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ASSISTANCE IN ESTABLISHING A MINERAL RESOURCES DEVELOPMENT PROGRAMME

SI/SEY/86/801

SEYCHELLES

Technical report: Non-metallic mineral resource development*

Prepared for the Government of Seychelles
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Neville R. Hill, expert in industrial rock and mineral resource development

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United Nations Industrial Development Organization
Vienna

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Explanatory Notes

Exchange Rate : Approx R.5.99 to US$

Minimum wage : R.1108 per month

Inflation rate : 0.8% annual increase in retail price index.
(to June '86)

Unemployment : 14.8% (in Dec. 1984)

Units:

cu.m	: cubic metre
ft , in,	: feet, inch (Imperial units retained from original reference)
m	: metre
M	: million
oC	: degrees Celsius
R.	: Seychelles rupees
Rs.	: Indian rupees
sq.ft	: square feet
t	: metric tonne
y	: year

Abbreviations:

BRGM	: Bureau des Recherches Geologiques et Minieres (of France)
CFTC	: Commonwealth Fund for Technical Co-operation
LSU	: Laboratory Services Unit
MND	: Ministry of National Development
MPER	: Ministry of Planning & External Relations
PUC	: Public Utilities Corporation
RTS	: Radio & Television Seychelles
SEYBREW	: Seychelles Breweries Ltd
SEYPOT	: Seychelles Potter's Co-operative
SMB	: Seychelles Marketing Board
SPU	: Special Projects Unit
TDU	: Technology for Development Unit
TSSS	: Technological Support Services Section
UCPS	: United Concrete Products (Seychelles) Ltd

Abstract

This report details the work of the UNIDO Consultant in Non-Metallic Mineral Resource Development: post SI/SEY/86/801/11-51/32.1.B during two months in September-October 1986. The objective of the mission was to identify possibilities for developing new industries and/or products to promote increased utilization of local industrial rocks and minerals. Training needs were to be identified, a strategy for the development and strengthening of industries in the sector was to be proposed and advice given on measures to initiate further investigation of potential resources.

It is recommended that UNIDO and/or bilateral support be offered for the Construction Materials Laboratory and Bureau of Standards, proposed within the new Technological Support Services Section of the Ministry of National Development, in the form of equipment and technical assistance and also to assist TSSS provide more extension services to existing industries. It is recommended that 5000t of the coral limestone stockpile should be conserved for several industrial uses. The importation of cement should normally be in bulk so as to capitalise on the existing handling and bagging facilities and eliminate present losses through importing it in bags. The quartz sand resources need to be known and a survey by either local or foreign specialists could be commissioned. There is scope for a further potters co-operative to be established; the Praslin clays can be assessed by SEYPOT and most future testing of materials such as clays, sands, etc should be done in Seychelles. Costs of the proposed pre-cast concrete houses should be closely monitored in comparison with houses made from concrete blocks. The Seychelles granites may lack the exceptional qualities to make them attractive as an export commodity and there is no present solution to how the pink granite especially, on Praslin, can be put on freighters at a competitive price. Any working of granite for local sale has to be by modern powered equipment to keep productions costs low and offer suitable working conditions. By-product lime from the acetylene plant can replace the expensive imported white paints for decorating buildings and marking out sports grounds. MNDs policy to existing industries in the mineral and building materials sector could be aimed at obtaining a higher utilization of their present production, handling and distributing facilities, technical know-how and managerial ability.

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INTRODUCTION

Previous to the present mission a UNIDO project SI/SEY82/801 assisted the Government during the period November 1983 to December 1984 in its investigations for the establishment of heavy clay and ceramics industries. Some clay samples were collected and submitted to laboratory testing by the UNIDO-CSSR Joint Programme at Pilsen in Czechoslovakia. In view of UNIDOs recommendations the Government requested to review future follow-up possibilities with UNIDO and in this respect a Tripartite Review Meeting was held in December 1984. Government indicated its plans to establish a National Resource Development Programme and urged UNIDO to provide 2 m/m assistance to support the preparatory studies related to the non-metallic resources. Mr. N. Hill was selected for consultant in Non-Metallic Resource Development.

The overall purpose of the project was assistance to the Government in their planning activities, for the promotion of new commercial and industrial areas, to enhance the increased use of indigenous natural and human resources. The consultant also was particularly conscious of the te[illegible] in the forward to the National Development Plan 1985 - 1989 in [illegible]ich the President stated: "The new Plan sets out to make Seychelles more self-reliant...., a nation that is able to meet more of its requirements from its own resources.... The Plan seeks to make full utilization of all our resources.... We cannot allow ourselves ...to import the things we can produce ourselves".

Schedule

August	
28 - 29	Briefing at UNIDO, Vienna.
31	Arrival at Duty Station
September	
1	Initial briefings at MPER, MND and TDU.
2 - 30 October 1 - 2	Obtaining data by meetings and visits to approx 45 organizations or people on Mahe identified as possibly relevant to the mission.
3 - 4	Visit to Praslin.
6 - 16	Compiling relevant import statistics, identifying possible industrial opportunities and writing report.
17	Meeting with P.S. Ministry of Industry and technical assistance to the Department of Information.
18 - 22	Completion of report and draft PRODOC and final meetings with MND and MPER.
23	Departure from Seychelles

23 - 26 In Addis Ababa for meeting concerning next mission

27 - 28 In Vienna for de-briefing at UNIDO.

RECOMMENDATIONS

1. UNIDO and/or bilateral support should be offered to assist the Ministry of National Development(MND) to move the existing Technology for Development Unit(TDU) to improved accomodation and to re-establish it as the new Technological Support Services Section (TSSS). In particular additional equipment is required for the Construction Materials Laboratory etc of the Laboratory Services Unit of TSSS. On the spot training by technical assistance experts in selected fields should be offered working also alongside Seychellois staff in other Units of TSSS, such as the Seychelles Bureau of Standards and the R&D Unit's Mineral Resources Group.

2. The new Technological Support Services Section (TSSS) should aim to provide more support to existing and planned industries by providing extension services - working on industry's present and future needs, demonstrate methods e.g.of conserving cement in construction, encourage sponsored development/testing work, etc. TSSS can ensure there is the market potential and likely commercial feasibility before projects are committed to spending much foreign aid and/or Government cash on raw materials testing, major surveys or actual construction work.

3. At least 5000t of stockpiled coral limestone should be conserved for industrial non-fill uses: artificial marble, scouring powder, agricultural lime etc and trials by TSSS with SPU on lightweight concrete blocks. Future usage of the dredged coral should be under the control of SPU, or another suitable Government department, to try and reduce pilferage of this useful and commercially attractive material.

4. Importation of Ordinary Portland Cement should normally be in bulk so as to make the fullest use of the capital investment represented by the unloading, storage and bagging facility at the New Port as well as the available bulk delivery truck and concrete batching plants. If any 'free gift' cement has to be sold to the public it should be offered at the current market price prevailing in the Indian Ocean area.

5. MNDs Industrial Planning & Promotion Section could consider in future commissioning a short feasibility study for the establishment of a pottery co-operative on Praslin. TSSS could commission SEYPOT to make the necessary tests on selected Praslin clays. This additional ceramic industry would make handthrown items for tourists and jiggered and

slipcast pots and other containers for packaging of food products for export and tourist markets. The organization and operation of this pottery could initially follow that of the successful SEYPOT co-operative.

6. The demand for pre-cast concrete products should be re-assessed. The scope of the pre-casting plant being constructed at SPUs quarry at Petit Paris might best be limited to those items for which there would be a ready sale. These are more likely to include standard size lintels and beams, pipes, storm water drains, etc. If the equipment supplied some time ago under bilateral aid is inappropriate it should be offered for sale to the private sector.

7. As granite for export from Seychelles is a high risk venture, Government may agree that it would be inappropriate for any new financial support to be offered, at least initially, other than from private sources.

   Granite products for local sale might best be aimed at providing polished flooring and paving materials and the methods used have to be highly mechanized if production costs are to be kept low enough and the working conditions sufficiently attractive.

8. The presently available 3-4t of by-product lime, and 10t available annually in future at the acetylene plant should be taken and used for higher value applications than say in building plaster. These include waterproofed white decoration for buildings and whitewash for marking out sports grounds such as the National Stadium.

9. It is suggested that the Ministry of National Development (MND) may wish to re-organise the library on the second floor of Independence House . The many multiple copies of reports and other documents could be distributed to other appropriate departments, including the National Archives. If more shelf space could be provided access would be facilitated and an archivist could be employed to complete re-arranging the reports, etc into subject groups.

10. It is suggested that in future MND may like to consider adopting policies which will better enable the companies working in the non-metallic rock and mineral and building materials sector to utilize their existing production, handling and distributing facilities, technical know-how and managerial ability to the greatest possible advantage of the Nation as a whole.

I. ACTIVITIES AND OUPUT

A. Job description

The complete Job Description is shown in Annexe 1. Specifically the consultants duties were to be:

- Review and appraise the locally available data and information on the mineral resources of the islands.

- Identify potential areas of developing new industries and/or products to promote the increased utilization of locally available industrial minerals.

- Investigate the performance of existing industrial set-up, specifically the building materials and pottery making industries, providing support to known sectors e.g. tourism, and identify further needs for technological changes and improvements for training in production and marketing techniques.

- Prepare a report setting out a strategy for the development and strengthening of non-metallic mineral based industries in the country, giving advice on the short and long term measures to be taken to initiate further investigations relevant to the exploration and exploitation of potential resources.

- The expert is also expected to prepare a technical report setting out the findings of his mission and his specific recommendations to the Government.

It was not found necessary to revise these activities and objectives and broadly the consultant aimed his work at achieving those aims.

B. Activities

The list of organizations and individuals contacted in connection with the activities of the mission is in Annexe 2.

Analysis of selected import statistics

The 1984 and 1985 Imports, by Commodity and Country of Origin, were examined for those two recent years with particular reference to non-metallic rocks and minerals, items manufactured from them such as sanitaryware and any other items, e.g. corrugated galvanized iron sheets for which it might be possible to substitute by starting local manufacture of roofing tiles, say. To see what trend if any had taken place over the past 15 years, the

same items were, where possible, extracted from the Trade Reports for 1970, 1975 and 1980 (Anon. 1970 etc. For full list of references see Annexe 3.). The tonnages and values, in 000's of rupees, for the selected imports are shown in Annexe 4.

These have been analysed to determine where particularly high figures occur or where there is a marked tendency to increase in recent years.

Appraisal/review of mineral resource data

Prior to the mission certain reports, including that by Baker (1963), were obtained from the British Geological Survey (BGS) in UK. In addition the Dialog service of the Science Reference Library of the British Library, London was visited to access the GEOREF and GEOARCHIVE databases in the USA. Printouts were obtained for keywords 'SEYCHELLES' and 'MINERAL'.

In Seychelles, reports were seen from several sources: these included the Technology for Development Unit through Dr. Gendron, the MND library at Independence House, from Mr. Clifford Adam at the Grande Anse (Agricultural) Experimental Centre, from the Central Bank and also the records held at the National Archives, La Bastille were also consulted. Papers and bibliographies were loaned by other individuals such as Mr. Guy Lionnet.

In some instances the existence of a report was known but a copy could not be obtained e.g. the report on the clay at Anse Soleil by M. Bouchard? of FEDEAU. Lists of the titles of many of the references published in English and French earlier this century and previously have been examined. Apart from guano, granite and coral, there were few if any references pertaining to other potentially useful materials. It is believed that later reports, particularly that by Baker (1983) on the Geology and Mineral Resources of the Seychelles Archipelago, with its 69 references, cover whatever of significance had been published previously. Whilst in no way claiming that all recent and relevant reports on the non-metallic rocks and minerals of Seychelles have been reviewed, the consultant believes that the List of References in Annexe 3 includes those of most potential use to any discussion of the development of such resources. The data judged to be useful in the present study, especially concerning clay deposits and granite, are listed in annexes.

One problem found, common in many other countries as well, was that not all technical reports and other documents had had a copy lodged with the central records office, in this case the National Archives, which in Seychelles is required by law. This is not a criticism of the very helpful service provided by that department. It is more a reflection of the apparent reluctance of officials worldwide to make more freely available to the public the many technical, non-confidential reports that are sent to them or their departments.

Visits to some raw material deposits

It was not the intention, nor was time available, to make a full field reconnaissance of the available resources. Otherwise there would have been repetition of previous work. Instead excursions were made in order to see the nature of the materials likely to be of most industrial significance.

Granite of the grey variety was seen at the SPU quarry at Petit Paris. The difficulty of extracting the granite separately from the frequent bands of tough but flaky dolerite was readily apparent. Some pink granite occurs at about three locations along the east coast of Mahe, south of the airport but the best exposures occur on Praslin. There it was seen at Cap Samy in Baie St.Anne and also well exposed on the steep road joining Anse Marie-Louise and Anse Consolation. (A list of cited granite locations is in Annexe 5).

Coral limestone. The coral limestone recently dredged for reclamation of land for the East Coast Project was inspected at stockpiles opposite the Providence - Petit Paris area and off Plaisance. It is obviously an excellent material for use as fill and the base for roads but also it has good potential as a light weight aggregate e.g. for lighter weight hollow concrete blocks. Its colour is a fairly clean creamy white and if ground to a fine powder it should appear whiter still. At present the stockpiled resource amounts to 65 - 75,000 cu.m. (See Annexe 6).

