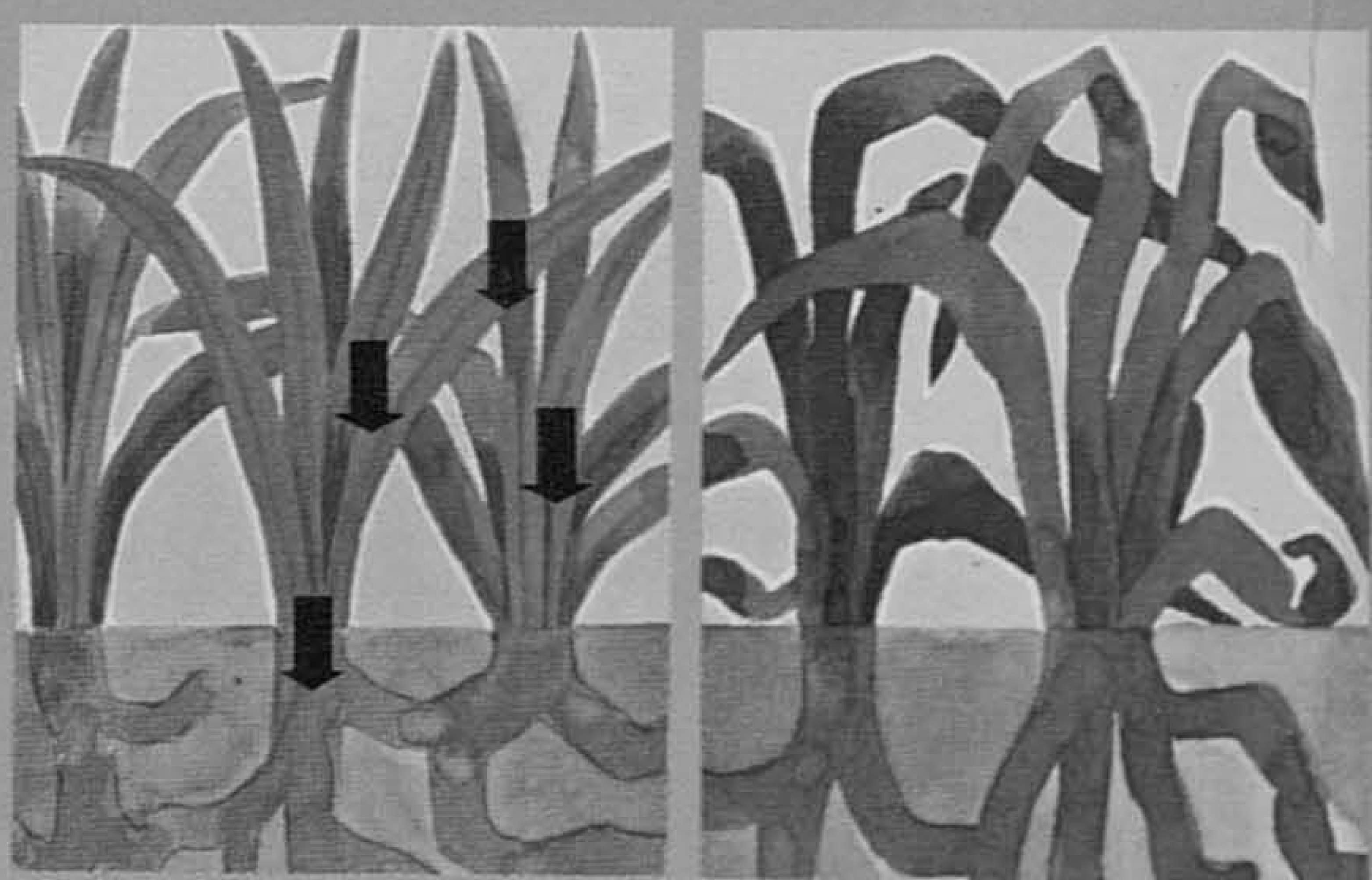
Published by the Incorporated Society of Planters, Persiaran Lidcol, Kuala Lumpur 04-06.
Printed by Yau Seng Press, 26 Jalan Silang, Kuala Lumpur 01-21
APRIL 1976
KDN ... Vol. 52 No. ...

The Planter

NEW
20 kilo
BARU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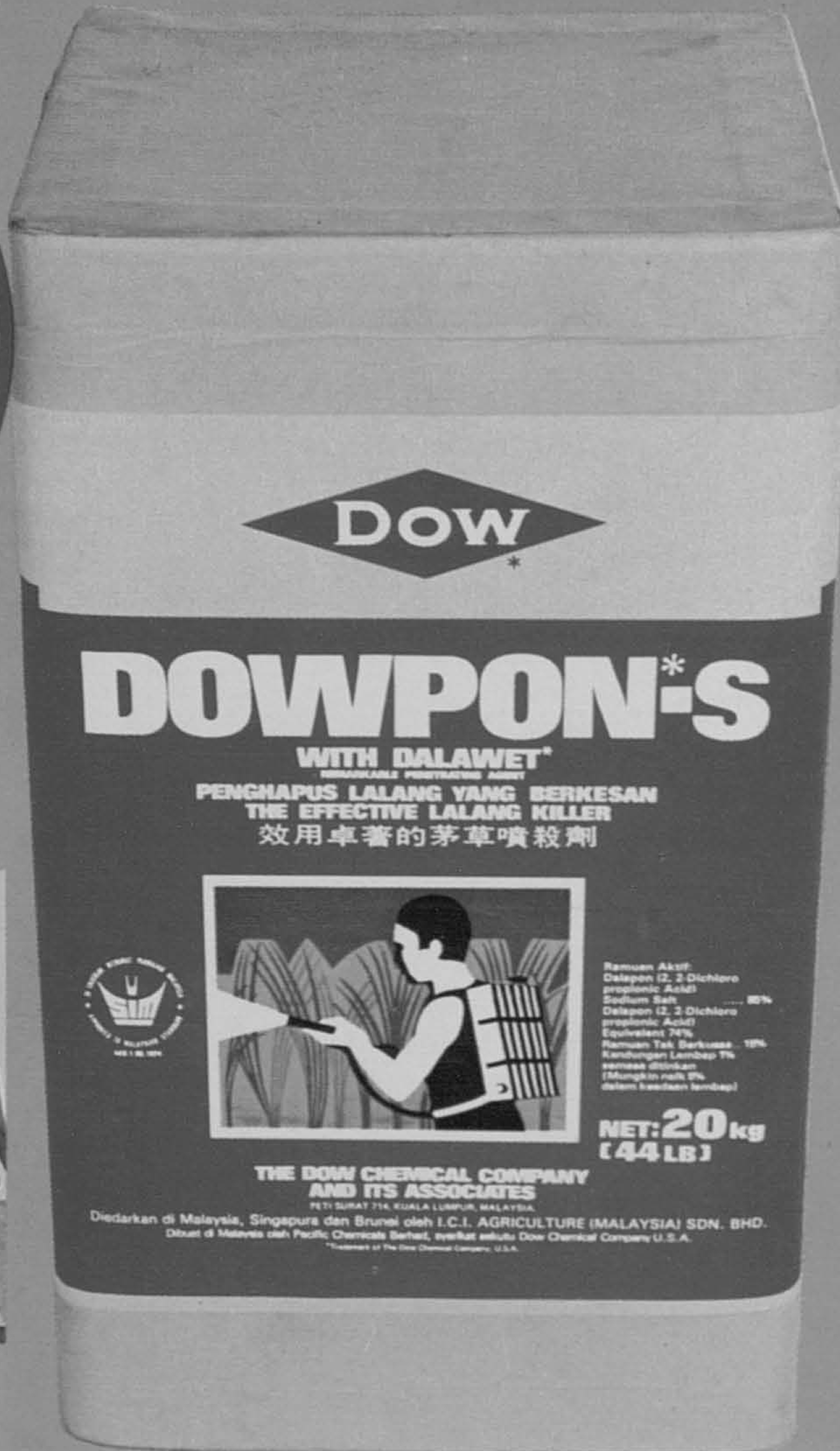

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The Planter

KDN 9432

MAGAZINE OF THE INCORPORATED SOCIETY OF PLANTERS

VOL. 52 APRIL 1976 No. 601

Publishing office :

1 Pesiaran Lidcol
Kuala Lumpur 04-06
Malaysia

Postal address :

P O Box 262
Kuala Lumpur 01-02
Malaysia

Telephone : 86396/209705

Telegrams : ISPLA

Price : M$3.00

Annual subscription : M$36.00

The Incorporated Society of Planters

Founded 1919

THE SOCIETY REPRESENTS the Planters of Malaysia and other territories, whose personal and professional interests it is bound to endeavour to secure and promote.

OBJECTS foremost in the Society's Memorandum of Association are:

To promote the general interests of the planting profession.

To promote the advancement and facilitate the acquisition of that knowledge which constitutes the professional qualification of planter.

To watch over, promote and protect the mutual and individual interests of its members in respect of matters pertaining to or arising from their employment in the planting profession.

To promote and maintain good feeling, co-operation and understanding between members and their employers.

