful operation.

John A. McGowan suggests a set of rules to be followed when transplanting Trochus:

1. The animals must be delivered to the site in good condition.
2. There must be a large enough area of suitable Trochus reef to support a sizable population. About 4 miles of reef is a minimum.

3. The introduced animals must not be disturbed for a period of at least five years. (At the age of 2 years, when Trochus is about 3 inches in size, it begins to reproduce itself.)

4. Large numbers of Trochus must be introduced. A minimum of at least 750 adults for every 5 miles of reef is required.

5. The transfer of the animals from home reef to new site must be as rapidly as possible.

The most important factor in carrying out a transplantation project is the selection of proper sites on the new reefs. A Trochus colony should be similar to a sanctuary. There should be about 750 large Trochus concentrated together in an area of 1oo x 2o yards. This area should be on the outer edge of the reef, in or near the surf zone where the depth of water is 5 to 10 feet, depending on the tide.

Proper care must be taken of the Trochus during their collection and subsequent transportation. They may be kept in wire or bomboo baskets with a large mesh size. The baskets should be suspended 4 to 6 feet below the surface. Trochus may be kept out of water safely for as long as 36 hours in a clean, shady place. The bags must be saturated with cool, clean sea water every half hour. If the voyage is to last more than 36 hours, a suitable live tank must be used. It can be made frome wood or steel and must be absolutely clean inside. Clear cool sea water must be circulated constantly through the tank, There should be at least 3 gallons of water for each individual Trochus. The water should be replaced about once an hour. The oxygene requirements of Trochus are high.

Upon arrival at the destination, the Trochus must be transferred immediately to the previously selected site.

Although research has provided enough information to institute a transplantation program, there is still much more to be learned about Trochus, if we are to manage it as a crop.

Excellent work has been done by:

John A. McGOWAN: The Throchus Fishery of the Trust Territory of the Pacific Islands.

Michel ANGOT: Conclusion d'une Etude Scientifique de l'Institut Français d'Oceanie sur le Troca en Nouvelle Calédonie. In: Bulletin Trimestriel de la Commission du Pacifique Sud. Nouméa, Octrobre 1958.

Michel ANGOT: Evolution de la pêche du troca. (TROCHUS NILATICUS L.) en Nouvelle Calédonie. Un exemple d'"overfishing" avec ses causes et las remedes apportes. In: La terre et la Vie, 106, No.4, 1959, p. 307-314.

J. BARREAU et L. DEVAMBEZ: Quelques résultats inattendus de l'acclimatation en Nouvelle Calédonie. In: Le Terre et la Vie. NO. 1, Paris 1957.

R. GAIL et L. DEVAMBEZ : Bibliographie analytique du troca. (TROCHUS NILATICUS L.) Decument Technique de la Commission du Pacifique Sud. No. III. Nouméa, Janvier 1958.

Transplantation would have to be done by a competent institution.

4.5. The economic impact of a trocas industry on the islands' economies.

Taking into account the extensive waters of Turks and Caicos Islands to breed trocas, it should be easy to produce 2oo t of trocas every year. If there were no competition between conch and trocas, and the latter could be considered as additional crop, the gross domestic product could be increased by at least 100.000 US $, assuming that the shells are exported as unprocessed raw material. The value added could be increased by three to four times the value of the raw material, if processing of the raw material could be done in the country.

The minimum contribution to the national product could therefore be 4oo to 5oo.ooo US $. Depending on the degree of mechanization of processing 5o to 15o persons could be employed in manufacturing and another 5o persons as part-time fishermen with a gross revenue of more than 100.000 US $ . These figures are rough estimates and could be considerably higher.

There is no doubt that a trocas industry could be very profitable as far as processing and fishing are concerned. Any size of factory from 100.000 US $ upward could be implemented, nevertheless, economies of scale would be important passing from an investment of 100.000 US $ to 1,100.000 $. The industry would not do any harm to the environment, if properly conceived.

There is no reason to fear any negative influence on the biological equilibrium, taking into consideration feeding habits and other characteristics of the trocas.

5. Utilization of other mother-of-pear shells.

During the very short sojourn of the advisor at Grand Turk only one mother-of-pearl shell could be identified: the top shell.

This shell is much smaller than the Trochus, but has a beautiful mother-of-pearl with a light greenish hue and would be well suited for manufacturing of buttons. Little can be said about available quantities. But probably, there are not enough top shells for an industry. Other suitable shells are not known.