Sand. Although quartz sand is said to be in short supply and builders tend to take calcareous beach sand, there are probably numerous small deposits accessible in the lower reaches of streams flowing off the Red Earth Series, which is the main soil type on the granitic islands. Quartz is a principal component of the granite, together with felspar and some ferromagnesian minerals, and the most durable during erosion. Hence it accumulates at points where the stream velocity drops to allow reducing size grades to sediment out. A good example occurs just inland of the bridge at Les Mamelles. Mr. Francis Antoine, owner of the block works there, obtains a washed quartz sand, sub-angular to rounded and generally in the 1-10mm size range. The deposit lies beneath about 45cm of mud and extends down to an indeterminate depth, possibly as much as 2m. Although the stream bed is tidal at this point, beside the road, there is enough flow of fresh water to have prevented a build up of marine salts. The content of salt, causing efflorescence on plastered surfaces and corrosion of reinforcement, is a main hazard to using unwashed beach sand. There is a sand and gravel Act which is aimed at ensuring that licences for removal of sand are granted only for those parts of river systems where there has been no accumulation of sea salt. (Locations where quartz sand is known to occur are in Annexe 7).

Clays. Frequent exposures were seen, usually in road cuttings, of the sometimes thick, reddish-brown, clayey soil, of the Red Earth

Series which is the weathered surface of the granite. Examples found included alongside Chemin Val d'Endor about 1km from the Baie Lazare coast road where several exposures up to 2m thick have been dug, similar exposures above La Gogue village and the large 10m thick area where the top soil has been stripped to expose red and brown weathered granite just north-east of La Gogue dam. (This latter deposit is marked on Picture (sketch map) 3 of reference Anon. 1984b. Tests by the UNIDO-CSSR Joint Programme showed it to be largely kaolinite and quartz, together with iron and aluminium hydroxides, as is general with these clays originating from the granite, but it lacked the physical properties needed for ceramic use).

From general observation white or at least lighter coloured clays expected to have lower iron contents and to fire to a cream or white colour seem to occur infrequently, at least on Mahe. One of the few places is where the Pottery School obtains its white clay at La Gogue (and which is said to be 'too plastic' to use without addition of other clay e.g. from Anse Soleil).

On the other hand three exposures of lighter coloured clays were seen on Praslin and this could be of significance in view of opinions expressed by MND that any new pottery or other ceramic project should be located on that island. (The clays on Praslin, though, can be expected to suffer the same disadvantage of being rather too refractory for making pottery at an appropriate firing temperature. Cooper (1985) did not find any white burning kaolinites on Praslin). On the north side of the main road through Vallee de Mai, at the crest of the hill just east of the car park, there is at least 5m of pale pink clay exposed in a clean vertical face only 20m from the road and having easy truck access. In a road cutting about 100m west of the entrance to Chateau de Feuilles, between Baie Ste.Anne and Anse Marie-Louise, there is about 2m thickness of whitish clay exposed. Finally, and less important, there is pink crumbly weathered granite, 15-20m high, in the large quarry at Anse Takamaka, about 50m west of the point at Anse Cimetiere. Although the clay content appears to be quite low this is another indication of a lighter coloured product of granite weathering occurring on Praslin. (Locations known for deposits of clay, with test results in some cases, are in Annexe 8).

Some previous projects and practices

Lime. In the past lime was produced by small batch kilns that burned coral. The slaked lime was said to be of poor quality. In 1980-82 there was a lime project for which the Government allocated R.65,000 for the construction of a small catenary arch batch fired kiln by the WEL premises at Petit Paris (Anon. 1981a). It was reported (Anon 1984a) that the lime produced was of good but varying quality and the project was found to be unfeasible on financial and ecological grounds. The kiln temperature was said to have reached above 960oC but the quicklime was friable and

hence the coral limestone would not have been suitable raw material for a continuous vertical shaft kiln, say, owing to the fine material blocking the draught. (The import statistics, see Annexe 4, suggest there has been little demand for lime and none in the last two years. In any case there is the by-product lime available from the acetylene plant and though small in quantity it is excellent for building and decorative uses - see Annexe 9).

Salt. Previously there has been solar salt production from seawater. An old salt pan can be seen on Praslin where the main road from Vallee de Mai meets the coast at the south-east end of Grand' Anse. From 1980-82 R.2.5M was invested by the Government in a project aimed at providing the 300t of salt consumed annually. The project was abandoned; one of the problems was said to be the unusually high rainfall at that time.

Clay Bricks, Tiles, etc. UNIDO project SI/SEY/82/801 : Establishment of Heavy Clay and Ceramic Industries, worked initially to find and test clays appropriate for the manufacture of red bricks and roofing tiles. This was extended to include dinnerware when results were obtained with ceramic clays from Anse Soleil Road and Val d'Endor Estate (see ref: Anon 1984b). In 1984, following a report by Muller et al (1983), Government's view was that red brick production would not be economically viable nor ecologically acceptable. Cement was readily available and the cost of building a house in bricks would be higher than when using blocks. The foreign exchange drain for import of fuel for firing bricks (and tiles) would be greater than that resulting from the import of cement for an equivalent wall area of blocks.

Granite. There have been attempts in the past to achieve export of granite and, as reported later, a further study has been in progress. In about 1978 Impala Granite of South Africa were invited by a local private company to look at the export potential for Seychelles granite. At that time the price paid for pink granite was said to have been US$200/cu.m. but US$600 for black granite. The South African company was said to be interested in proceeding further only if adequate resources of black granite could be found. In 1981 blocks of Seychelles granite were displayed at the Verona marble and granite fair in Italy (ref. Anon 1981b). In 1983 the Sociedad de Exploitation de Granite (Seychelles) Ltd, in which the Government had a 25% share, was reported (ref: Anon 1983) to have 350t of granite blocks, representing 3.5 months quarrying, at the New Port awaiting shipment to Italy were it was to be further prepared and publicised in Milan. Three types of granite were sent including pink and a greenish-grey. The 2m blocks, mostly from Grand Anse and some from Takamaka, were cut using pneumatic air drills and a rock splitter. It was found that the major problem was to move the blocks to the port followed by loading on to a ship. Shipping into Victoria was mainly southbound and to get suitable freighters to call going north would have required a considerable incentive for the shipping company (ref: Jackson 1986).

Construction with Red Earth. There are several instances of houses, and larger buildings, having been constructed successfully using red earth. Baker (1963) refers to pise de terre construction having been used with much success for cottages at Mamelles. Information on other examples, at Ma Constance and on Praslin, is given in Annexe 10. More recently a local company was offered a French process for making a highly compacted 'brick' from red earth and 5% cement but it was rightly turned down as in no way would they be able to compete with concrete blocks.

Beach sandstone blocks. Baker (1963) lists locations where beach sandstone appears to be suitable for use as building stone. The flaggy rock, from 3 to 18 inches thick, had been used in a few places, was easily trimmed and satisfactory provided it was left out in the open for a rainy season to wash out much of the saline moisture.

Guano. The previous exploitation of the well known deposits of phosphatic limestone or guano resulting from thousands of years accumulation of bird droppings is recorded in much detail by Baker (1963). Since 1981 production is believed to have ceased and the last occasion that guano figured amongst the exports in the Trade Report was 1981. A small quantity is sold to farmers from the shop in Victoria run by the Department of Agricultural Promotion of MND.

Existing industries in the non-metallic sector

Bulk cement handling and bagging. Details of the cement bulk handling and bagging facility at the New Port are given in Annexe 11. The present total capacity of the four silos is 4640t and the smaller, 800t silo is usually reserved for Sulphate Resisting Portland Cement. Because of the large deliveries of bagged cement, supplied through bilateral aid, the cement terminal is expected in 1986 to handle only 7000t OPC and 1500t SRPC or only 30-40% of last year's throughput. Some cement passes direct from the silos into the 12t bulk cement truck operated by John Howards the contractor for the East Coast Project. No other cements are handled though the company sometimes gets requests for coloured cements. There is obviously no scope here for a clinker grinding plant there being no local materials such as volcanic pozzolanas that could be made use of. The importation by the Government of cement in bags, particularly the larger shipments of 5000t, causes a considerable handling and storage problem. Wastage occurs and there are other losses and much of this 'gift' cement eventually enters the open market at as much as 33% below the R.751.80/t selling price for bagged cement imported in bulk from Kenya through the private sector. (It has recently been mentioned that a principal contractor on Mahe has been able to negotiate for cement at a lower price from Singapore).

Aggregates. The principal supplier of crushed (granite) aggregate for public consumption is United Concrete Products (UCPS). The granite is now extracted with updated equipment at the Brillant quarry requiring only 8-10 men there. The rock is then taken to the company's crushing and grading plant at Pointe Larue. All grades of granite aggregate are sold at R.135/t. Some quartz sand is sold at R.125/t and coral beach sand for R.100/t. The company finds that builders were not prepared to pay an extra R.5/t for the beach sand to be washed and in general customers are more interested in lower prices than the quality of the products. As a consequence standards of construction in houses, etc are said to have fallen. (Some building materials prices are given in Annexe 12).

The other major quarry operator is the Special Projects Unit (SPU) which is a Department within the President's Office. It's operation is based at Petit Paris where there is a mobile crushing plant. The quarry was originally opened to supply stone as 'armour' for the harbour construction. Now four grades of aggregate are delivered to the contractor's batching plant at the East Coast Project. SPU's plant has been supplied through bilateral aid. No allowance is being made for depreciation and at present it's aggregate is available only to Government departments including the East Coast Project at around R.90/t, i.e. 33% below the UCPS price. The management of SPU state that they have to operate as a commercial entity and try and get rid of any 'public works department' image that it may have. It is not clear, though, how SPU expects to finance any future plant renewal necessary if the replacement value of the present plant is not being amortized.

Blockmaking etc. UCPS is the principal producer of concrete blocks. These are the standard 18in X 8in and from 4 to 9in in width. (Some solid blocks 3in wide are also made). The hollow 6in blocks sell for R.4.70 and the 6in solid blocks for R.7.25. A mobile 'egg layer' system is used. Currently UCPSs block output is only around 900 a day compared with 4-5000 a day, or say 100,000 a month, normally.

There are several much smaller blockmaking operations both on Mahe and Praslin, and probably elsewhere. Locations known include Pointe Cedre (Anse Etoile), Pointe Conan, Plaisance and on Praslin by the Britannia Restaurant, Grand Anse and by the quarry near the airstrip at Amitie. Frequently blocks are made by builders at the site of the building under construction, as in the case of the new restaurant just built by the sea at Bel Hombre. A good example of a small blockworks is that by the bridge at Les Mamelles. Two manually operated moulds are used and 100 to 150 standard 4in solid blocks are made daily which sell for R.3.00 i.e. 20% below the UCPS price. The quality is quite good but could be improved if more attention were given to curing the blocks, even for up to 3 days covered by paper or palm leaves rather than left to dry out under the sun. (The same point is also valid, though, for the UCPS blocks).

Readymixed concrete. The only readymixed concrete operation on Mahe is that of John Howards, the East Coast Project contractor. The batching plant has a capacity of 25 cu.yd. an hour and there are two readymixed trucks in use. The contract is due to finish around mid-1987 and it has already been arranged for these items to be incorporated used in the SPU project now under construction.

Lightweight concrete. Equipment was imported in 1976 by Mr.Franco Boldrini for the production of 'beton cellulaire' i.e. lightweight insulating or structural concrete made from cement, sand and a foaming agent. It has been used on only three contracts, including the Central Bank, and the equipment is currently for sale. Further details are in Annexe 13.

House building. There is a housing deficit variously described as being 2,500 required now and then 300 a year (Payet 1986) or a target of 500 a year for the next 5 years (NCS). Government's aim is to build for R.1000-1200/sq.m. or say R.100,000 for a 90 sq.m. house. The actual building rate is said to be around 120-130 houses a year. According to Mr.Payet the bottleneck is money. Labour represents 35% of the cost and of the 65% for materials all is imported except for sand. Hence there is an imported element of at least R.50,000, say, in the cost of a house. The Seychelles Housing Development Corporation is the the main provider of funds for house purchase.

Pottery. Apart from the Polytechnic's Pottery School (see Annexe 14), the only ceramics manufacture is by the Seychelles Potters' Co-operative (SEYPOT) at Le Mamelles. Some details about its operation are given in Annexe 15. It's products are entirely hand thrown on six potters wheels and are sold to the hotel and tourist market. The current clay body is made up of 75% clay from Anse Soleil and 25% from Val d'Endor. Being kaolinitic with little fluxing components, it is still fairly porous even when fired at 1250oC. Attempts have been made to reduce the firing temperature by making additions of potash felspar without success so far. Technically one of SEYPOTs aims, when other commitments allow, is to try and reduce the firing temperature to Cone 6, i.e. approx 1200oC. Glazes have to be imported still and there seems little prospect of finding suitable local substitutes. Though the items sold are expensive even by local standards, SEYPOT claims to be able sell more than they can produce. Sales have been valued at R.22-23,000 a month and were R.30,000 in August 1986. The six potters forming the co-operative retain 42% of the price of their items that are sold and the remainder covers operating costs. SEYPOT is operating successfully and is the only co-operative in the industrial sector. There are two expatriates, funded through Voluntary Services Group (Seychelles), providing assistance with administration, sales and technological aspects of production. At present, as with the Pottery School, there is no readily identifiable Seychelles design or style in the products which would help to establish the

pottery in the art world and create more export demand. SEYPOTs policy seems to be to continue at present with what it knows how to do, developing steadily to recruit and complete the training of more potters in two years time and possibly extending its range to include, for instance, a limited number of individually designed large wall tiles or plaques having a recognisable Seychelles identity. It may well be that, apart from establishing a similar pottery co-operative on Praslin, SEYPOT represents the only viable form of ceramic industry that is possible based on Seychelles resources of clay. (In this context it is relevant to note that the CFTC funded expert Cooper (1985) suggested that a pottery to produce tableware would have to be based on 'fully prepared, imported, ready to use clay').