ACHIEVEMENTS of the Society are a technical education scheme, the publication of authoritative works on tropical agriculture, a monthly magazine featuring original technical articles, the sponsorship of conferences and symposia on tropical crops. and the organisation of joint consultation with employers.

MEMBERSHIP of the Society is open to: —

A Those directly employed in plantation management such as estate managers, assistant managers, superintendents, supervisors and cadets, and

B Executive engineers, estate medical officers, and qualified scientific or administrative staff of estates or organisations mainly concerned with the planting industry.

Category B may include those employed in such other senior executive, administrative, professional or advisory capacities as may be deemed by the Executive Council as being equivalent thereto

Neither category shall include clerks, conductors, hospital assistants, etc.

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Contents

April 1976

The Planter

KDN 9432

MAGAZINE OF THE INCORPORATED SOCIETY OF PLANTERS

(1) *The Planter* is published monthly from the Society's Office at 1, Pesiaran Lidcol, Kuala Lumpur 04-06, Malaysia.

(2) It features original technical articles in tropical agriculture, for the benefit of the planter (in active service or practice), papers relating to the Society's Technical Education Scheme, and other contributions of more general interest.

(3) The magazine's current print order is 2 000 copies and this is steadily rising.

(4) *The Planter* is read in some 51 countries*.

(5) Copies are exchanged with a wide range of agriculturally based institutions.

(6) Subscription copies go to 32 countries.

(7) Annual subscription is M$36, including postage by surface mail.

(8) Regular advertisers include national, regional and international organisations.

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Editorial:

JUNE HIGHLIGHT ON OIL PALM

Malaysian sponsors will host two major international meetings on oil palm and palm oil during the week beginning June 14, 1976. The Malaysian International Agricultural Oil Palm Conference from June 14 – 17 will be followed by The Malaysian International Symposium on Palm Oil Processing and Marketing from June 17 – 19.

Sponsored by the Malaysian Agricultural Research and Development Institute (MARDI), the Oil Palm Growers' Council (OPGC) and the Malaysian Palm Oil Producers' Association (MPOPA), and organized by the Incorporated Society of Planters (ISP), the events will be larger and broader in scope than any held before. It will see the first international meeting of oil palm planters, scientists and research workers for 4 years, a period which has seen huge areas planted to oil palm, and notable advances in its cultivation.

Over 50 papers are to be presented at the Conference, which will discuss all agronomic aspects of oil palm cultivation from selection and breeding to harvesting of the ripe fruit. Typical of the scientific and technological orientation of today's oil palm plantation industry will be papers as diverse as those dealing with breeding palms from tissue culture and the use of computers in the management of fertilizers, and in yield forecasting.

The Conference has registered well over 700 participants from Malaysia and overseas. The latter from some 28 countries.

The Symposium which follows the Conference will emphasize the unceasing efforts of Malaysia's palm oil producers to maintain and improve the quality of an oil which is vital to the country's economy and of which Malaysia is the world's leading producer and exporter.

Well over 500 participants including participants from 27 foreign countries have registered for the Symposium, which will discuss 30 papers on subject ranging from processing and refining of palm oil to its end uses by the consumer. Much interest will focus on marketing methods and the trade prospects for Malaysia's palm oil. The successful conversion of palm oil mill waste into animal feed, and a viable solution to the treatment of mill effluent, will point up the concern of the industry with environmental problems.

The ISP is delighted that MARDI, OPGC and MPOPA have entered the arena as joint sponsors of oil palm/palm oil conferences, and the ISP is proud of its continued association, in the new role of organizers rather than carrying the whole burden alone. The special interest of the Ministry for Primary Industries is also much appreciated.

The upshot of five days of discussion, inside and outside of the conference hall, should lead to greater knowledge and greater cooperation within the industry, both in the Malaysian and in the world industry concept.

The oil palm industry has made tremendous progress in recent years, especially within Malaysia. However the competitive position of palm oil needs not only to be maintained but if possible enhanced to keep it clearly in the forefront of competitiveness.

Both the conference and symposium will deal with a lot advanced techniques and should achieve much, and if planters generally find a lot of the papers too scientific for easy digestion, the organizers apologise. However every effort has been made to accommodate all sections involved in breeding, planting through to end uses. There should be much of interest to participants generally.

Planter, Kuala Lumpur **52**: 118–126 (1976)

Possible utilisation of by-products from palm oil industry

J. L. R. KIRKALDY* AND J. B. SUTANTO*

SUMMARY

The potential value of possible by-products from palm oil mill wastes in Malaysia is estimated to be about $380 million annually. Manufacture of paper/paperboard/pulp and activated carbon from the by-products are the most promising.

INTRODUCTION

The maximisation of use of energy has always been the goal of engineers and scientists, but the achievement of this goal has always, and indeed still is, been restricted by economic factors. Recent changes in crude oil prices have forced industry to re-examine these energy requirements and to move nearer a state of total energy utilisation. At the same time, the realisation of the fact that the natural resources of the world are not infinite is driving technologists to look at schemes for the conservation of these resources by recycling and utilisation of the waste. The above two facts are interlinked and lead to the concept of total utilisation. In this article an attempt is made to examine the Palm Oil Industry from the Total Utilisation Concept in the light of present day costs.

Fig. 1 summarises a typical process flow diagram of a Malaysian palm oil mill indicating the various important output.

With much greater production of palm oil in the near future together with the production of other vegetable oil it is expected that the price of oil would not be as attractive as it is at present. Therefore, for the industry to be more viable, research and development to find other outlets of the palm oil products/by-products must be a priority particularly since Malaysia has already committed almost 1.5 million acres of land for oil palm cultivation. A well-coordinated programme is obviously necessary, not only searching for the alternative outlets for the oil itself but also quality upgrading by refining (Tan, 1974) and maximum utilisation of the waste products by further processing. At the same time, the environmental and disposal problems must be concommitantly solved. It is obvious that the conversion process must be feasible both economically and technologically. At this early stage of technological speculation, somewhat conservative estimates may be acceptable to all sectors of the palm oil industry.

As indicated in *Fig. 1,* for every million ton of palm oil produced (the equivalent of 5 million ton (ffb) the following approximate quantities of wastes are available: —

- 0.5 million ton of empty bunches
- 0.5 million ton of pericarp fibre
- 0.8 million ton of palm shell
- 1 to 1.5 million ton of sludge containing 5% solid matters.

* Both Department of Chemical Engineering, University of Malaya, Kuala Lumpur.

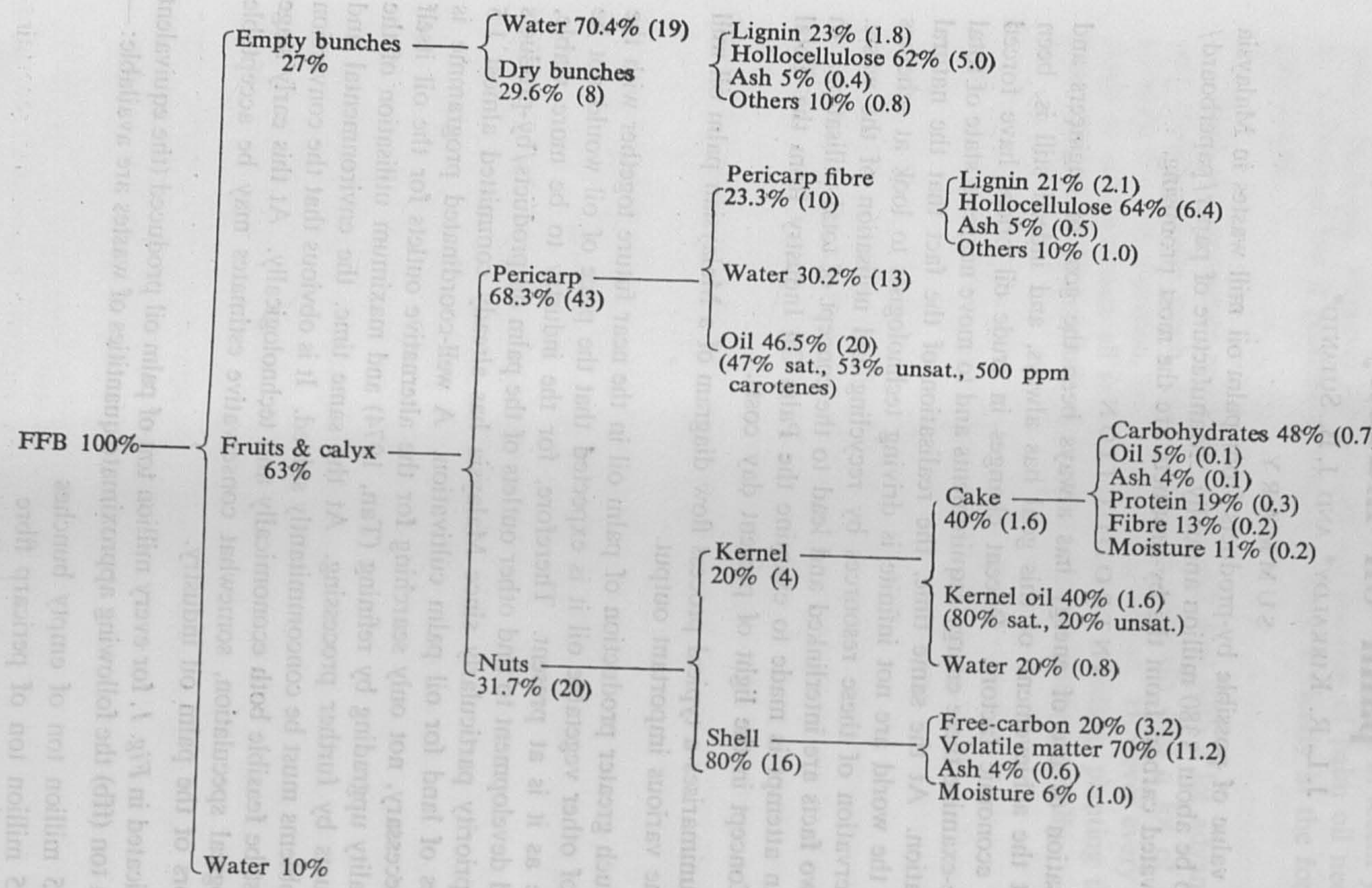

Fig. 1. A diagramatic representation of input and output of a palm oil mill. (Figures in bracket indicate weight portions of the original ffb).