Water treatment. Since 1980 the Water and Sewerage Division of PUC has made considerable reductions in the quantity of imported chemicals required for water treatment. The details are given in Annexe 16. In essence the need to use imported soda ash to reduce the acidity of the raw water has been eliminated so far at three of the larger treatment plants and will eventually be entirely unnecessary. This has been achieved by utilizing the neutralizing effect obtained by passing the water through 50mm lumps of coral limestone obtained from the stockpiled material on the East Coast Project. In addition the consumption of chlorine has been reduced, by around 50%. In 1980 hydrated lime was tried from the small kiln at Petit Paris but it tended to clog the pipes. It is uncertain whether coral limestone has been used in this manner elsewhere. Whether it has or not it could be of interest and possible adoption where similar conditions exist in other countries. To this end Mr. Bernard MacGaw of the Water Quality Control Section based at Hermitage might like to consider whether this work would merit publication in an appropriate international journal.

Mineral water. Since 1981 the natural oligomineral water from a spring at Val Riche has been bottled by PUC. Annual sales are now around 0.75M litres, worth over R.3.0M, and it has been possible to eliminate the need to import mineral water.

Paint. Small amounts of industrial minerals are imported by the paint industry. These are listed in Annexe 17 but in no case is there an opportunity for substitution of local materials unless the coral limestone, when finely milled, can meet the fineness and whiteness specification of Filla 10 and 5, which total only about 15t/y or, less likely, the Snowcal 60M/L of which approx 12t/y is imported.

Brewing and soft drinks. SEYBREW also imports very small amounts of industrial minerals, also listed in Annexe 17. In no case could these be eliminated. At an early stage in the mission it was felt that there was scope for reducing the import of bottles by introducing more incentive to return promptly the many bottles seen lying around. After figures obtained from the brewery were discussed with the General Manager it was agreed that the scope

for any saving is limited and any change in the present system of refund, etc could cause more problems than it would solve.

Sand Blasting. Naval Services Ltd operates a shipyard at the New Port and includes sand blasting. Around 20t a month of locally obtained quartz sand is consumed.

Present and planned projects

Granite for Export. In July 1986 the Government signed an agreement with the GMR group, a private firm whose chairman is Mr. Mario Ricci, for a feasibility study to identify the commercial potential existing for the export of Seychelles granite. It is understood that GMR has commissioned an Italian firm of consultants to carry out the study. In September 1986 the locally based representative of GMR stated that the initial findings were that the world market is good and that they would be able to sell all they can supply and at a competitive price. The only problem would be to achieve a supply of the stone. The report had been completed and was to be presented to MND in October (Lauro 1986). (By the end of the mission the findings of the consultant's report for GMR had not been published). As stated earlier, any such venture has to overcome a major logistics problem if the pink granite, especially, is to be put on board freighters at a low enough cost.

Granite for Local Sale. A small team of North Koreans has been working since June 1985 based at the SPUs Petit Paris quarry operation. Training is being given to six Seychellois workers in manual methods, with chisels, wedges and bush hammers, for preparing and carving granite to make items such as grave stones, garden pots, kerbstones, etc. It is understood that US$200,000 of equipment, including cutting shaping and polishing tools, has been ordered from Italy and these should improve output and the unit cost of products. The project is intended to have an annual output of 1200 sq.m. In addition, in May 1986 the Small Industries Development Organization of the Ministry of Industry of the Indian Government, in its Feasibility Study report for Setting Up Small Industries in Seychelles (ref. Anon 1986) presented a Project Profile entitled Granite Cutting and Polishing. This proposes the production of 9000 sq.ft. a year of polished granite items, which are not specified but are indicated to be for use in construction of hotels, restaurants, etc. The granite boulders were to be chipped by manual methods and then fed to grinding and polishing machines. The proposed investment in equipment would be Rs.150,000. Neither of these two bilateral aid projects seems to be properly oriented so far to take account of present wage levels and aspirations of Seychellois workers which now require a much higher level of mechanization to achieve less drudgery and greater personal income levels.

One of three scholarships currently funded by French bilateral aid is for a Seychellois to be taught how to use granite as a material for sculpture.

Precast concrete panels. SPU is currently erecting a batching and precast yard at its Petit Paris quarry specifically to supply precast units for the erection of houses. (The plant was supplied some time ago through bilateral aid from the Sandino company of Cuba). The Government's intention is that the project will help alleviate the current housing shortage. It is not clear if the system was found to be suitable for local market conditions or to what extent it would have advantages over the present well established method of building with blocks. (Experience in the 1960's and early 70's in Europe has shown considerable problems and risks involved when systems of 'industrialized housing' have been tried and there has been a swing back in recent years to more traditional and well proven methods).

Artificial Marble. MND has been approached by an entrepreneur, already manufacturing in Kenya, with proposals for the production of artificial marble sanitary ware, etc. The process would use milled coral limestone and an imported resin. A possible joint venture has so far not been finalized. An existing Seychellois company has also been considering entering into such a venture but on the basis that the market for sanitaryware would be that resulting from the building of 500 houses a year, which at the present time is unrealistic. Crushed granite, as well as coral, was being considered as the local filler material. The imports of sinks, wash basins, bidets, water closet pans and urinals shown in Annexe 4 suggest that the value of such imported ceramic materials to be replaced by artificial marble is around R.1.25M. In addition there could be other outlets such as wall panelling.

Ceramics. Following the report Development of a Pottery by the CFTC expert (Cooper 1985), MND has been considering his proposal to manufacture tableware using mechanized plant (though this would require the importation of fully prepared raw materials). The present intention would be to leave SEYPOT to continue as it is and start the new factory when sufficient trained personnel become available from the Polytechnic. Cooper envisaged an investment of R.1.1M in plant, machinery and working capital.

Mother of Pearl. Following the study by UNIDO specialist Mr. Guntner the Government has signed a contract with him for the supply of equipment, etc for a factory to produce buttons, jewellery and also articles made from turtle shell and local wood. The factory is expected to be commissioned in July 1987. The Algerian Government has provided funds of US$245,000. MND understands it will not be necessary to use cultured shells as the existing locally available shells are adequate both in quality and number. Further technical assistance from UNIDO would be sought when the plant has started up and it is then possible to identify what type of expert assistance should be recruited.

Scouring powders. At present items labelled 'Vim' and 'Ajax' are imported. Around 70% by weight of the components of such scouring materials is a white filler powder. This can be 'extra fine sand or similar' or 15 micron size calcium carbonate. UWE Industries presently makes laundry soap, detergent materials, etc and is ready to make scouring powder at once if the Government provides some form of protection against the imported brands. The market for scouring powder is estimated to be around 40-50t/y and of this around 35t would be provided by local raw material in the form of finely milled coral limestone. Other industrial minerals or inorganic chemicals imported by UWE Industries are shown in Annexe 17 but there is currently no scope for replacing any by other local materials.

School chalk. Chalk Crayon is the title of another Project Profile put forward by the Indian Government Small Industries Development Organization team (Anon 1986). The profile describes making the chalks from a mixture of china clay and plaster of Paris produced from mineral gypsum, neither of which have been found to occur as available resources in Seychelles. (It may have been assumed that the gypsum would be obtained as a by-product of the defunct solar sea salt project). Production capacity is proposed as 90,000 boxes, each containing 100 chalk sticks. The total cost of the items of equipment proposed was Rs.25,000.

Ground glass. It was mentioned by the brewmaster of SEYBREW that around 1.5% of the 3,0M bottles imported annually, i.e. 45,000, get broken during handling and filling in the brewery. At 150g per bottle this is around 7t of green, amber and white glass. SEYBREW has a small hammer mill and is contemplating milling the broken glass to provide coloured sand for possible use by builders, etc.

Construction projects. The East Coast Project in progress will continue well into 1987 and is the principal construction activity. Due to start shortly is the new sewerage pipe system for Victoria, the capital. The third phase of the Victoria Hospital project is expected to begin in December 1986. Work on the BBC World Service Relay Station has begun near Barbarons Estate. The Tuna Canning Factory being built at Victoria will have a capacity of 8000t/y, employ 200 and will be the biggest enterprise in the country when it starts in June 1987. Still under consideration is the South Mahe Water Scheme. Originally planned to have a reservoir near Baie Lazare, the project may now be based on a larger dam to be constructed in the Grand Anse area.

Technical support to industry. Prior to recent changes in the administration at MND, TDU had been given responsibility for Standards, Quality Control and Metrology but the required range of equipment is lacking. A Standards and Construction Materials Laboratory was already planned. At present TDU is still working under very cramped circumstances in accomodation at Pointe Larue. There is an urgent need to move TDU to alternative premises which have been proposed at the site of the old technical school in

Mont Fleuri.

No centralized means exists for ensuring that the quality of local and imported materials and products is to the required specification. Discussions with people in the building and building materials industry have indicated that there has been a decline in local standards. As a consequence although the cost of building may have remained fairly steady, the quality and durability of housing and other buildings is considered to have depreciated.

TDUs programme has been primarily development work, especially on renewable energy, and advising Government on energy policy matters and appropriate technology. In addition, besides the recent inclusion of metrology, quality control and standards, including building materials, there is a UNIDO funded project for the establishment of a Science and Technology Documentation Centre. Unlike the work of the Grand Anse Experimental Centre, within MNDs Department of Agricultural Promotion, TDU currently lacks extension services to support existing industry, especially in the sector covered by this assignment.

The present state of industries producing, handling or consuming non-metallic rocks and minerals including building materials suggests that there has been a decline in its development, especially in the extent to which it has been able to effectively operate its plant and other facilities. Certain decisions in the past have meant that the fullest possible use of already existing facilities has not been obtained. Thus some plant has not been fully utilized and those industries have not been able to invest in new processing plant and product manufacture.

C. Findings and Results

Import trends

There was a sharp rise to 55t, worth R.43,000, in the import of slate in 1985. Since 1980 there has been a slight increase in the amount of natural sands imported though this had reached only 10.5t, costing R.24,100, by 1985. The amount of dolomite imported for agriculture is 15-20t a year; it may not all be replaceable by local limestone as there is said to be some magnesia deficiency. Salt imports fluctuate being nearly 800t in 1970 and 200-400t recently and costing around R.1400/t. The amount of chlorine is decreasing and was 26t, costing R.148,000, in 1985. Lime has not been imported recently. Portland cement reached 22,000t in 1980 and recently is around 15-17,000t which, valued at around R.10M, is the main item imported in the non-metallic mineral and building material sector. Contrary to opinions expressed, the value of ceiling panels, if they come under code 661.82, is relatively low at R.30-60,000 recently. Among ceramic items, by far the most

significant is under code 662.45 which includes the glazed ceramic tiles. This seems to have increased strongly to 400-500t recently valued at R.2.00M in 1985. After cement the next most costly item is glass bottles, including jars and pots, but being mostly for filling with alcoholic and soft drinks. Between 500 and 900t/y have been imported recently costing R.2-3M. Other major items are window glass (664.40) and glass vases, etc (665.21 to 89). Tableware, listed under pottery (666), is a quite significant item valued at R.4-900,000 annually. Sanitary-ware, such as sinks, water closets, etc, is currently costing around R.1.25M a year and so may indicate a reasonable market for 'artificial marble'. Despite there being local resources of mother of pearl, imports of articles made from it have increased recently to R.33,000 in 1985. This should decline with the start up of the local plant, in June 1987?

Indigenous resources of non-metallic minerals

Granite. This is the principal local mineral resource in volume terms but, apart from its important use as a source of aggregate, it is otherwise of very uncertain value. There is no published description of there being resources of commercially important varieties other than the common grey colour or the pink granite which occurs principally on Praslin. The frequent occurrence of bands of dolerite is a major inconvenience in quarrying operations. There is no well developed natural system of jointing or other regular breaks in the rock which normally would be made use of in quarrying stone.

Coral Limestone. The recent dredging and stockpiling of coral from the East Coast Project is a most useful new non-metallic mineral resource. The largest potential use, apart from road construction and fill, is as aggregate for lightweight or insulating blocks or possibly also in some cast concrete. Other important uses are in water treatment as being practised now for adjusting the pH, as agricultural lime for reducing soil acidity, as a fine white filler for scouring powder and possibly also in some paint formulations.

Sand. The lower reaches of streams flowing off the weathered granite soils are all likely to be potentially useful sources of sometimes quite clean quartz sand. Excessive build up of harmful salts is unlikely where some flow of fresh water occurs, even in the wider and tidal sections of the river estuary. Rain washed calcareous beach sands above the high water mark also may have low salt content and be suitable for mortars for brickwork and rendering. Such sands are of a fineness suitable for soil conditioning.