There are promising outlets for all of these processing wastes, many of which are not new to the industry. The fibrous waste materials can be converted to chemical pulp, potash fertilizer or used as solid fuel for steam or power generation. The palm shell is particularly interesting because of the free-carbon content and easy handling:

Fibrous wastes for fuel

Almost all palm oil mills in Malaysia utilise their pericarp fibre waste as fuel for the factory steam generation. This practice is similar to sugar-cane milling and refining where bagasse is used as fuel to generate steam to concentrate sugar solution in the multi-effect evaporators and to supply heating energy in the other parts of the factory.

The use of empty bunches for solid fuel is not usually practised here in Malaysia because the empty bunches have low calorific value due to their high moisture content (more than 50%) and mills already have enough of steam generated from pericarp fibre.

Table 1 shows the estimated potential of fibrous wastes utilised as energy sources. Assuming all mills in Malaysia are processing 5 million ton ffb annually, they will generate a potential heat of more than 27×10^{12} or 27 MM Btu per year, equivalent to 76,000 million Btu per day or 3,000 mil. Btu/hr. The equivalent quantity of steam generated is about 6.5 mil. ton per year or approximately 1.7 million lb/hr that may be priced at about $91 million annually. If conversion to electrical energy is contemplated a total generating power of over 200 MW is realised and an extra income of $110 million is possible.

Table 1. Estimated potential of fibrous wastes as energy sources.

Waste	*Quantity mil. ton/yr*	*C.V. Btu/lb*	*Pot. heat MM Btu/yr*	*Potential electricity(1) MW*	*Value as steam(2) mil. $*	*Value as electricity(3) mil. $*
Palm shell	0.8	8000	14.336	109.09	47.2	57.3
Pericarp fibre	0.5	6000	6.720	51.14	22.2	26.9
Empty bunches	0.5	6000	6.720	51.14	22.2	26.9
Total	1.8		27.776	211.37	91.6	111.1

Note : (1) Assuming a plant heating rate of 15,000 Btu/kwh.

(2) Assuming 55% efficiency in steam generation and a steam price of 0.6 cents/lb.

(3) Assuming an electricity price of 6 cents/kwh.

A palm oil mill of 10 ton ffb/hr capacity will have a potential generating capacity of about 3 MW from its 50 million Btu thermal energy per hour. An additional annual income of about $1.9 million from the sale of electricity or $1.7 million from steam may be realized.

Fibrous wastes for chemical pulp

Vegetable fibre may be defined as those solid which is insoluble in water consisting of cellulose, pentosans and lignin. The approximate compositions of vegetable fibres normally used for making paper pulp are shown in *Table 2.* The palm oil mill fibrous waste is shown here for comparison.

Table 2. Approximate compositions (% dry weight) of some sources of cellulose pulp.

Fibre	*Lignin*	*Pentosans*	*Alpha-cellulose*	*Ash*
Softwood	26 – 34	7 – 14	40 – 45	1
Hardwood	23 – 30	19 – 26	38 – 49	1
Bagasse	19 – 21	30 – 32	40 – 43	2
Rice straw	12 – 14	23 – 25	28 – 36	14 – 20
Bamboo	24 – 29	16 – 18	50 – 55	1 – 2
Palm oil waste :				
Pericarp fibre	21	24	40	5
Empty bunches	20 – 25	21 – 26	35 – 42	5

The main constituent of the fibre is cellulose which is a polysaccharide or a form of glucose polymer. Different degree of polymerisation (DP) in the natural plant result in different types of cellulose. Most wood celluloses possess DP of about 6,000 or an average molecular weight of $162 \times 6{,}000$. The terms alpha-cellulose, beta-cellulose, gamma-cellulose, hemicellulose and hollocellulose are associated with various carbohydrate fractions of plant material. Hollocellulose refers to the fraction which is left after the lignin is removed and is an important part in paper pulp making. Lignin is basically an aromatic cementing the fibres together by means of the intercellular layer surrounding them.

In paper pulp making, the objective is to remove all lignin and retain as much hollocellulose as possible. However, in an actual pulping mill, a small portion of lignin cannot be removed and a certain percentage of cellulose is lost. Hence, the best raw material for pulp making is a fibrous wood or non-wood containing a high content of hollocellulose. The actual portion of hollocellulose is considerably higher than the combined pentosans and alpha-cellulose as shown in *Table 2.* Other constituents such as gums, carotene, resin, colouring matters, etc. are not included in the table.

These compositions indicate that both pericarp and empty bunches fibres are possible fibrous raw material for paper pulp making. Relatively high lignin and ash contents and the presence of colouring matters may create difficulties in the pulping process. Investigations are necessary to determine what type of paper/paperboard can be produced from such fibres. The wide variation of paper/paperboard classification which is partly dependent on fibre length makes the choice somewhat easier.

Research and development in chemical pulp making from oil palm fibrous waste materials need to be initiated considering the quantity and the availability of these materials. More than 20% of ffb consists of dry fibre which includes empty bunches and pericarp fibre. If mills in Malaysia process 5 million ton ffb annually, 1.0 million ton of fibrous waste is available to make at least 300,000 ton of paper pulp assuming a 30% recovery is achieved. A total value of $135 million can be expected if the price of paper pulp averages $450 per ton. The equivalent paper/paperboard that may be produced is about 320,000 ton having a potential value of $240 million at a price of $760 per ton. A 10 ton ffb/hr mill may increase its revenue by more than $2 million annually if paper pulp is produced from the fibrous wastes.

However, we must also remember that although making paper is easy, being one of the oldest technologies, making profit from paper is not so simple. From past experience encountered by many nonwood pulping mills utilising rice straw as the fibrous raw material failures were basically caused by uncertainties in the collection system and storage problems. Transportation cost is relatively high and recovery is low. Proper storage is essential to prevent deterioration of the straw. The storage must be ample as the harvest is seasonal. All of these add up to higher production cost. However, the utilisation of palm oil mill fibrous wastes will not face with these problems as empty bunches and the pericarp fibre are available daily, storage is not necessary and transportation may be minimized by selecting the location of the pulping mill.

Paper making is generally a capital intensive venture, this may be so for many integrated paper mills in developed countries where pulp and paper production are integrated in one complete mill. However, there are also many small pulping mills utilising nonwood fibrous raw materials such as bagasse, cereal straw, etc. with capacities ranging from 50 to 100 tons per day. Hence, it is possible that a palm oil mill discarding more than 150 ton/day of fibrous wastes to consider a chemical pulping on site, as a new investment to increase mill revenue. The minimising of transportation cost of low value and bulky raw material makes processing on site very attractive. However, other cost elements such as effluent handling, water supply, skilled personnel, etc. must be taken into account also. Alternatively, it might be possible to set up a combined pulping mill to process the fibrous wastes collected from two or three palm oil mills in the vicinity.

Many technological and economic factors, however, are involved in chemical pulping process. Continuous supply of chemicals and abundant water supply are essential. Many pulping mills recycle their chemicals and process water to reduce production costs. As the cost of the palm oil mill fibrous wastes is almost nil, the venture can very well compete against the pulping process that uses cultivated wood as the fibrous raw material. Regardless of mill type and size, the cost of the fibrous raw material is always a significant variable cost. The cost of wood chips as raw material usually amounts to more than 30% of total production cost.

Chemical pulping and paper/paperboard making need special attention considering the Malaysian import of more than $230 million worth of newsprint and all kinds of paper/paperboard in 1974. Wrapping and packaging paper/paperboard alone amounted to more than $100 million.

Another possible source of fibrous material is the old oil palm trunks that will be abundant in the near future in replanting the 1.5 million acres of plantation throughout Malaysia. However, its availability, collection and storage may not warrant any fresh investment.

Palm shell for charcoal and activated carbon

Palm shell generally contains about 6% moisture, 70% volatile matters, 20% free-carbon and 4% ash. The presence of 20% free-carbon, in addition to the carbon content of the volatile matters, makes the palm shell suitable for a thermal degradation to produce charcoal and activated carbon. Charcoal is a high grade solid fuel and may also be used as a source of carbon in metallurgical works. Further thermal degradation of charcoal under well controlled condition will produce activated carbon. Activated carbon is the best known solid absorbent due to its large surface area of the pores with high absorptive capacity. The industrial uses of activated carbon include water treatment, gas purification, solvent recovery and decolourizing of many liquid solutions such as sugar syrups in sugar refineries.

Carbonization of shell to produce charcoal may be carried out in a simple ground-oven similar to the oven used for the charcoal making from wood which has been practised for many years in this region. The palm shells may be stacked inside a square hole of 6′ × 12′ × 4′ high with front and rear openings for filling and emptying the oven. A series of small openings at both ends may be provided for the regulation of the air supply. The quantity of air supply is very critical as too much air will burn more carbon completely resulting in poor yield. The air supply is usually reduced to almost 'shut off' after the wood or shell has been set on fire. Other methods of carbonization such as fixed bed incinerator can also be used.

Making activated carbon is somewhat more complex. A fluidised bed combustion column is usually required in order to control the further carbonization of the pores without complete burning of the char. Activation here simply implies an opening up or creation of micro pores inside the carbon particles by burning part of the carbon compounds to drive the combustible organic constituents. The creation of millions of pores increases the total available surface area by hundreds of thousand times. An activated carbon may have surface area up to 1,500 square meter per gramme available for absorption processes.

If production of active carbon is contemplated it would seem logical to use the same fluidised bed column for the carbonisation of the shell. The palm shell, however, must be first crushed and classified to a certain size distribution for good fluidisation with minimum carried over losses.

Assuming an overall conversion of 10% of the shell weight, processing 5 million ton ffb would have a potential quantity of about 80,000 ton activated carbon valued at more than $100 million. A palm oil mill of 10 ton ffb/hr has a potential of 1,400 ton of activated carbon annually valued at about $1.6 million. A small fluidised bed combustion column complete with a hot gas recycle system and an automatic temperature control unit will be quite adequate for the purpose.


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Empty bunches for potash ash fertilizr and coir fibre

Most palm oil mills in Malaysia incinerate their empty bunches coming directly from the stripping or threshing station. The 5% ash contains a substantial amount of potash fertilizer. Such ash is a valuable by-product and is usually recycled back as potassium fertilizer in the oil palm plantation. Processing 5 million ton ffb has a potential of 20,000 tons of such fertilizer, and a 10 ton ffb/hr has a potential of about 350 tons annually.

Another potential by-product that can be produced from empty bunches is coir fibre. Malaysia imported 566 ton of coir fibre in 1973 valued at $174,000. Palm oil bunches may be mechanically refined using a fibre machine similar to those used for refining the coconut fibre in several tropical countries. For the oil palm empty bunches, however, an oven drying may be necessary which may be a disadvantage and making the process not economically feasible.

Coir fibre is usually obtained from the mesocarp of coconut. The longest and finest fibre, known as mat fibre, is usually spun into yarn for making mats and ropes. The coarser fibre, known as bristle fibre, is used for brushmaking. The shorter staple fibre known as mattress fibre, is used for stuffing mattresses, upholstery, etc. For upholstery and rubberised mattresses it is advantageous to use curled fibre (T P I, 1970).

The effluent by-products

The average 23,000 gpd mixed effluent of 20,000 BOD quality containing 5% solid matter and 1% oil discharged from every 10 ton ffb/hr palm oil mills has been a controversial problem for palm oil industry in Malaysia. A number of suggestions have been put forward recently (Stanton, 1974; Mardi report 1970; Webb, 1975) to accommodate the possible pollution acts enforcement in this country. Many palm oil mills have also tried various methods of treatment. Centrifugation to concentrate the effluent, adding surface active agents to speed up settling and other mechanical separation techniques on laboratory scales did not seem to reduce BOD value below 1,000 ppm. A number of proposals, particularly in relation to the biodegradation characteristics of this effluent (Stanton, 1974), have also been put forward.

Webb and co-workers (1975) suggested the CENSOR process to utilise the mill effluent for animal fodder. They claimed an increase of revenue to palm oil industry amounting to $126 million annually in 1977 assuming the market price of such animal fodder reaches $300 per ton. This process suggested the absorption of the fermented sediment of the effluent in a mixture of kernel meal and tapioca.

At present, it would appear that no single technique will give a satisfactory way of disposal of the effluent, but it may be possible to utilise the sludge by combining two or more systems. A scheme such as shown in *Fig. 2*, would on paper at least, seem to be feasible.

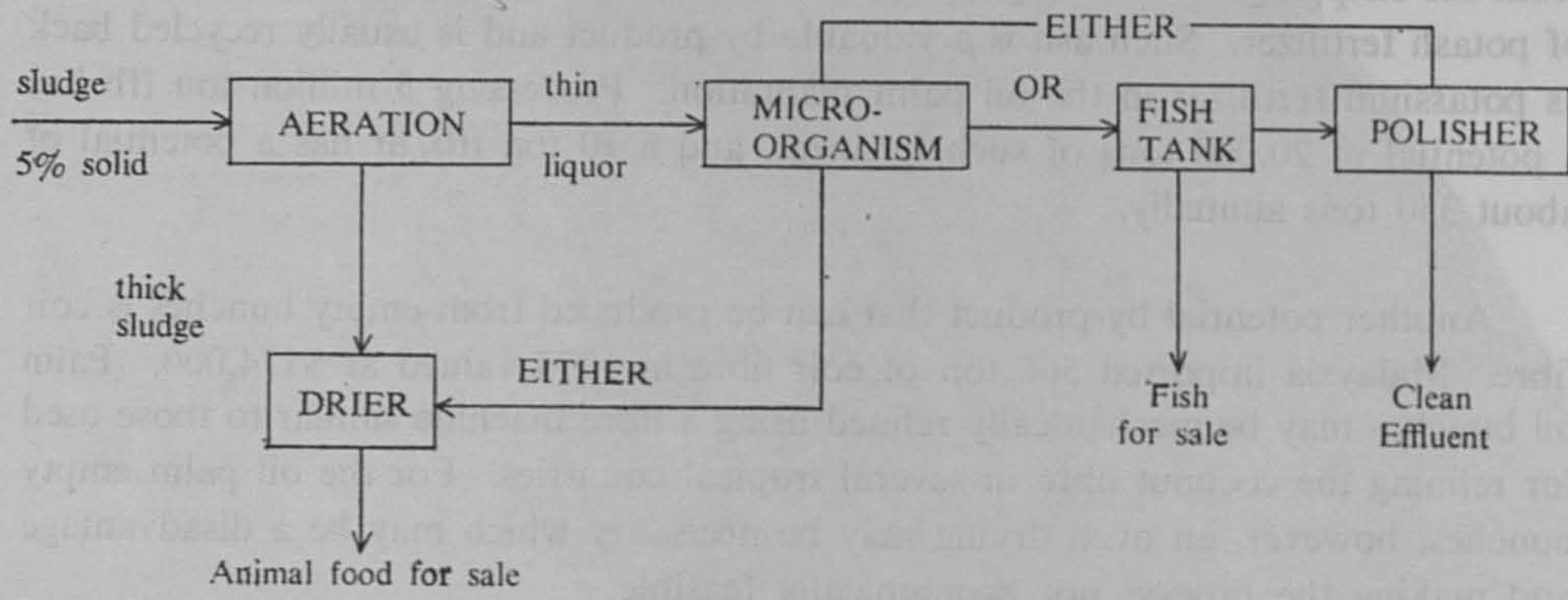

Fig. 2. Suggested scheme for effluent treatment.

It is known that suitable aeration or aerobic fermentation can produce coagulation of sludge giving a thin liquor with a BOD value of the order of 1,000 ppm. Micro organisms have been used to reduce the BOD of rubber effluent from ca. 2,000 to 200 ppm and it is reasonable to suppose that a suitable organism can be found to grow on the thin liquor. These organism can then be harvested and dried for fodder or perhaps used to feed fish and the fish subsequently harvested for sale. A final polishing may or may not be necessary to produce a clean effluent. It is not possible at this stage to work out the economic implications of such a scheme.

CONCLUSIONS

Table 3 summarises the various by-products which can be obtained from waste product from the Palm Oil Industry. Obviously there is considerable potential for increasing the sale revenue of the industry by further processing of the by-products. However, more experimental data is necessary before the technical feasibility and profitability can be evaluated. Work being carried out at the University of Malaya indicates that conversion of the empty bunches into chemical pulp is technically possible and present data indicate the same order of quantities of chemicals as conventional processes will be required. As the cost of the raw material is low the use of empty bunches to make paper is likely to be very competitive with conventional processes.

Table 3. Alternative by-products made from wastes of palm oil mill.

Basis: 1 million ton of palm oil, or 5 million ton ffb.