Clays. There are large resources of clayey material within the sometimes thick layer of red, brown and yellow (but rarely white) soils which have resulted from the weathering and decomposition of the underlying granite. These are mostly primary clays i.e.

still located where they originally formed. Much quartz is present and has to be washed out before the clay can be used for pottery. More rarely the deposit is secondary, i.e. has been transported by water and the clay become washed almost free of quartz sand. These are likely to be more suitable but are usually poorly exposed in the bottoms of stream sections or in marshy areas such as Mare aux Cochons on Mahe and Plaine Hollandaise on Praslin. (Plaine Hollandaise is a possible location for a new water reservoir). All these clays seem to be of the same type, i.e. highly kaolinitic with also much aluminium and iron hydroxides. To achieve a ceramic bond a high temperature is needed during firing and the porosity of articles may still be unacceptably high even after a temperature as high as 1250oC. The absence of other basic sources of alumino-silicate, such as volcanic ash, etc has meant that there is little or no prospect of finding other types of clay. (It has been mentioned, though, (Boldrini, 1986) that the mud in the bottom of the small boat harbour has quite different ceramic properties - no further details are known but this could be worth investigation by SEYPOT and the Pottery School).

Red Earth. This clayey and usually also sandy soil can be extracted from numerous locations on the granitic islands. Although not being used at present as a building material there is plenty of evidence that it can be used successfully for building walls, provided some precautions are taken to protect it from rainwater and possible invasion by termites. Internationally there is now much new interest in earth as a building material, e.g. in France and previously in Egypt, etc.

Guano. Baker (1963) estimated the resources of guano still available then on "islands having substantial deposits where extraction for export could be revived or continue for many years" as being:

	Tons
St.Pierre	10,000 to 15,000
Astove	About 5,000
Assomption	160,000
Desnoeufs	24,000 to 32,000

The average amount exported over the last five years until the final recorded export in 1981 was 4,700t annually. Recently, a survey understood to have been carried out by BRGM of France (Anon 1980's?) has suggested that very much larger phosphate resources exist. The conclusion reached by the survey is that exploitation can be envisaged as follows (unverified translation of the original French):

> Restart mining on Astove and Assomption to produce 10,000t for 8 to 10 years.

Study the feasibility of using the phosphatic sands, especially on Marie-Louise, Alphonse, Farquhar, Astove and Desroches, for local agriculture.

Study the potential of deposits of phosphatic sediments in the lagoons on Alphonse, Farquhar, Astove and Cosmoledo which, if proved, may represent large reserves (suggested as being possibly of the order of tens of millions of tonnes) and which could be the basis of a large scale mining operation.

By-product lime. Around 1Ct/y of hydrated lime, Ca(OH)2, (known in the industry as carbide lime) is being produced at the acetylene plant of L'Air Liquid at the New Port. There is already an accumulation of 3-4t for disposal to whoever wishes to collect and use it. This material is white and has virtually all the potential uses of normal hydrated or slaked lime, though not for any treatment of water for drinking.

Mother-of-Pearl. The available resources of this sea shell were not verified during the mission. Contrary opinions were received as to whether or not it would be necessary to cultivate mother-of-pearl to ensure that adequate quality and resources of this raw material would be available. Plant for manufacture of articles is due to start in June 1987 following technical co-operation provided by UNIDO project SI/SEY/82/803: Development of Mother-of-Pearl Manufacture.

Potential new industries or products

Following his comprehensive survey of the mineral resources of Seychelles, Baker (1963) concluded that "the islands do not contain any economic mineral deposits of large value that could revolutionize the economic situation". Even so, "the full utilization of local materials wherever possible can help the Seychelles economy a little by reducing the amount of imports". This latter point is very much Government's policy today, as exemplified, for instance when the President recently suggested that it would be better to make more use of Seychelles' own flowers rather than be importing the artificial variety (Rene 1986).

With the possible exception of new industries based on the current stockpiles of coral limestone the situation still seems much as it appeared to Baker in the early 1960's. This present survey has endeavoured to identify or confirm whatever possibility may exist of achieving additional exploitation of local non-metallic mineral resources, including an industrial by-product chemical.

Products based on stockpiled coral limestone. There are various potential uses for this material in addition to the present land reclamation, road construction and as fill for building sites. There is scope for establishment of a small, crushing, grading

and milling operation, to supply grades of this limestone as follows:

Some coarse material, around 50mm, to complete the present and future needs of the water treatment plants.

A medium grade up to about 25mm for architectural use, to reflect heat from surfaces, various decorative applications, e.g. as exposed aggregate on walls, in gardens, etc.

Material around 2 to 12mm suitable for manufacture of extra-lightweight hollow concrete blocks or in situ insulating concrete.

A fine grade, probably less than 2mm, (but depending on the recommendation of the Department of Agricultural Promotion), for use as a soil conditioner, particularly for correcting soil acidity before the application of fertilizers.

Another fine grade to the fineness specification required for manufacture of artificial marble. (If MND decides not to have a joint venture with a foreign entrepreneur, it may wish to consider proposals that a Seychellois company is understood to be preparing and which already has technical know-how in making resin bonded mouldings).

An extra fine grade, up to 15 microns, suitable as the basis (around 70% by weight) of scouring powders.

Depending on degree of whiteness, and other physical requirements, an ultra fine grade for use as a filler in plastics and an extender in paint formulations.

Whitewash. The 'carbide' hydrated lime from the acetylene plant has many uses, particularly in building work. As the quantity available now is only about 4t with around 10t annually in future, any commercial exploitation of it should aim to produce a product that competes with high cost alternatives and thus sell for as high a price as possible. The obvious market is white decorative paint and also whitewash for marking out sports grounds, etc. In addition to plain 'whitewash', there is scope for making waterproof grades by use of simple formulations that include salt, tallow and possibly other fatty or oily compounds.

Granite paving. There may be a market locally for some form of polished floor tile or paving stone. One builder is able to make concrete paving slabs with polished granite aggregate surfaces. The import statistics show a big demand for glazed ceramic tiling, costing R.2.00M in foreign currency. A way is needed of economically preparing, cutting and polishing local granite, primarily as stone paving, and using the waste in polished granolithic floor tiles. (Such an industry here needs a high degree of mechanization; labour intensive methods are not viable).

Ceramics industry. From consideration of the available raw materials, fuel costs, lack of adequate market for structural clay products, etc the possibilities for any extension of the present ceramics activities in Seychelles is very limited. There appear to be no local, natural advantages which would ensure the success of a factory for tableware, for example. Despite its high costs, SEYPOT is currently a successful and significant venture. If there is Government will to extend the ceramics industry then a replica co-operative pottery, with any appropriate improvements, e.g. resulting from SEYPOTS own experience, might be established on Praslin. Such a new ceramic venture could begin by making slip cast or jiggered pots or other containers for the packaging of high class local food products for export and tourist sales. (Unless shown otherwise, say by trials at SEYPOT, the clays on Praslin may be more difficult for pottery making than is already the case on Mahe).

Technical and other support

Support is needed to assist Government to move the present TDU into improved accomodation, re-establishing it as the new Technological Support Services Section, comprising R&D Unit, Seychelles Bureau of Standards, Hydrology and Metrology Unit and the Laboratory Services Unit. The latter will include the Construction Materials Laboratory. Additional training is needed for staff recruited to provide direct technical assistance to industry. (A draft project document is in preparation for submission to UNIDO)

It is believed that recent changes in the administration at MND will result in much closer official support for the role played by local industry in national development. For example, the important facility at the New Port for unloading, storing, despatching and bagging bulk deliveries of cement is presently working very much under capacity (see Annexe 11). This is due to some large deliveries of cement being allowed to be imported in bags, with all the various problems that causes. Government may wish to review this policy in future though encouraging the seeking of alternative quotations so as to keep the price paid from rising above the general level of international prices available for this part of the Indian Ocean.

II. UTILIZATION OF THE RESULTS

It is not known to what extent the results of the mission's work will be used. The only case in which a finding may already be being made use of is as a result of publicity given during an interview with RTS to the by-product lime available at the acetylene plant.

It is likely that the proposal to conserve for industrial uses around 5000t of the stockpiled coral limestone can be implemented straightaway. SPUs batching plant will have a storage hopper available to take coral limestone. (Although able to crush the coral and grade it into sizes down to 5mm, special milling equipment would have to be found and installed for making the fine powders that have been suggested)

Technical co-operation for establishing the new facilities for MNDs Technological Support Services Section, welcomed by the Government depend on UN and/or bilateral funds being available to meet the likely costs of equipment and technical assistance.

III. CONCLUSIONS

In general, with the exception of the now available stockpiles of coral limestone, the opportunities for an increased utilization of the non-metallic rocks and minerals have not changed greatly since the last major survey which included these resources, carried out in 1961 (Baker 1963). Institutional facilities for testing of local raw materials, building materials etc and for carrying out other work in support of industry are currently being reorganized in a manner appropriate to the Nation's present stage of development.

Stockpiled coral limestone

There are existing and potential industrial uses for this material, which is high in calcium carbonate, in addition to the reclamation and road fill for which it has been dredged. There are potential applications in lightweight concrete, agriculture, artificial marble, scouring powder and possibly plastics and paints in addition to its present use in water treatment.

By-product lime

Although relatively small in resource terms, the existing 3-4t of hydrated lime and 10t annually in future from the acetylene plant is valuable and before long the company will be forced to dump it. There is an immediate application at the National Stadium to replace the expensive imported paints costing, it is said, the equivalent of US$600 in foreign currency, and used to mark out the football pitch and running track, as well as at other sports grounds. The other applications of normal hydrated lime are possible such as for plasters and effluent treatment though not for treating drinking water.

Cement

Importation of Portland cement in bags is resulting in losses and makes handling and storage more difficult compared with importation through the existing bulk handling and bagging facility.

Guano

The remaining resources identified in 1961 appear to have been very much increased by a survey specially carried out recently. Estimates now suggest there may be tens of millions of tonnes in the lagoon areas of Alphonse, Farquhar, Astove and Cosmoledo, compared with only about 0.25Mt estimated previously as being available for exploitation from various islands.

Granite

The findings of a new study of the feasibility of marketing Seychelles granite internationally are currently awaited by the Government. To date it is not clear that any colour of local granite is of interest for export and the logistical problem of quarrying, preparing, transporting, handling and loading onto freighters is still not solved.

Polished flooring and paving is probably the best market for granite for local sale. The present range of products being demonstrated and the labour intensive methods used are not appropriate to local conditions.

Pre-cast concrete houses

It is not clear that there is a local market for 'houses from the factory' or that their erected cost can compete with comparable houses constructed from the well accepted concrete blocks.

Sand

There is a need for locating additional resources of quartz sand for building and other purposes, including sandblasting. Survey work could be initiated, in the lower levels of streams running off the granite soils, using a local soil surveyor or other specialist. Otherwise a foreign expert could be recruited to assist the proposed Mineral Resources Group within TSSSs R&D Unit. The expert would have to be provided with the necessary local support facilities, such as 4-wheel drive vehicle, sampling equipment and assistant personnel.

Clays

Evidence so far from testing and local pottery production, as well as the apparent lack of market for structural clay products, indicate that any ceramic industry based on local clays should continue along the lines followed successfully by SEYPOT. Testing in the Seychelles of clays from Praslin, coupled with a short feasibility study, may show that a new pottery can be launched and located on that island. Local manufacture of glazed wall tiles would not be competitive with the cheap imports now costing R.2.00M annually but individually crafted and well designed decorative tiles could be successful in addition to the handthrown items now being sold to the hotel and tourist trade.

Libraries and archives

The present MND library on the second floor of Independence House contains many technical reports of value to the work of visiting consultants. In several instances there are multiple copies. References are no longer in separate subject groupings and finding required documents is now difficult. The National Archives at La Bastille is not receiving copies of all documents, reports and other papers (which is understood to be required by law).

Private industry

The non-metallic rock and mineral sector of industry, including much of the production of building materials, is mostly in the hands of relatively small private companies, many of which are family-run businesses. These have accumulated, over many years usually, an invaluable expertise and entrepreneurial capacity. There are indications that this sector has not developed in recent years as one might have hoped or has even declined.

Technical support to industry

The Technology for Development Unit of the Ministry of National Development urgently needs to be relocated and re-established as the proposed new Technological Support Services Section. Compared with the former TDU, TSSS needs to be oriented more to supporting existing and planned industries and products by offering extension services. Government would welcome support from UNIDO and/or bilateral technical co-operation for the purchase of remaining items of equipment for testing of construction materials and training in Seychelles of laboratory staff by experts in selected technical disciplines. (It is hoped to be able to submit a draft project document by the end of the mission).

ANNEXE 1

JOB DESCRIPTION

U N . T E D N A T I O N S

26 November 1985

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
(UNIDO)
Request from the Government of Seychelles

JOB DESCRIPTION
SI/SEY/86/801/11-51/32.1.B

Post title	Consultant in Non-metallic Mineral Resource Development
Duration	Two months
Date required	As soon as possible (at the latest mid-January 1986)
Duty station	Victoria, Seychelles, with travel in the country
Purpose of project	Assistance to the Government in their planning activities, for the promotion of new commercial and industrial areas, to enhance the increased use of indigenous natural and human resources.
Duties	The consultant will be attached to the Ministry of National Development and he is expected to:

- Review and appraise the locally available data and information on the mineral resources of the islands.
- Identify potential areas of developing new industries and/or products to promote the increased utilization of locally available industrial minerals.
- Investigate the performance of existing industrial set-up, specifically the building materials and pottery making industries, providing support to known sectors e.g. tourism, and identify further needs for technological changes and improvements for training in production and marketing techniques.
- Prepare a report setting out a strategy for the development and strengthening of non-metallic mineral based industries in the country, giving

advice on the short and long term measures to be taken to initiate further investigations relevant to the exploration and exploitation of potential rescurces.

- The expert is also expected to prepare a technical report setting out the findings of his mission and his specific recommendations to the Government.

Qualifications A specialist with minimum of 10 years experience in the planning and development of no-metallic mineral based industries.

Language English

Background The Seychelles archipelago comprises 92 islands but information 97% of the population lives in the three main islands: Mahe, Praslin and La Digue. The total population amounts to 62,000 of which 50% are under 20 years of age. The economy was traditionally based on farming but now mainly depends on tourism.

A UNIDO project SI/SEY/82/801 assisted the Government during the period November 1983 - December 1984 and its investigations for the establishment of heavy clay and ceramic industries. In this connection, some indigenous raw materials samples were collected by the project experts and tests were carried out abroad. In view of the recommendations made by UNIDO and the raw material testing results, the government requested to review future follow-up possibilities with UNIDO and in this respect a TRM was held in Mahe Island on 11 December 1984. During the meeting, the Government indicated their plans to establish a National Resource Development Programme and urged UNIDO to provide 2 m/m assistance to support the preparatory studies related to the non-metallic mineral resources.

APPENDIX 2

ORGANIZATIONS AND INDIVIDUALS CONTACTED

Organization	Personnel	
Ministry of Planning & External Relations National House, Box 656, Victoria Tel: 24041.Tlx:2260 MINHAE	Mrs D.De St.Jorre Mr. Alain Payette Mr. Alan Lloyd	Principal Secretary Econ Coopn Officer Chief Engineer East Coast Project
Ministry of National Development,(MND) Independence House, Box 199, Victoria. Tel: 22881	Mr. Georges Payet	Principal Secretary (until 19.09.86)
MND: Industry Divn.	Mrs. M.MacGaw Dr.S.Gendron Mr.Brian Morel	Under Secretary Principal Secretary (from 20.09.86) Ind Dev Officer
MND: Land Use Planning and Environment Division.	Mr. Alain Roux	Head
MND: Information Systems Div.	Mr. Errol Dias	Chief Statistician
MND: Technology for Development Division, Anse aux Pins Tel:76631	Dr.S.Gendron Mr.Radley Weber	Chief (to 19.09.86) Tech Dev Officer
MND: Department of Agricultural Promotion Soils & Plant Diagnostic Laboratory, Grande Anse Tel:78427/78252	Mr. Clifford Adam Mr.Anton Moustache	Director
Ministry of Education and Information, Mont Fleuri Tel: 44030	Mr. Guy Lionnet	Senior Education Officer, author,etc

Special Projects Unit Box 691, Victoria Office tel:21970 Quarry tel:22206	Mr.W.P.B.Noad Mr.Bob Hall	Director Materials Superintendent
Delegation of the European Communities, Box 530, Victoria, Tel: 23940	Mrs.G.De San	Assistant to the Delegation
U.S.Embassy, Victoria House Tel:23921/2	Mr. David Bus	Admin. Officer
Indian High Commission Le Chantier, Victoria Tel: 24489	Mr. B.N.Sudheendra	Commercial Officer
Fed Rep Germany Consulate Storey House Victoria Tel: 22306	Herr Eichler	Consul General
British High Commission Victoria House Tel: 23055/6	Mr. G. Greaves	Deputy High Commissioner
Cuban Embassy, Economic Office, Bel Air, Victoria Tel: 24461	Sra Alicia Bordas Sr M. Rodriguez	Head of Office Exec Interpreter
USSR Embassy Le Niol Box 632 Victoria Tel: 21590/23122	Mr. Demetrie Riabov	
French Embassy Mission de Co-operation, Mcnt Fleuri, Victoria Tel: 22190/22015	Mlle.D. Robin	Head of Mission
Chinese Embassy Plaisance, Box 680 Tel: 44295/44279	Mr. Zhu Yongzhang Mr. Zhang Jinhai	First Secretary Economic Attache and Interpreter
Public Utilities Corpn(PUC) Water & Sewerage Division Unity House, Victoria Tel: 22321 ext.275	Mr. S. Rousseau,	Water Manager
PUC: Water Qual Control Section Hermitage Treatment Plant Tel: 22771	Mr.B.MacGaw	Officer in charge

Development Bank of Seychelles Box 217, Victoria. Tel: 24471/2	Mrs G.Thomas	Deputy Director
National Archives La Bastille, Box 720 Tel: 21330	Mrs. F.Sinon	Archives Assistant
Nation Newspaper, Press Office, Union Vale. Tel: 24220	Mr. Richards Karunairajan	Features Editor
Seychelles Fishing Authority Fishing Port,Victoria Box 449 Tel: 21297	Mr. Philip Michaud Mr.Francoise Marie	General Manager Manager Tuna Canning Project
Seychelles Tea & Coffee Co. Ltd, Box 184, Victoria. Tel: 78221 Tel: 24444	Mr. Ranjan	General Manager
Seychelles Marketing Board (SMB), Fish Division Long Pier, Box 71 Victoria, Tel: 21909/22217	Mr. R.W.Doughty	Operations Manager
Seychelles National Oil Co Kingsgate House, Box 230, Victoria Tel: 22282/3	Mr.Surya N.Khanna	Petroleum Technical Adviser
National Consultancy Services Ltd (NCS), Mont Fleuri, Box 31. Tel: 21235 Tlx: 2315 NCSL SZ	Mr. C.M.H. Tirant	Architect
Penlac Co Ltd (Paint manufacturer) Le Rocher, Box 368 Tel: 21707/8	Mr. O. Montocchio	Manager

UWE Industries Seychelles Ltd, (Soap,detergent manufacturer) Le Rocher, Box 381 Tel: 22150. Telex: SZ2280	Mr.J.Kwast	Managing Director
Seychelles Breweries Ltd., Le Rocher (Brewery) Box 273. Tel: 22209	Mr.W. Trautner	Brewmaster
United Concrete Products (Seychelles) Ltd, Box 382, Victoria. Tel: 76600/9	Mr. J. Albert	Manager
Seychelles Potters' Co-operative Les Mamelles, Box 669. Tel: 44080	Mr. David Duncan	Production Manager
Seychelles Polytechnic Department of Art and Design, Mont Fleuri, Tel: 23898	Mr.Rodney Payette	Ceramics Instructor
Soc d'Exploitation de Granite (Seychelles) Ltd (now defunct) Tel: 21400 Home tel: 21305	Mr.W. Jackson	Former Director
GMR Group, (Granite project) Sans Souci. Tel: 78221	Mr.G.C.Lauro	Commercial Manager
Larue Glassworks (pty)Ltd (Fibreglass products) Pointe Larue Tel: 76833/76831 Tlx: 2279 larue sz	Mr.Walter Larue Mr.Baudouin Jacobs	Managing Director
L'Air Liquide (SEY) Ltd, Box 262, Victoria Tel: 22723 Tlx: 2294 mel sz	Mr. Roy Wheeler Mr. Y. Govinden	Director Manager
WEL Supplies Division Huteau Lane, Victoria Tel:22901	Mr. Benilde Cedras	Supplies Manager

BODCO Ltd Building Materials Suppliers Harbour Trading Estate Box 270, Port Victoria Tel: 23009	Mr. Basil Soundy	Director
Cement Co (Seychelles) Ltd New Port, Box 479, Victoria Tel: 22168	Mr.A.Jean Baptiste Mr. Rene Widmer	Manager Director
Allied Builders Seychelles (pty) Ltd, P.O.Box 215, Les Mamelles Tel; 22367 Tlx: 2339 allbld sz	Mr. B.K.Patel	Director
Hughes & Polkinghorne, Chartered Architects, Shalom, Francis Rachel St., Le Chantier. Tel: 22946	Mr. Jack Moulinie	Architect
Barker & Barton Seychelles, Box 457, Victoria House, Victoria. Tel: 22750/23866	Mr. Roger Alan	Quantity Surveyor
John Howards, East Coast Project Contractor, New Port, Victoria. Tel: 24051/2	Mr. Malcolm Souter	Project Manager
Beton Cellulaire, Ma Joie. Tel: 41276	Mr. F. Boldrini	Director
National Stadium, Victoria	Mr. G. Boniface	Groundsman
Naval Services Ltd, New Port, Victoria. Tel: 22026	-	-

ANNEXE 3

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ANNEXE 4

SELECTED IMPORTS INTO REPUBLIC OF SEYCHELLES

Current (Oct.1986) exchange rate approx. Rp.5.99 to US$

t. = Tonnage in metric tonnes
R. = C.i.f. value in thousands of Seychelles Rupees,
- = nil or less than half in the final digit
0.0 = less than 100kg in weight or less than R.100 in value
n.e.s. = not elsewhere stated
n.l. = not listed

Section 2, Crude Materials, Inedible, except Fuels.
Division 27: Crude Fertilizers and Crude Minerals (excluding coal, petroleum and precious stones):

271.20 Sodium nitrate, natural

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	n.l.	n.l.	n.l.	n.l.	n.l.	0.20	0.68	0.22	1.00

271.40 Potassium salts, natural, crude.

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	n.l.	n.l.	n.l.	n.l.	n.l.	0.35	1.48	-	-

273.11 Slate

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	n.l.		57.4		19.0	2.88	3.28	55.77	42.68
		(inc marble,granite)							

273.12 Marble, travertine and other calcareous monumental and building stone of s.g.+2.5

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	7.0	(	see slate		)	1.1	3.8	135.8	263.2

273.13 Granite, porphory, basalt, sandstone and other monumental and building stone, n.e.s.

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
(		see	slate		)	2.2	7.2	2.0	20.6

273.22 Limestone flux and calcareous stone commonly used for the manufacture of lime or cement

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	2.2	n.l.	8.7	2.2	10.2	3.4	3.5	-	-

273.24 Calcined gypsum and plasters

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
(	see	limestone	etc	above)		0.2	0.7	1.3	1.5

273.30 Sands natural, not metal-bearing

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	n.l.	n.l.	10.1	2.6	12.4	5.0	8.6	10.5	24.1

277.21 Dust and powder of natural or synthetic precious or semi-precious stones

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	n.l.	n.l.	n.l.	n.l.	n.l.	0.0	0.2	-	-

277.22 Pumice stone; emery; natural corundum, garnet and other natural abrasives n.e.s.

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	n.l.	n.l.	n.l.	n.l.	n.l.	0.0	1.0	0.0	1.6

278.21 Clay eg., kaolin and bentonite, andalusite, kvanite and sillimanite,mullite, chamotte

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	n.l.	n.l.	n.l.	n.l.	n.l.	5.2	18.0	2.5	11.7

278.23 Dolomite

1970		1975		1980		1984		1985	
t	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	n.l.	n.l.	n.l.	n.l.	n.l.	14.1	45.8	17.5	18.7

278.24 Magnesium carbonate, natural, fused and deadburned

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	n.l.	n.l.	n.l.	n.l.	n.l.	0.0	0.0	-	-

278.30 Common salt, pure sodium chloride, salt liquors, sea water.

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
789.7	81.2	381.7	277.6	287.6	383.4	408.7	591.7	195.6	271.3

278.40 Asbestos

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	n.l.	n.l.	n.l.	n.l.	n.l.	0.1	3.6	0.0	1.3

278.91 Chalk

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	n.l.	n.l.	n.l.	n.l.	n.l.	2.0	4.5	19.3	31.0

278.93 Natural steatite; talc

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	n.l.	n.l.	n.l.	n.l.	n.l.	0.0	0.2	-	-

278.95 Siliceous fossil meals and similar earths, s.g. 1.0 or less eg., kieselguhr, diatomite and tripolite

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	n.l.	n.l.	n.l.	n.l.	n.l.	0.0	0.3	-	-

Section 5, Chemicals and Related Products, N.E.S.,
Division 52: Inorganic Chemicals

522.13 Chlorine

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	n.l.	n.l.	56.5 (Cl etc)	n.l.	n.l.	37.2	446.0	26.1	148.0

523.23 Neutral sodium carbonate

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	n.l.	n.l.	n.l.	n.l.	n.l.	18.7	35.0	0.0	1.7

Note: In 1979 the Water Department purchased 75t of soda ash costing R.145,000.

523.93 Calcium carbide

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	n.l.	n.l.	n.l.	n.l.	n.l.	8.0	32.1	6.0	23.9

Division 56: Fertilizers, manufactured.

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	18.6	n.l.	39.5	(see items below)					

562.11 Ammonium nitrate

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
(see 56 above)				10.0 (inc 562.14)	22.6	20.0	26.7	0.0	0.0

562.14 Calcium nitrate, magnesium nitrate.

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
(see	56	above)		(see 562.11)		0.0	0.0	0.0	1.2

562.29 Mineral or chemical fertilizers, phosphatic, n.e.s.

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
(see	56	above)		n.l.	4.6	26.0	52.6	-	-

562.31 Potassium chloride

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
(see	56	above)		n.l.	0.4	46.0	96.9	1.8	26.9

562.32 Potassium sulphate

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
(see	56	above)		(see 562.31)		10.0	26.8	36.0	110.3

562.91 Fertilizers, n.e.s., containing N,P and K.

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
(see	56	above)		n.l.	3.0	121.8	264.6	59.4	251.3

Section 6, Manufactured Goods classified chiefly by Material.
Division 66: Non-metallic mineral manufactures, n.e.s

661.10 Lime

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	1.4	2.5	1.0	23.0	51.8	n.l.	n.l.	n.l.	n.l.