Waste	*By-product*	*Quantity*	*Estimated value mil. $*
1. Empty bunches	Potash fertilizer	20,000 ton	2
500,000 ton	Fibre coir	250,000 ton	25
	Chemical pulp	150,000 ton	68
	Paper/paperboard	160,000 ton	120
	Steam	7 MM Btu	22
	Electricity	51 MW	27
2. Pericarp fibre	Chemical pulp	150,000 ton	68
500,000 ton	Paper/paperboard	160,000 ton	120
	Steam	7 MM Btu	22
	Electricity	51 MW	27
3. Palm shell	Charcoal	120,000 ton	8
800,000 ton	Activated carbon	80,000 ton	100
	Steam	14 MM Btu	47
	Electricity	109 MW	57
4. Effluent 1 mil. ton	Fodder	60,000 ton	10

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Utilisation of oil palm nut shells

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It is known that oil palm nut shells through destructive distillation can produce high quality activated carbon, creosote, phenol, methanol and acetic acid. With the vast and increasing quantities of the shells becoming available in Malaysia, a way may be found to undertake commercially the viable conversion of oil palm nut shells into such useful products. Prospects for the establishment of a new industry on this basis are reviewed and estimates of economic benefit to the country are attempted.

Malaysia is now the world's largest single producer of palm oil, accounting for 1,032,000 tonnes of the oil in 1974 from 1,335,000 acres under oil palm comprising 39.7% of world exports of palm oil (MALAYSIAN PALM OIL PRODUCERS' ASSOCIATION, 1975).

According to the Association's estimates, the production of palm oil in Malaysia will further rise to 2.0 million tonnes by 1980 when about 2.0 million acres are expected to be under oil cultivation.

This progress is however posing a problem to the industry in regard to the disposal of waste products resulting from the extraction of the oil. *Table 1* shows the quantity of shells requiring disposal, in relation to oil production.

At present, the shells are burnt in the boiler house of the extraction mills, a small proportion of them also being used as fillers in the making of roads in the oil palm and other plantations. But, the ever increasing quantities of shells becoming

*Table 1. The estimated annual production of palm oil and shells**

Year	Oil '000 tons		Shell '000 tons	
	Malaysia	*World Total*	*Malaysia*	*World Total*
1960	92	598	20	150
1965	143	548	40	140
1970	402	740	100	180
1974	995	1,465	250	370
1975	1,205	1,710	300	430
1980	2,320	3,100	600	800

* Export data from US Departmento of agriculture.

available with the steady expansion of the oil palm acreage are already posing problems in the speedy, efficient and viable disposal of shells and other waste matter, including mill effluent. The range of products which can result from the destructive distillation of oil palm nut shells is outlined in *Fig. 1.*

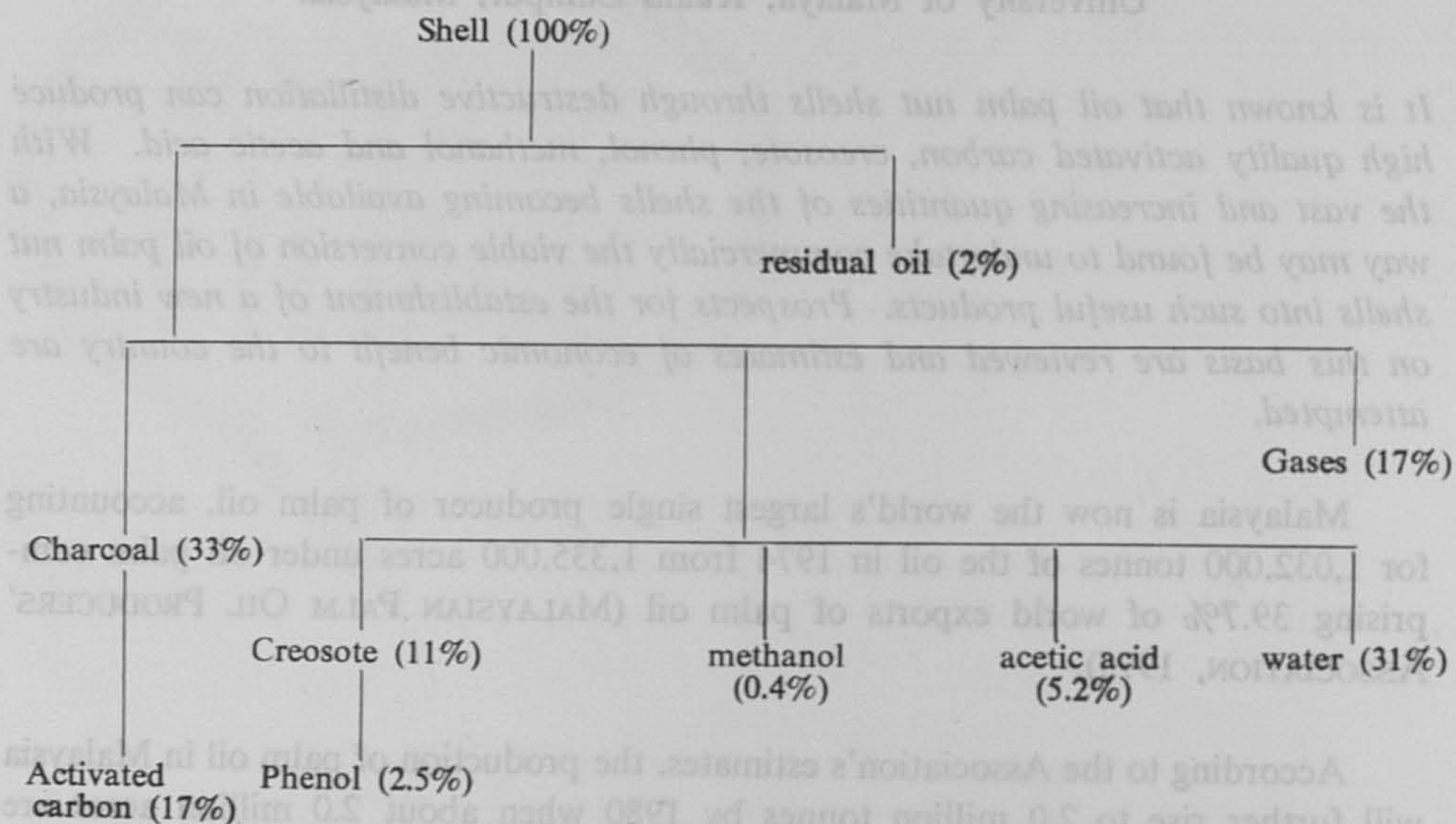

Figure 1.

It is highly possible to derive activated carbon of good quality from the charcoal obtained from the destructive distillation of oil palm nut shells for the following range of products results from the shells distilled: charcoal 33%, creosote (tar and phenolic compounds) 11%, methanol and acetic acid 5.6% and gases 17%.

Shells processed in crude kilns yield charcoal but such kilns contain no facility to recover creosote, acetic acid and methanol. The equipment used in the laboratory was however sophisticated enough to effect viable separations of products besides charcoal, also converting the latter into activated carbon.

DISCUSSIONS AND CONCLUSIONS

Processing fruit shells into viable products is not a new idea. Literature abounds in instances of such experiments, those on coconut shells being perhaps the most significant (Watson, 1919, Child, 1939). It was however once thought that production of palm oil would rise to such high levels as now especially in Malaysia, that sufficient quantity of shells would ever result leading to disposal problems (Georgi and Buckley, 1929).

Even granting that some 70% of the shells would continue to be burnt in the boiler houses of extraction mills, a considerable quantity of them would still be available for carbonisation, and for the extraction of other products of economic value (*Table 2*).

Table 2. By-products from oil palm nut shells in thousands of metric tons and values in US$ millions.

Year	Shells	Charcoal (value)*	Activated carbon (value)*	Creosote (value)*	Phenol (value)*	Acetic acid (value)*	Total value†
1975	300	—	51 (US$14m)	—	7.5 (US$5.5m)	15.6 (US$8m)	US$27.5m
		—	51 (US$14m)	33 (US$3m)	—	15.6 (US$8m)	US$25m
1980	600	99 (US$9m)	—	33 (US$3m)	—	15.6 (US$8m)	US$20m
		—	102 (US$27.5m)	—	15 (US$11m)	31.2 (US$16m)	US$54.5m
		—	102 (US$27.5m)	66 (US$7m)	—	31.2 (US$16m)	US$50.5m
		198 (US$18m)	—	66 (US$7m)	—	31.2 (US$16m)	US$41m

* Values quoted in parentheses are based on the following prices in US$ (per ton)—activated carbon US$270, charcoal US$90, creosote US$100, phenol US$730 and acetic acid US$500.

† Not included are residual crude oil and methanol, estimated at US$1.4m for 1975.

Hartley (1970) has estimated that the Tenera species of oil palm yields about 6.5% shell and 22% oil in terms of the weight of fresh fruit bunches processed. On this basis alone, Malaysian plantations would have some 300,000 tons of shell annually (at current acreages and yields) for disposal. The Dura species yields considerably more shell. *Table 2* shows that, at 1975 production levels destructive distillation of shells should yield some 51,000 tons of activated carbon and 33,000 tons of creosote or phenol with a total value of US$27.5 million. Their value (and production) could well double by 1980.

Extraction of palm oil from f.f.b. is carried out round-the-year in Malaysia, hence carbonisation of oil palm nut shells holds the prospects of a viable industry even for the production of charcoal.

Also, location of a carbonisation unit conveniently close to (or even in the same compound of) a palm oil extraction mill will result in considerable savings in the cost of transporting the 'raw material' for carbonisation—a prospect not shared by facilities utilising coke or coconut shells for production of activated carbon.

Production of creosote is also a 'boon' to Malaysia with her very large industries turning out wood-based products—creosote is an excellent preservative for timber and Malaysia, in 1975, is a net importer of this product.

With further refinements in extraction methods, it would be possible to consider also production of acetic acid, methanol and other chemicals resulting from carbonisation of oil palm nut shells on a viable basis.

A commercial-scale may cost about M$24 million while a pilot scale plant may be erected for only some M$150,000.

Utilisation of f.f.b. debris in this manner would also help to reduce considerably the problems encountered in the treatment and disposal of palm oil mill effluent. Thus, a new industry of considerable environment importance may emerge if serious consideration is given to disposal of f.f.b. shells through destructive distillation as envisaged by the authors.

Acknowledgement. This work is supported by a grant No. F 252/75 from the University of Malaya. The authors thank Mr. Muk Mun Tat of Socfin Co. Bhd for the supply of samples.

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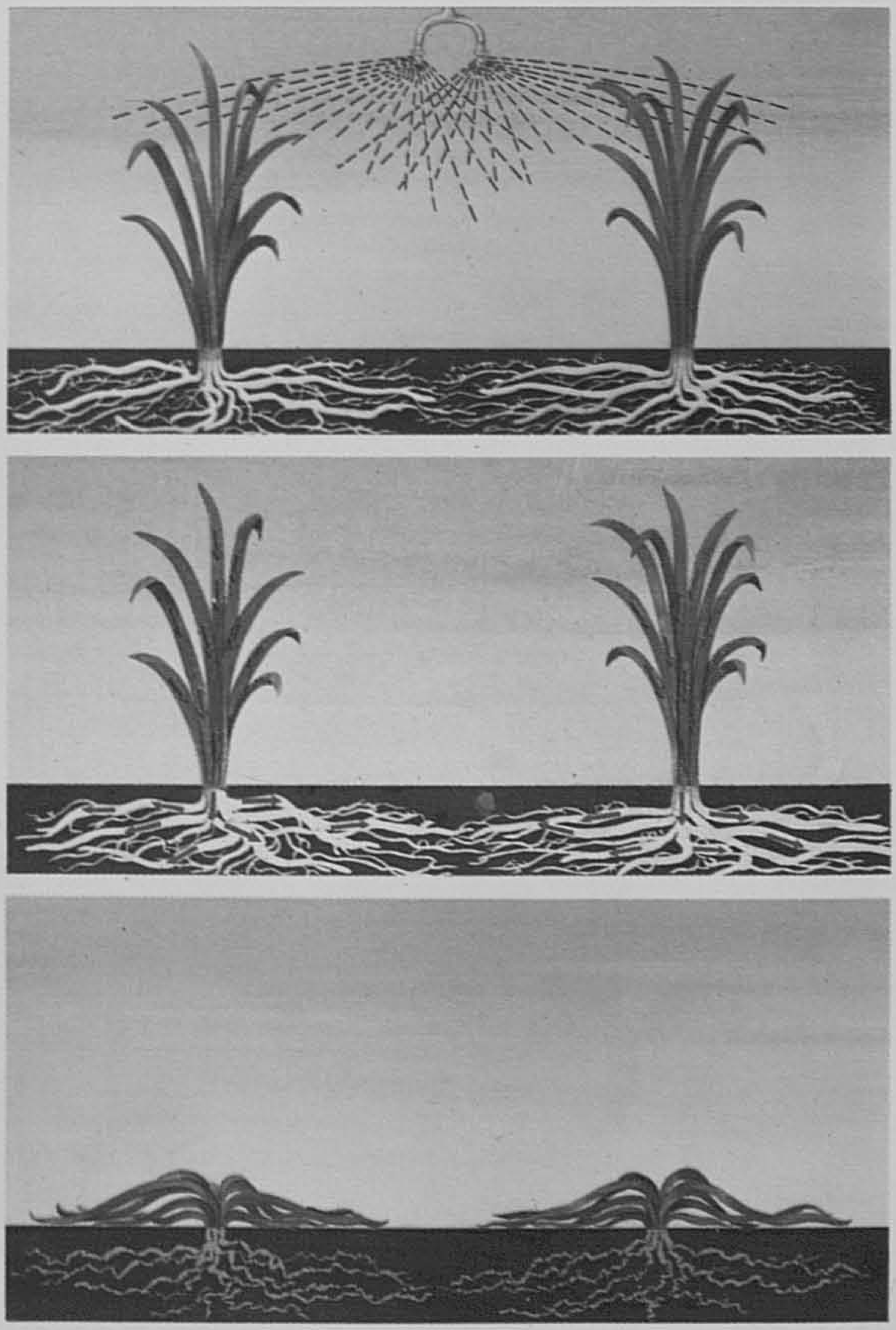

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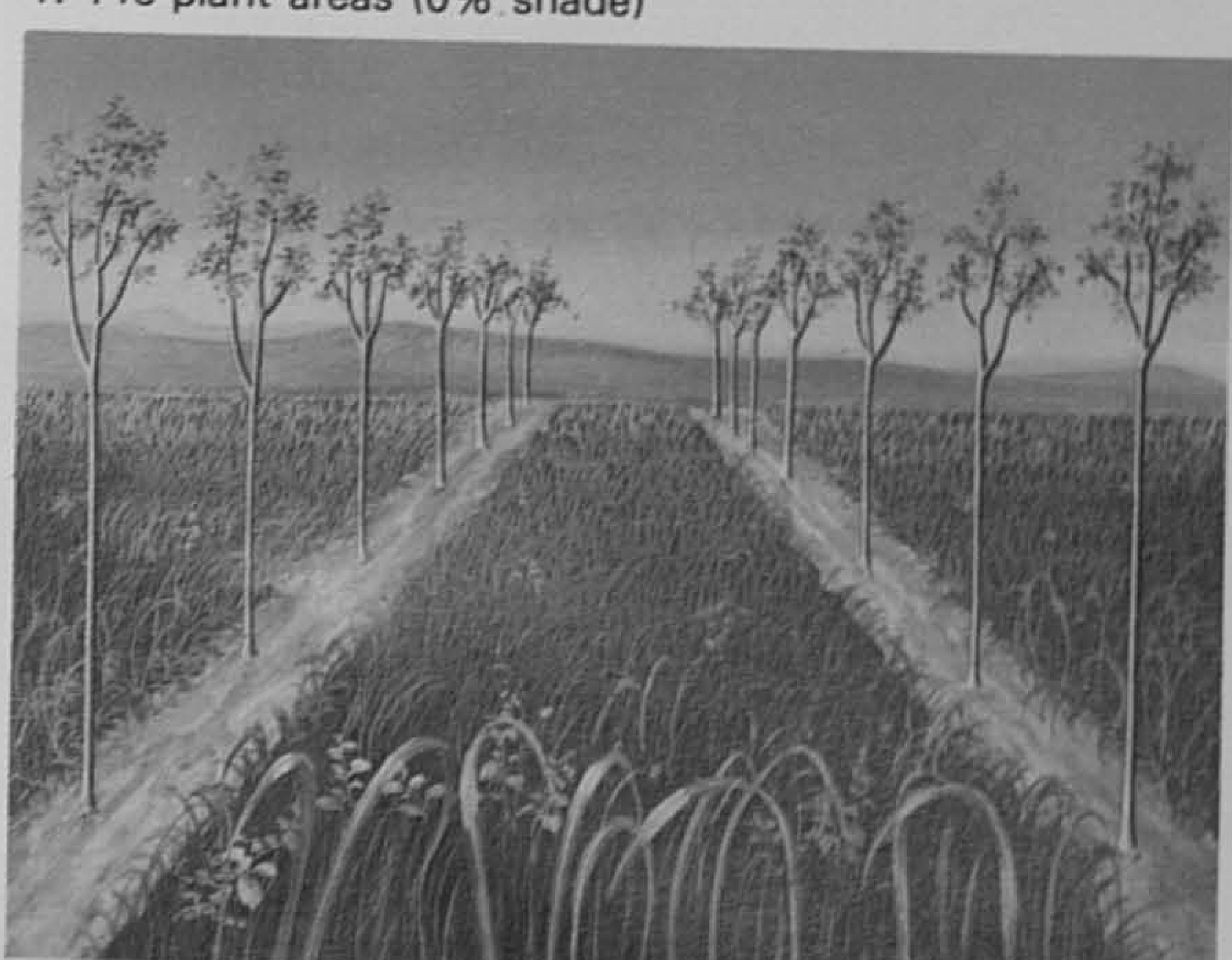

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Planter, Kuala Lumpur **52**: 131–138 (1976)

The Zenith process and refining of palm oil

YNGVE HOFFMANN

(translated from Oleagineux, Vol. 29, May 1974)

The last few years have shown increasing interest in palm oil. There are many reasons for this and, among other things, the production increase that is expected to take place during the next few years has already initiated an increasingly active marketing. According to certain estimates, the production is expected to double the 1970 figure of 1,700,000 metric tons up to 3,400,000 metric tons in 1980.

The composition of fatty acids in palm oil also means that it is not involved in the nutritional physiological discussions, which are mainly dealing with the C12- and C22-fatty acids. It also means that it is unaffected by stability problems due to high content of linolenic acid.