661.20 Portland cement, etc.

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
26.9	3305	10204	2738	21938	13499	10666	10235	17328	10527

661.82 Panels, boards, tiles, etc of fibre, straw, wood waste, etc agglomerated with cement, plaster, etc

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	207.4	n.l.	159.1	113.1	786.3	13.2	60.1	1.6	34.5

661.83 Articles of asbestos-cement, of cellulose fibre-cement, etc

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
(see		661.82	above	)		555.6	1212.3	13.5	32.7

662.30 Refractory bricks and other refractory materials

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	3.0	n.l.	10.6	0.0	0.5	0.0.	0.4	15.7	122.7

662.40 Non-refractory ceramic bricks, tiles, pipes, etc

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	94.8	(	see		items		below		)

662.41 Bricks

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
(see 662.40)		n.l.	5.8	n.l.	n.l.	n.l.	n.l.	22.4	52.0

662.42 Roofing tiles, chimney pots, architectural ornaments,etc

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
(see 662.40)		n.l.	230.3	n.l.	103.7	50.9	533.7	9.4	40.4

662.44 Unglazed ceramic setts,flags, paving hearth and wall tiles.

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	n.l.	n.l.	154.4	91.5	333.0	19.8	137.6	34.5	169.9

662.45 Glazed ceramic setts, flags paving, hearth and wall tiles

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	n.l.	n.l.	389.9	140.6	857.3	428.8	1939.4	466.4	2007.3

663.10 Hand polishing stones,grinding and cutting wheels,etc of natural stone, artificial abrasives, etc.

1970		1975		1980		1984		1985	
t.	R	t.	R.	t.	R.	t.	R.	t.	R.
n.l	35.3	n.l.	17.4	n.l.	82.7	4.4	122.7	5.8	182.9

663.20 Natural or artificial abrasive powder, on fabric or paper, etc

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	3.3	n.l.	87.1	7.3	261.2	5.3	199.5	9.3	350.6

663.81 Fabricated asbestos and articles thereof

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	23.4	n.l.	13.5	n.l.	n.l.	6.1	82.9	27.2	212.1

663.82 Friction material

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
(see 663.81 above)				2.1	183.3	1.9	201.4	2.4	280.1

664 Glass

664.40 Cast,rolled,drawn or blown glass

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	n.l.	n.l.	488.9	153.0	1031.9	528.6	2091.6	96.9	768.9

664.60 Glass bricks, tiles, slabs, paving blocks

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	n.l.	n.l.	n.l.	n.l.	n.l.	3.7	35.6	0.3	12.2

664.70 Safety glass

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	n.l.	n.l.	n.l.	n.l.	n.l.	2.3	97.7	1.8	106.6

664.80 Glass mirrors

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	12.7	n.l.	54.6	n.l.	481.4	10.2	275.4	7.8	229.4

664.90 Glass,n.e.s. inc glassfibre

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	269.2	n.l.	135.7	20.7	304.2	(see items below)			

664.91 Glass cast, rolled, drawn, cut to other than rectangular shape

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
(see 664.90 above)						8.0	194.7	0.3	15.3

664.94 Glass fibre, and articles

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
(see 664.90 above)						(10.2	214.3	10.2	170.3

665 Glassware:

665.11 Carboys, bottles, jars, pots, for conveyance and packing of goods.

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	6.7	n.l.	460.2	763.4	5583.3	481.1	1933.0	888.8	2811.5

665.21,29,81,89 etc Glass vases, glass, other, etc

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	66.3	n.l.	644.9	88.9	3161.0	80.8	2099.4	78.2	1394.7

666 Pottery, inc tableware and ornaments

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	45.5	n.l.	290.2	35.0	901.3	15.6	373.2	22.0	635.0

674.00 Universals, plates and sheets of iron & steel

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	1101.6	(	see		items		below		)

674.80,92 & 99 Sheets and plates of iron or steel, corrugated, chanelled, ribbed, of high carbon steel (i.e. mainly the corrugated galvanized iron roofing sheets?)

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
(see 674 above)		n.l.	883.5	245.1	598.7	152.4	656.7	60.3	321.5
		(674.80)		(674.99)		(	674.92		)

Section 8: Miscellaneous Manufactured Articles
Division 81: Sanitary, Plumbing etc Fittings, n.e.s.

812.20 Sinks, wash basins, bidets, water closet pans, urinals, baths, etc of ceramic materials

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	95.0	n.l.	476.0	79.3	1611.1	n.l.	1208.8	n.l.	1305.3

Division 89: Miscellaneous Manufactured Articles, n.e.s.

899.12 Worked mother of pearl and articles thereof

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	n.l.	n.l.	n.l.	n.l.	n.l.	n.l.	19.2	n.l.	32.8

899.19 Worked vegetable or mineral carving

1970		1975		1980		1984		1985	
t.	R.	t.	R.	t.	R.	t.	R.	t.	R.
n.l.	n.l.	n.l.	10.6	n.l.	69.7	n.l.	35.4	n.l.	0.9

ANNEXE 5

GRANITE DATA AND SOME LOCATIONS

Ref: K.Suwa et al. Geology and Petrology of the Seychelles Islands. Eighth Preliminary Report of African Studies, Nagoya Univ. March 1983. (The Japanese team of six visited Seychelles in Sept-Oct 1981).

Grey granite (of the grey granite - gneissose grey granite series) makes up the main part of Mahe. It is grey to greenish grey, coarse grained, equigranular and massive with no foliation. It occurs in a stock like form, discordantly emplaced in the gneissose granodiorite, to the NW of Port Victoria. The gneissose grey granite which is grey to white-grey, occurs in islets east of Port Victoria such as Cerf. The pink granite (of the porphyritic granite - pink granite series) occurs sporadically from the airport to Anse Royale and in a 6 sq.km body in Baie Lazare village on the SW coast. It is salmon pink to brownish pink in colour, coarse grained and equigranular.

Granites of the Seychelles are essentially hornblend-bearing and alkalic, with the hornblend somewhat sodic and the main felspar usually a perthite with a minimum amount of albite-oligoclase as discreet grains. The granites are intruded by dolerite dykes.

New Age Determinations

713 ± 19Ma for the gneissose granodiorite and
683 ± 16Ma for the porphyritic granite of Mahe island
60 ± 4Ma for the diorite at North Island

Geological Maps

The Japanese team revised the geological map of Mahe - see Fig.1 on p.7 of the paper - and made a geological sketch map of the Mahe-Praslin Group - see p.9 of the paper.

Pink Granite

Besides Praslin, there are occurences of pink granite on Mahe as well. The largest is around 6 sq km at Baie Lazare Village. At least three other outcrops occur from the Airport, at Ile du Suete, southwards to Pointe au Sel.

Composition

	Grey %	Pink
SiO2	75	73.7
Quartz	31.2	25

Syenite of Silhouette and North Island:

Chemical Composition %		CIPW Norm Composition (%)	
SiO2	60	Quartz	0.8
Na2O	5.87	Orthoclase	27.42
K2O	4.64	Albite	49.67
CaO	2.45	Anorthite	6.28

Origin of the Seychelles

It is concluded in the paper from the normative ratio of Or to Ab that the Seychelles came from an area around NE Sudan and Northern Somalia as the Or/Ab ratio is similar to granites in that region rather than to granites in the Malawi/Mozambique area.

Other Information Obtained About Granite Locations

Brillant Quarry. Opened up recently by UCPS about 1km north of the SPU Petit Paris quarry. Said to be free of dolerite?

Petit Paris Quarry. Worked by SPU. Present face is limited due to the increasing height westwards and houses to the south. The face is being cut now to three levels. A new face has been cleared on the north-west side to be quarried when future contracts require it. There is water in the joints and fissures.

Police Bay. Right at the south end of Mahe, a quarry with a face approx. 15ft high was opened up by Italians but no blocks were ever exported from there. (Granite from here is being worked by the North Korean team based at SPUs Petit Paris quarry).

Grande Anse Estate. At the back of the Agricultural Research area on the east side of the road between the saw mill and the teacher's houses. It was here that the Soc. d'Exploitation de Granite (Seychelles) Ltd cut 40 to 60 2m blocks for export in 1983. A blueish tinge is said to occur in some granite here. (A greenish-grey was also among the granite sent to Italy, as well as the pink from Praslin).

Cap Samy, Praslin. Boulder outcrops exist on land belonging to Dr. Markham. Visited by Mr. Andrew Kinloch of SPU and North Korean team 15.07.86 and reported in memo to Mr. Noad, Director of SPU. Also a government quarry there, now with shock fissures as well as natural, following blasting to get (pink) granite for the Maison du Peuple. It is well exposed at the headland on the beach.

Mont Plezir in Anse Kerlan, Praslin. Mentioned by Mr. Kinloch as having mostly pink-white and black granite as also does the WEL quarry.

The depth of weathering of the Mahe granite has been reported to be as much as 17m.

ANNEXE 6

STOCKPILE OF CORAL LIMESTONE AND OTHER LIMESTONE RESOURCES

Information from Alan Lloyd, Chief Engineer of the East Coast Project, Mahe on 12.09.86.

Stocks of coral limestone

	Cu.m.
1. At the fishing port, unallocated, possibly for swimming pool and roads	28,000
2. Plaisance, for the refuse tips	20,000
3. Behind the commercial port, earmarked for infilling	10-15,000
4. Providence, close to the shore; spare at present but is 'disappearing'	7,000
TOTAL:	65-70,000

There are 120 hectares of reclaimed land. It could be reduced to say 100ha to make more coral available if needed.

The unit rate charged for dredging the coral ranged from R.10 to R.45-50/cu.m. If the dredger (Marco Polo) was needed to return it would cost around R.1M to have it do so.

Other limestone resources

Underwater

A preliminary survey on the Seychelles continental shelf by the Indian Research Vessel 'Gaveshani' indicated the existence of calcareous sands. The Energy & Technology Divn. of Min. Planning & External Relations in a Contribution to the National Development Plan, April 1984, considered that a key area was lime resource assessment on the continental shelf and the establishment of an exploitation programme. It was suggested this could possibly form the basis of an eventual lime and cement industry.

The 1985 Final Report of the cruise, carried out in March 1984, included a report: Seafloor Sediments around Seychelles Group of Islands. This referred to 8 samples taken only from depths of 1538 to 4620m. The calcium carbonate content varied from 26 to 95% and was >77% in the coarse fraction.

Beach sandstone

Baker (1963) lists on p.128 seven localities where beach 'sandstone' was observed:

1. The settlement, Ile du Nord, Farquhar.
2. Paya, Coetivy.
3. Muraille Bon Dieu, Desroches.
4. Near the settlement, Assomption.
5. The south end of Ile Denis.
6. On the coasts of Desnoeufs, Marie-Louise and Remire.
7. The north end of Astove.

During the present mission, beach sandstone was seen at:

Vista do Mar, Mahe just north of the hotel restaurant.
Anse Consolation, south-east tip of Praslin.

No analyses have been see for the beach sandstone but it appears to consist mostly of fine calcareous reef debris.

ANNEXE 7

LOCATIONS KNOWN FOR DEPOSITS OF QUARTZ SAND

Pages 129 to 131 of Baker (1963) deals with locations where quartz sand was found or known and gave seive gradings for 6 of these. He stated that 'there are large beach sand deposits of adequate purity and the rivers and streams contain only small and localizsd sand deposits. (Additional remarks are made where recent information was obtained or observations made during the present mission).

Location	Remarks
North-west end of plateau, Grand Anse, Mahe	Was being dug.
La Misere, by track leading to Dr. Phillip's house	Small amounts dug. Area is 120 X 150ft. 5000cu.yd of pure qz sand, to depth of 3-4ft, beneath 6in soil.
Cascade, impure, from reef-platform 50yds from shore	A considerable amount in the inter-tidal zone
Conan Point, inland of the of the coastal road	Small deposits on the surface
Mamelles, just inland of the bridge.	Being worked by Mr. Francis Antoine for blockmaking. Up to 2m? below 45cm of mud.
Rochon river.	Small, in built-up area.
Bel Hombre, outlet of the Le Niol river.	3,000cu.yds of quartz sand av. 15% calcareous sand. 150yd west of river 600cu.yd. almost pure qz sand forms the beach. 100yd east of bridge 2000cu.yd grey pure qz. sand beneath 1ft grey-brown soil.
Below Rose Belle Settlement, 30ft west of La Misere road, and 150ft west of Pont Sec.	45 X 55ft area, sand to 5ft depth, i.e. 450 cu.yds.

Locations used by PUC Water & Sewerage Division

Anse Royal. Usually in marshy areas.

Val d'Endor. 20-50cm of sand under soil with clay beneath.

Anse Louis. Above L'Esperance. May be largely worked out but was up to 2m thick.

ANNEXE 8

LOCATIONS KNOWN FOR CLAY DEPOSITS INCLUDING TEST RESULTS

1.

Type: Pale yellowish grey to white kaolinitic clay without quartz.