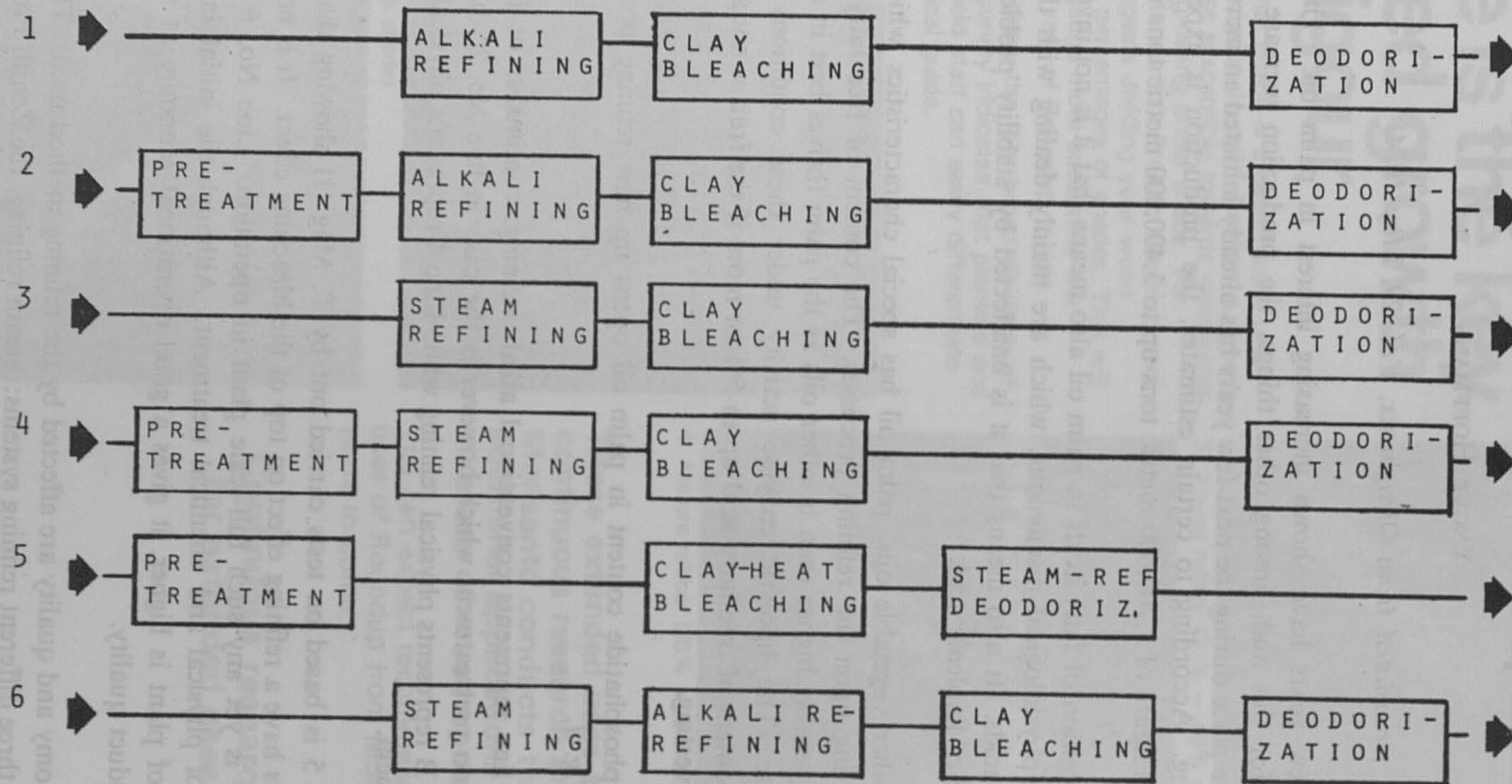
Like all other vegetable oils, palm oil has special characteristics which have significant bearing upon the refining processes. The content of free fatty acid is normally considerably higher than in other oils as the palm thrives best in a humid tropical climate. The lipolytic enzyme activity under these conditions rapidly increases the content of free fatty acid up to 5% or more if the fruit is not sterilized soon after harvesting.

The low phosphatide content in palm oil opens up new refining possibilities as shown in *Fig. 1.*

The first line represents conventional alkali refining, continuous or in batch. Here there is no pretreatment which however is the case in line No. 2, the Zenith Process. Line B represents physical refining while Line 4 represents physical refining with pretreatment.

Line No. 5 is based on tests carried out by T. Mag (1) showing that certain bleaching clays have a refining effect on top of the bleaching effect. It is not known whether there is yet any such full-scale plant in operation. Line No. 6 shows a combination of physical and chemical treatment. Although the initial investment for this type of plant is higher, it gives a good operational economy as well as a very high product quality.

The economy and quality are affected by the refining method used. This paper will deal with three different refining systems: steam refining, the Zenith Process and a centrifugal process. Contrary to the centrifugal process, where strong alkali—normally 4–N is used, the Zenith Process only uses 0.35–N lye.



Note : 1. Conventional; 2. Zenith process; 3. Physical refining; 4. Physical refining with heat treatment; 5. Mag's method; 6. Combined physical/chemical refining.

Fig. 1. Different methods of refining palm oil.

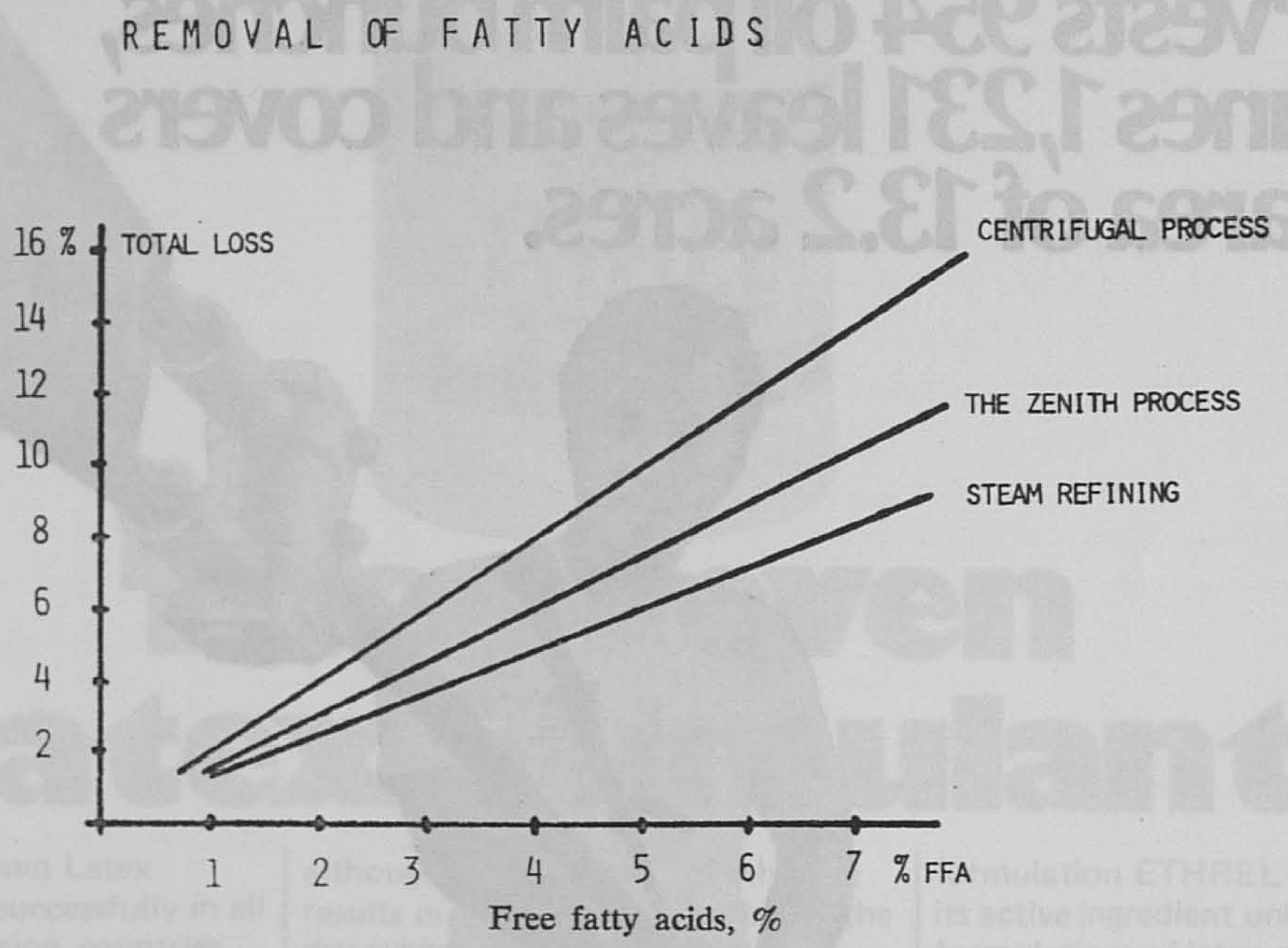


Fig. 2. Removal of fatty acids from palm oil.