Location: Mare aux Cochons, approx 5km WSW of Victoria. But not found by Cooper (1985)

Resource: At least 100 by 50yds and > 3ft depth; a minimum of 5,000 cu.yds.

Characteristics: Not mentioned

Utilization: Not mentioned

Reference: Baker (1963)

2.

Type: Mixed reddish and buff pure kaolinitic clay

Location: Eastern end of the northern plateau of Ile aux Cerf.

Resource: Probably 30 to 40 feet lateral extension and seen to depth of 5 feet.

Characteristics: Not mentioned

Utilization: Not mentioned

Reference: Baker (1963)

3.

Type: Kaolinitic clay

Location: In road cuttings at La Misere

Resource: 'No economic significance' but at least 15 to 18ft thick on Mr. Bradley's estate at La Misere and said to be suitable for brickmaking.

Characteristics: Some with small iron content yielded rose and brown coloured test bricks.No cracking during drying or firing by bricks made with iron-rich soil free of quartz

Utilization: Small bricks and pots from test firings seemed of good quality and colour. Baker suggests that this red-brown sub-soil would certainly be of use for brick and tile making.

Reference: Baker (1963)

4.

Type: White kaolin

Location: The former estate of Mr. S.B. Bradley at La Misere

Resource: Only as white pockets in the yellow clay

Characteristics: A china trial sample fired at 1280oC had a pleasant cream colour and was free from specking. Water absorption: 15.2%, brightness (reflectance to blue): 70.5%, contraction: 10.6%.

Utilization: Could provide basis for small local ceramic industry if in adequate quantity.

Reference: Baker (1963)

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5. (Same deposit as 10?)

Type: Yellow kaolinitic clay with iron and aluminium hydroxides

Location: La Gogue

Resource: Not mentioned

Characteristics:

80% < 20 micron size.
Approx 55% kaolinite clay content
Fe_2O_3 content is high: 25.39%
<1% alkalies and alkaline earths
Drying shrinkage: 9.9%
Pfefferkorn plasticity: 32%
Bending strength: 1.88MPa
Firing shrinkage at 1000oC: 3.8%
1250oC: 15.0%
1400oC: 21.2%
Absorption fired at 1000oC: 16.01%
1250oC: 15.3%
1400oC: 2.5%

Utilization: A clay useful for increasing the iron content of a body.

Reference: UNIDO-Czech Joint Programme report no. JP/154/83: Clays from Seychelles, by M.Novy. May 1983

6.

Type: Red and yellow kaolinitic clays

Location: Montagne Posee

Resource: Not mentioned

Characteristics: 80% <20 micron size.
65% kaolinite
13-15% Fe2O3
<1% alkalies and alkaline earths
Drying shrinkage: 8 - 10%
Pfefferkorn plasticity: 32-34%
Bending strength: 0.68 - 1.02 MPa
Firing shrinkage at 1000oC: 2.1-4.7%
1250oC: 11.9-12.9%
1400oC: 23.2-24.2%
Absorption fired at 1000oC: 46-49%
1250oC: 22-28%
1400oC: 5-6%

Utilization: Suitable for making structural ceramics

Reference: UNIDO-Czech Joint Programme report no. JP/154/83: Clays from Seychelles, by M.Novy. May 1983

7.

Type: Various, dark grey(S-1), intense red(S-2) and yellow(S-3,4 and 5)

Location: Not stated - details not given with samples?

Resource: Not known

Characteristics: 5 samples of clay S-1 to S-5 received in Havana Jan 1983

Utilization: S-3 possibly usable for brick production.
S-2 is 98% passing 0.063mm and has high Liquid and Plastic Limits (over 70%)

Reference: Diaz Denes 1983

8.

Type: Red/yellow kaolinitic clays and lateritic soil

Location: Montagne Posee Road, cadastre 3479

Resource: Not estimated?

Characteristics: Low strength and plasticity; high vitrifying temperature

Utilization: With additions of higher plasticity clay of lower vitrifying temperature could be suitable for red bricks and roofing tiles.

Reference: Anon (1984). UNIDO-CSSR Final Report

9.

Type: White and grey sandy clays, white firing

Location: Val d'Endor Estate, cadastres 3273, 3473

Resource: Not estimated. Duncan (SEYPOT) estimates the thickness at 3-4ft, beneath 1ft of soil

Characteristics: White and grey clays fire 'white'. Need washing to remove sand. High Fe and Al hydroxide contents may cause cracking during firing.

Utilization: Suitable for ceramic casting.
Note: SEYPOT uses 75% of a white-buff 'gungy' clay from Val d'Endor with 25% of Anse Soleil clay. This body could do with more strength say by adding 10% of (imported) ball clay. The present mix is still fairly porous after firing at 1250oC.

References: Anon (1984). UNIDO-CSSR Final Report.
Mr.David Duncan (SEYPOT) personal communication

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10. (Same deposit as 5?)

Type: Brown, yellow and red clays

Location: La Gogue, large exposure close to dam and beside la Gogue road.

Resource: Not estimated but appears to be several thousand tonnes from inspection in Sept. 1986 by Hill.

Characteristics: 'Inferior physical properties - unsuitable for any ceramic production' though could be used in a blend of clays.

Utilization: Nil

Reference: Anon (1984). UNIDO-CSSR Final Report

11.

Type: Yellow and brown clays

Location: Anse Soleil Road, cadastre 2875

Resource: Not quoted

Characteristics: Yellow clay has high alkali and alkaline earth contents. The physical properties of the Anse Soleil yellow clay is the best of those tested by the UNIDO-CSSR programme
Note: the SEYPOT mix, i.e. with 25% of Val d'Endor clay, has D.S.= 12% and F.S.= 6.2% and is still fairly porous even after firing at 1250oC i.e. items such as mugs are likely to leak

moisture if not glazed.

Utilization: The yellow clays are suitable alone or in blends for ceramic production. Anse Soleil clay makes up 75% of the body being used by both SEYPOT and the Polytechnic Pottery School.

Reference: Anon (1984). UNIDO-CSSR Final Report
Also personal communications from Mr. David Duncan of SEYPOT and Mr. Rodney Payette of the Polytechnic Pottery School.

12.

Type: White plastic clay.

Location: La Gogue, approx 500m from the dam between the road and the stream.

Resource: Not seen

Characteristics: Too plastic for use on its own.

Utilization: The Polytechnic Pottery School at Mont Fleuri uses 25% of La Gogue clay with 75% of Anse Soleil for both hand building and throwing on the wheel. But this body has to be fired at 1240 to 1280oC.

Reference: Personal communication from Mr. Rodney Payette, Pottery School ceramics instructor.

13.

Type: Grey clay firing white

Location: Anse Boileau

Resource: About 1 acre in extent

Characteristics: White firing clay

Utilization: None so far?

Reference: David Duncan (SEYPOT) personal communication

Cooper (1985) concluded that none of the local clays is of adequate quality or sufficient size for the production of white-ware, such as tableware, etc. He suggested that the known clay deposits should be exploited by artisan potters to produce items for the tourist market.

ANNEXE 9.

BY-PRODUCT CARBIDE LIME FROM THE ACETYLENE PLANT OF L'AIR LIQUID (SEY) LTD

The Company is importing around 7t/y carbide for manufacture of acetylene gas. This could increase to 9t/y in 1987.

Mol.wt CaC_2 = 64. Mol.wt. $Ca(OH)_2$ = 74

then 9 X 74/64 = 10.4t of dry by-product lime in 1987

(Also one can say that 1kg carbide gives 300 litre acetylene + 1200g dry slaked lime).

The value of this compared with OPC is low i.e. R.750 X 10.4 = R.7800 but its volume, e.g. in a plaster, is much greater than that of cement.

Currently about 3 to 4t has accumulated in the concrete-lined pit beside the plant at the New Port and some is having to be stacked around the sides.

Some of the lime has been used for whitewashing houses. The company's office in Francis Rachel Street, Victoria has used it. Mr. Roy Wheeler, Director of L'Air Liquid, has also demonstrated how to make it waterproof with salt and/or alum. Alternatively it could be boiled with tallow or other fat. The free availability of this lime has been advertised in the Nation newspaper with little or no response. Mr. B.K. Patel of Allied Builders used it for plastering rooms at the Polytechnic's Hotel and Tourism Training School at Bel Hombre and claimed it to be very successful. (He mentioned proportions of a 1:2, lime:cement being painted on or applied very thinly over a normal cement rendering t needed only going over with a steel edge on the following day. (Note: 1:2, lime:cement would be far too strong and it is presumed he was referring to a 1:2:6, cement:lime:sand mortar?).

Example of Potential Local Use for Carbide Lime

At the National Stadium in Victoria, the white lines on the football pitch are marked out each Friday with imported Plascom PVA Copolymer Paint. The 25 litre drums. when available, are sold by two merchants at R.350 each. It is believed that at least two 25 litre drums are purchased annually, i.e. R.700 a year.

The running track at the National Stadium is marked out with imported Snowcem Cement Paint from 7kg tins said to cost R.75 each. The whole track done once a year and consumes 15 tins. Subsequently touching up requires a further 8 tins on each of

three more occasions. Thus about 39 of the 7kg tins are used a year or about 273kg costing R.2925. (Snowcem Cement Paint is available now only in 20 litre tins, from two suppliers, each charging R.250 for this size. If the 20 litre tins are equivalent in covering power to say 3 of the 7kg size tins, then 13 would be needed a year costing R.3250).

The total annual cost of imported paint for painting all the white lines is therefore around R.3625 (or about US$604). Limewash, prepared by adding water to hydrated lime such as carbide lime, is traditionally the material used in the U.K. etc for marking sports grounds and is available free in Victoria at a distance less then 0.5km from the Stadium.

The two other principal football grounds on Mahe use black waste oil from the power station as imported white paint is said to be too expensive to use.

ANNEXE 10

LOCAL CONSTRUCTION OF HOUSES WITH RED EARTH

A Mr. Dofay (now deceased) used to make red clay bricks by hand.

Louis Sauvage built several houses at La Misere from 'bricks' of compacted red earth. According to Guy Lionnet the house above Bel Air formerly owned by Mr. Hunt and later the Soviet Embassy was also made of red earth and is now at least 50 years old.

On Praslin a housing scheme five years ago used earth and cement pressed blocks. These are said to have been satisfactory but this method of construction has not met with official approval.

In the past red earth and lime was used for walls also 95% red earth with 5% cement but was said by NCS to have been a failure.

At Ma Constance, north of De Quincey village, 2 or 4 houses were built of red soil and cement and then rendered with a coating of cement slurry. No reinforcing steel was used. The blocks measure approx 30 X 15 X 7.5 cm. and were laid in a lime-sand mortar. The house of Mrs. Lea Mellie was built 22 years ago and is approx 8 X 4m, on a raised foundation with cgi roof. There is no deterioration of the walls on the side protected by the longer roof overhang. Some termite infestation was seen and they may enter via a crack in the blocks.

ANNEXE 11

CEMENT BULK HANDLING AND BAGGING PLANT AT THE NEW PORT

Information from Mr. Tony Jean Baptiste of Cement Co (Seychelles) Ltd and Mr. Rene E. Widmer, Indian Ocean Manager for Marine Cement Ltd which owns 100% of Cement Co. (Seychelles) Ltd. Marine Cement Ltd is a subsidiary of Cementia Holding AG, Zurich and Blue Circle Industries Ltd, London. Bamburi Portland Cement Co Ltd, Mombasa is one of many cement factories belonging to the parent companies who also operate a fleet of eight bulk cement carriers up to 24,000 DWT. There are bulk installations owned also at Mauritius (24,000t capacity) and Reunion (9,600t) as well as 5 other locations.

Silo capacity:

Nominal capacities:	3 X	1500t
	1 X	800t
Nominal total		5300t
Actual capacity now	:	4640t

Bagging rate: 500 X 50kg bags per hour
= 25t/h

There is a suction pipe to the ships which typically are from 6000t to 14000t. They have to have their own air compressors to deliver into the silos.

The forecast throughput for 1986 is 7000t of OPC and 1500t SRPC. This is said to be 30-40% of last year.

Prices:

OPC:	
3 ply bags	R.751.80/t
4 ply bags	R.758.40/t
5 ply bags	R.776.00/t
SRPC:	R.795.00/t

ANNEXE 12

SOME PRICES FOR BUILDING AND CONSTRUCTION MATERIALS

UCPS

Hollow concrete blocks

	R.
18 X 8in X 4in	3.75
6	4.70
8	6.35
9	6.50

Solid concrete blocks

	R.
3in	3.75
4	4.85
6	7.25
8	9.25
9	9.90

Crushed aggregates

1.5 - 1.25in	R.135/t
.75	
.5	
.375	
.25	

Concrete sand	R.125/t
Coral sand	R.100/t

Reinforced culvert concrete pipes:

Diameter	Length	Price per unit
12in	4ft	R.255
16	3	255
18	3.5	295
24	4	379
30	3.25	415
36	3.25	448
45	1	253

Paving slabs

Reinforced	2 X 2ft X 4in	39
"	2 X 2ft X 2.5in	31
Non "	2 X 2ft X 2in	21
Non "	3 X 2ft X 2in	24

P & J Hardware

White cement	R.5.00/kg
C.G.I. sheet 30g	3.90 per linear ft
	or 12.50 per linear metre
Ceramic wall tiles	
150 X 150mm, white	1.40 each
" coloured	1.60
Ceramic floor tiles 20 X 20cm	4.70
	and 4.00
Ceramic wash basin	404.20
Ceramic toilet	949.40
Masonite standard hardboard	
8 X 4ft X 3.2mm	24.80 per sheet

ANNEXE 13

BETON CELLULAIRE

In 1976 Mr. Franco Boldrini imported equipment from Chembau of Italy for mixing and pumping 'beton cellulaire', i.e. aerated concrete. The process uses ordinary Portland cement and sand mixed with water and a proprietary foaming agent sold by Chembau. The sand can be either calcareous beach sand for non-loadbearing insulating concrete, at around 350kg/cu.m., or quartz sand for denser structural concrete of density 1000kg/cu.m.

The system is claimed to produce 1 cu.m. of concrete every 12 minutes. The insulating mix can be pumped through 4" plastic pipe to a height of 35m.

Unfortunately, only three contracts have been carried out with this system. These were to provide in situ insulation for the embassy of the Soviet Union at Le Niol, Oceangate House and the Central Bank.

Two years ago Mr. Boldrini submitted proposals to the MND for a programme of house building using the beton cellulaire system. With a workforce of 120 he claimed that 220 houses could be completed in a year. Each would be of 93sq.m. and complete, including septic tank, for a price of R.88,563. Mr. Boldrini has agreed to update his figures and submit new proposals to MND. (Even so the two year old prices appear to compare favourably with Government's present aim, as quoted by NCS, of building houses at a cost of R.1000-1,200/sq.m.).

Because of disappointment over the lack of official interest in making use of the system, Mr. Boldrini is now seeking to sell the equipment at a price of R.80,000. He said that in 1976 he paid US$34,000 to import it. He offers to use the system to build a demonstration house and act as technical adviser for a short period to whoever decides to buy the equipment consisting of mixers, pumps, sand elevator, piping, etc.

Mr. Boldrini operates a carpentry business, with a total work-force of 28, and has a workshop at Ma Joie, beside the last house up the hill past the Management Centre, tel.no: 41276.

ANNEXE 14

THE POLYTECHNIC POTTERY SCHOOL

Information mostly from Mr. Rodney Payette, Ceramics Instructor at the Pottery School of the Polytechnic's Department of Art & Design. (Formerly it was the Ceramics Training Centre started in 1977 by Jack Wilson in what was previously an old fish market. The Polytechnic opened in 1983 and took over the CTC).

The Course. The first students were in 1979. They do three years and besides chemistry, French, maths, etc they do 20, 50 minute pottery classes each week. There is only a first year at present; another 10-15 students will start next year. Students from other islands were better but there is an accomodation problem and all are from Mahe now.

The present aim is to make half the pottery by turning on a wheel and half by figuring or sculpting. Present designs include rock sculpture, small turtles, other animals, etc. A style that will be recognized and known as being Seychellois is being sought.

Raw Materials. The mix used is 25% La Gogue white clay and 75% Anse Soleil and is fired at 1240 - 1280oC. It is used for hand building and also for throwing. A particular wood ash has been used as a glaze, also green, brown and white bottle glass.

Equipment. Two small electric pug mills. A hand operated slab roller. There are five kilns, three of which need attention; due to lack of money this is difficult. The largest is by Wenger (now called Pottercraft), of Stoke-on-Trent, about 4' X 3' X 2' internal capacity, say 24 cu.ft. and is mainly for glaze firing. The cycle needed is 20-24hrs firing and 2-3 days cooling. There are two earthenware kilns each about 3.4 cu.ft. one of which is not working. Also not working is a stoneware kiln, about 3.4 cu.ft which just needs the electric switch repaired. The shelving for the large kiln needs resurfacing as they got overfired and the items tend to stick to the shelves.

ANNEXE 15

THE SEYCHELLES POTTER'S CO-OPERATIVE

Information mostly obtained on 18.09.86 from Mr. David Duncan who has worked at SEYPOT for the past four years.

History. SEYPOT was started about 7 years ago as one of many co-operatives encouraged by the Government. At present it is believed to be the only co-operative working in the industrial sector. Products are made entirely by throwing onto six potters wheels and include mugs, vases, pots, ashtrays, lamp stands, etc.

Personnel. The Co-operative is owned by its Members who are the six present potters, one of whom, Mr. Fabien Belle, is the Co-operative's Chairman. There is a secretary doing the accounts and a person paid by the Members to prepare the clay. David Duncan was recruited to work on production and technical development work such as to lower the firing temperature needed. In fact he has to do the administration as well. The sales side is done by Jackie, a lady who, like Mr. Duncan, is funded by Voluntary Service Group (Seychelles), a service arm of the Africa Inland Mission (AIM) International. (There is a pottery manager available who is ready come to SEYPOT who also would be funded by VSG). More potters could join the Co-operative but it will be two years before any more complete their training at the Polytechnic Pottery School and more training would be needed after starting work at SEYPOT.

Raw Materials. The present body is 75% Anse Soleil and 25% Val d'Endor clays. The intention is to include 10% ball clay to gain more green strength. In 1985 the clay useage was 7.5t and there is reckoned to be plenty available for the future.

Characteristics. The D.S. is approx 12% and the F.S. 6.2% making a total of 18.2% shrinkage. The biscuit firing is at 1000oC and the final one after glazing is at 1250oC but the body is still fairly porous.

Glazes. These are imported. No lead glazes are used and in any case the firing temperature is too high. Ground glass e.g. from bottles would require 1150 - 1200oC which is between the two firings.

Overheads: Electricity is the main item and costs R.3-4000 a month. There is also a truck that was donated and is used to collect clay, etc.

Marketing. There are 10 or 12 shop outlets and in hotels. There is no problem in selling even quite large pots to tourists. Hotels take 45-50% of sales and about a futher 10% is retained in Seychelles. Typical hotel orders would be, say, for 192 each of ashtrays, vases and candle lanterns - such items tend to disappear from regularly from hotel rooms. Currently SEYPOT can sell more

than they can produce. Typically sales have been R.22-23,000 and were R.30,000 in August (1986); R.25,000 consistently is the present target. Part of the sale price of each item goes to the individual potter; the rest goes to the Co-operative to pay the overhead costs. The accounts are audited by the Ministry's official auditors.

Two catenary arch kilns were built and have been fired with wood, but are unsatisfactory compared with the electric kilns.

Future Development. Earthenware would not be suitable as tableware for hotel guests and the proposals by Cooper (1985) are not supported. Mr.Duncan believes that in addition to continuing with the making of items thrown on the wheels SEYPOT could try marketing a few well designed large size wall tiles for local homes. The aim was to hand over the running of SEYPOT to local people in October 1987 but without a full time manager there is little chance of training a Seychellois to take over.

ANNEXE 16

WATER AND WATER TREATMENT

Information obtained mainly during meetings with the following in Victoria, Sechelles: Mr.Stephen Rousseau, Manager, Water & Sewerage Division, Public Utilities Corporation (PUC). Mr. Bernard MacGaw, Officer in charge, Water Quality Control Section, W & S Division, PUC.

Raw Water

Normally water comes from springs in the granite. The exception is on La Digue where it is collected from the calcareous sand (Shioya Series) of the coastal plateau.

The granite water has a pH of 6.2-6.4. In the dry season the water is very pure. A typical hardness level, as carbonate, is 10-15 ppm. As one would expect, the La Digue water is quite hard.

Without treatment, the granite water is agressive, particularly to asbestos cement pipes and other concrete materials due to the acid pH and low content of impurities.

Treatment

In the past the pH has been adjusted, to the required 8.0-8.4 level, by dosing with soda ash. The amount of soda ash used in 1984 was 60t, costing around R.110,000. The quantity imported that year was 18.7t valued at R.35,025.

Chlorine gas or chloride of lime has been used for killing any germs. The consumption of chlorine has been considerably reduced i.e. from 10ppm to around 5ppm. A 1000kg drum of chlorine is said to cost R.18,000 and to last for 6 to 8 weeks. At La Digue where the water hardness is very high HTS granular chlorine is used having 70% available Cl.

Following pilot plant trials in 1979 with different size grades of coral limestone, it was decided to reduce the raw water acidity by passing it through a bed of nominally 50mm size coral lumps. By using 50t at Le Niol treatment plant in 1980 it was possible to completely eliminate the use of soda ash and similarly with 50t of coral at Anse Royal in 1981. Now, in 1986, 400t of coral is being placed in the tanks at Hermitage and a similar quantity will be used at the Cascade works. There are 10 much smaller treatment plants at which each is to have 10t of coral. The coral is delivered from the reclamation area at a cost of R.20 s/t. Obviously, to be effective the coral limestone must have both a high content of calcium carbonate and good porosity and the Seychelles coral seems to be excellent in both respects. It has been suggested that the chlorine would be best added to the acidic water, i.e. before it passes through the coral, otherwise some of the chlorine is 'lost' in having to counteract any alkalinity that is produced.

Use of charcoal for colour removal is still at an experimental stage.

Filtration and Sand Useage

Anse Royal is a source of sand usually found in marshy areas. At Val d'Endor the sequence is soil overburden, sand and clay beneath it. (Similar possibly to the 'dambo' deposits of Zambia and parts of Malawi). At Anse Louis, above L'Esperance, the deposit was up to 2m thick but may be largely worked out now. Mare aux Cochons, west of Victoria, is another sand location mentioned.

The total cost of digging, sieving and transporting the sand to the works is R.125/t which is said to be about a tenth of the price that would be paid for imported sand.

Although the uniformity coefficient differs slightly from that which is recommended it is not critical. The purity is good; in the WHO/ISO standard test with 25% HCl only 0.5% is dissolved whereas up to 2% is acceptable. Quartz bearing gravel, 3 to 10mm, is sieved to produce the 0.5 - 1.5mm fraction needed for the slow sand filters at Rochon dam and Anse Royal. (The Le Niol filter is not in use at present). Pressure filters, e.g. at the 10 small filtration units, require 0.7 - 1.8mm size range. Hermitage and Cascade use rapid gravity filtration.

Mineral Water

Since September 1981 it has been possible to completely eliminate the importation of mineral water through the bottling of spring water from Val Riche. Having a natural mineral content of 500 - 600 mg/litre, Eau de Val Riche, bottled and sold wholesale by PUC, is labelled as 'Natural Oligomineral Water' (whereas to qualify as proper 'mineral' water it would have to contain at least 1000mg/l it was said).

It is sold in two sizes of plastic bottle; 1.5 litre at R.6 and 0.75l. at R.4.50. Monthly sales now average 60,000 litres or around 0.75M litres annually.

ANNEXE 17

SOME IMPORTS OF INDUSTRIAL MINERALS AND INORGANIC CHEMICALS BY LOCAL INDUSTRIES

UWE Industries (Soap and detergent manufacturer)

Soda ash. About 500kg every 3 months
Caustic soda. 80 - 100t/y
Caustic potash. Very little, about 50kg every 2-3 months
Sodium silicate. 40 - 50t/y
Bleaching earth. A little, but could increase if Government expands edible oil industry e.g. cooking oil.

SEYBREW (Brewery and soft drinks)

Diatomite. As filter aid, about 5t/y from France.
Aluminium sulphate. For water treatment, only 50kg/y.
Chlorine. 15kg a month.
Phosphoric acid. 100kg/y

PEL (Paint manufacturer)

* Snowcal 60M/L. 1t/month
* FILLA 10 and 5. 1.2t/month
Microtalc. 100Kg/month
Aluminium silicate. 1.4t/month
Red oxide. Just started to be used.
Kaolin. Being tested.
Micaceous iron oxide. 72kg in past 8 months.
White pigments, e.g. Titanium dioxide. 2t/month

* Snowcal is a chalk whiting, i.e. calcium carbonate.
FILLA is also probably a limestone product, i.e. calcium carbonate

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APPENDIX 18

MISCELLANEOUS INFORMATION ABOUT FUELS AND FUEL COSTS

Exchange rate approx R.5.99 = US$

Fuel prices:

Gasoline	: R.4.97	per litre
Diesel	: R.4.07	" "
Kerosene	: R.2.1	" "
LPG gas	: R.15	per kg. (ref:Cooper 1985)

Electricity:

1st 500KWhr	: R.1.54	per KWhr
2nd 500KWhr	: R.1.38	
+ 1000KWhr	: R.1.33	

Waste oil

200,000 litres of waste lubricating oil and 100,000 litres of waste medium fuel from the electricity generating station are available, annually?, according to TDU (Dr. Gendron). UNIDO has carried out a study for TDU on its utilization and it can be used to fire kilns.

Coconut husks

There are dumps of coconut husks in the plantations. Examples occur at the Bougainville Estate on Mahe though some may be used in the SADECO Copra Kiln Bougainville which is still working. There is a large dump by the road alongside the disused copra? kiln about 0.5km south-east of the church in Grand'Anse, Praslin.

Wood and sawdust

About 2-3t of waste is piled up at the joinery/carpentry works of contractor Herman Maria, in Pascal Village between Victoria and Beau Vallon, Mahe.

Packing crates

One importer of building materials states that disposal of wooden packing crates is a problem and were being dumped at St.Antoine but presumably will now go to the dump on the reclaimed area near the New Port.

ANNEXE 19

PROPOSED NEW ORGANIZATION FOR MND AND ITS TECHNOLOGICAL SUPPORT SERVICES SECTION