There is no doubt that steam refining gives the best yields (*Fig. 2*). The Zenith Process gives considerably smaller losses than other continuous alkali refining methods. A palm oil with a content of free fatty acid (M–270) of 4% gives the following approximate losses per 1,000 tons of neutral oil.

Steam refining	...	8 tons
The Zenith Process	...	20 tons
Centrifugal Process	...	40 tons

In other words, the amount of neutral oil depends upon the refining process adopted. This has a very significant bearing upon the economies since the acid components do not command a good price in comparison to the neutral oil.

None of the methods used to remove fatty acids can easily give a final product with satisfactory and permanent bland taste. Pretreatment and/or subsequent treatment becomes necessary. Alkali refining requires bleaching and deodorization to produce a final product with good taste values. There is an established taste level and taste durability which to a great extent depends on the state of oxidation of the final product.

Steam refining requires bleaching, partly in order to remove the heavy metals that affect the stability, thus requiring considerably larger amounts of bleaching clay than that which would have been necessary just for colour removal. Moreover, the

bleaching temperature is usually higher. This change in bleaching conditions causes a reduction of the oxidation level in the steam refined product and better taste values from an oxidation point of view. However, the problem of formation of cyclic compounds resulting from the breakdown of carotene exists.

Our limited trials with steam refining have not convinced us that steam refining yet gives the same quality values as alkali refining according to the Zenith method. Therefore, an interesting combination for those who refine palm oil with a high free fatty acid content is of course No. 6 in the *Fig. 1* wherein one tries to utilise the advantages of both systems.

However, one set-back in the steam refining is that it requires a larger amount of bleaching earth than usual: 3% activated bleaching clay is needed during steam refinnig while 1.5% is sufficient during alkali refining.

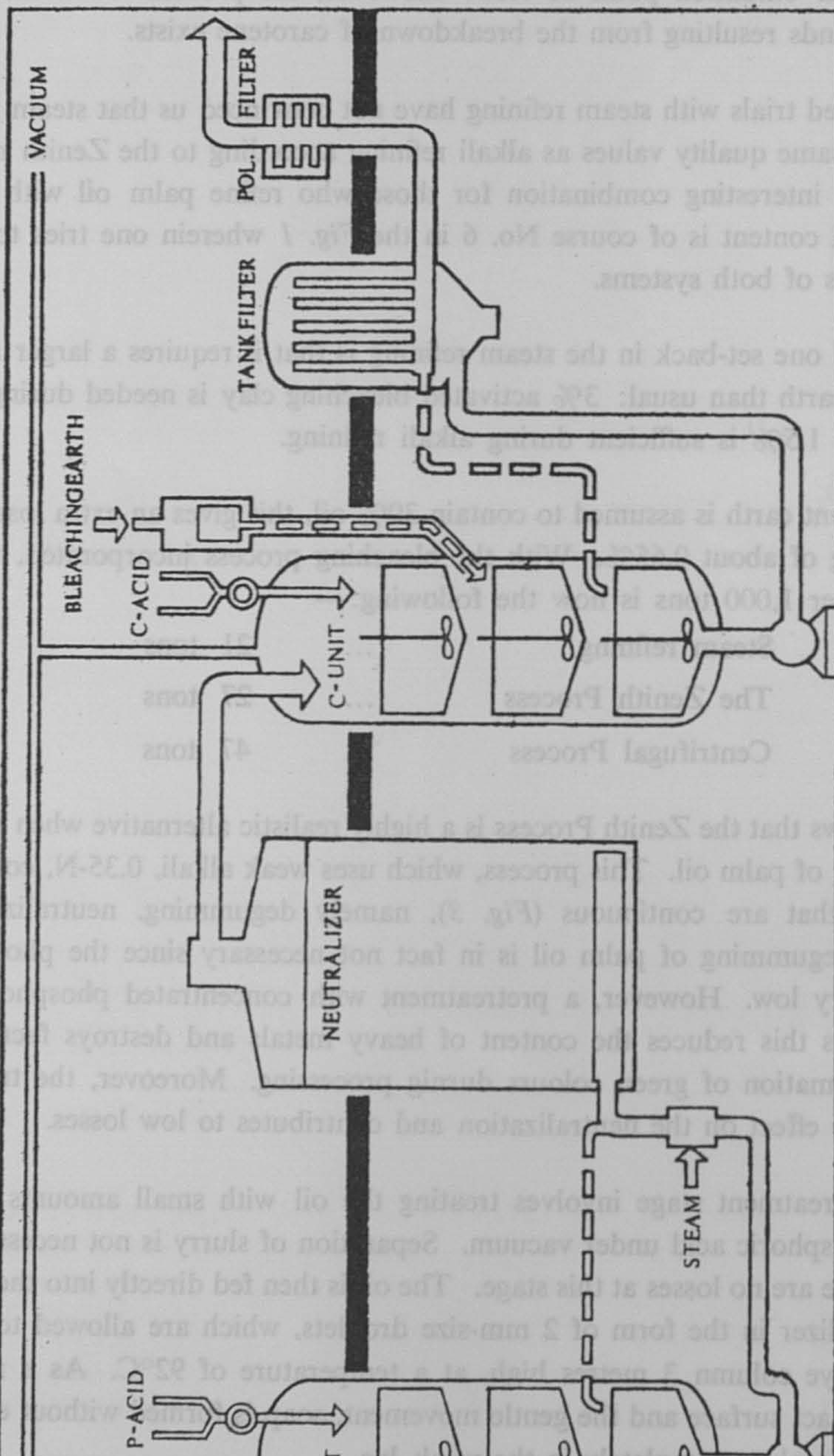
If the spent earth is assumed to contain 30% oil, this gives an extra loss during steam refining of about 0.65%. With the bleaching process incorporated, the loss comparison per 1,000 tons is now the following: —

Steam refining	...	21 tons
The Zenith Process	...	27 tons
Centrifugal Process	...	47 tons

This shows that the Zenith Process is a highly realistic alternative when it comes to the refining of palm oil. This process, which uses weak alkali, 0.35-N, consists of three stages that are continuous (*Fig. 3*), namely degumming, neutralizing and bleaching. Degumming of palm oil is in fact not necessary since the phosphatide content is very low. However, a pretreatment with concentrated phosphoric acid is valuable, as this reduces the content of heavy metals and destroys factors that cause the formation of green colours durnig processing. Moreover, the treatment has a positive effect on the neutralization and contributes to low losses.

The pretreatment stage involves treating the oil with small amounts of concentrated phosphoric acid under vacuum. Separation of slurry is not necessary and therefore there are no losses at this stage. The oil is then fed directly into the bottom of the neutralizer in the form of 2 mm-size droplets, which are allowed to ascend through the lye column 3 metres high, at a temperature of 92°C. As a result of the large contact surface and the gentle movement, soap is formed without emulsion which then dissolves completely in the weak lye.

Coming out from the top of the neutralizer, the oil is fed into the bleaching tank, where initially, soap traces are split by the addition of citric acid in aqueous solution. After drying, the oil is bleached using bleaching earth added under vacuum. After this the oil is filtered and is transferred for deodorization.



Symbolic flow chart

Fig. 3. Symbolic flow chart in the Zenith process for refining palm oil.

Many yield operations in full factory scale have shown that the total loss factor for palm oil refined by the Zenith Process is 1·4. As has been shown in a previous article, this factor represents the relation between practical loss in the refinery and theoretical loss according to laboratory determination of neutral oil in the crude oil. The explanation for this low loss factor is that the saponification of neutral oil is kept at a low level and that no emulsion is formed.

A crude palm oil with an oxidation value of over 25 is often difficult to refine to a good taste stability, regardless of the refining method used. It is therefore necessary to pay the greatest care also during processing, transportation and storage of crude palm oil. There is no way of removing secondary oxidation products from an oil and therefore an oxidised oil must be regarded as destroyed from a durability point of view. *Table 1* shows the average values for arrival analyses of 29 quantities of crude palm oil.

Table 1. Averages of values obtained in analysis of 29 samples of palm oil on arrival at destination.

Levels	Oxidation values			FFA	Calorimetric colour			Lovibond 1" cell		
	PV	AV	OV		460nm	550nm	670nm	Red	Yellow	Total
Maximum	—	—	35.8	4.0	—	—	—	—	—	360
Average	8.5	5.2	22.2	2.6	126	1.2	0.1	26	28	288
Minimum	—	—	12.6	1.9	—	—	—	—	—	250

Lovibond Total = 10 × R + Y

The changes of taste due to oxidation are of course most easily observed in oils containing linolenic acid, such as soyabean and repeseed oil, where already an oxidation value of 2.5 in the refined oil will eventually cause taste problems. However, even the palm oil can easily obtain an off-flavour after a short period during storage if the oxidation value exceeds 5. The typical stearine-like palm oil taste can thus be directly traced to oxidation.

By working to a great extent under vacuum in a suitable construction, the oxidation value shows a steady decrease during a Zenith Process refining, *Fig. 4.*

The splitting of the triglycerides which causes free fatty acid of course also caused monoglycerides and diglycerides. Hans Halvarsson/Olof Qvist (2) have described a new method of determining low contents of monoglycerides in fats and oils. The results as applied on palm oil are shown in *Fig. 5.* Most of the monogly-

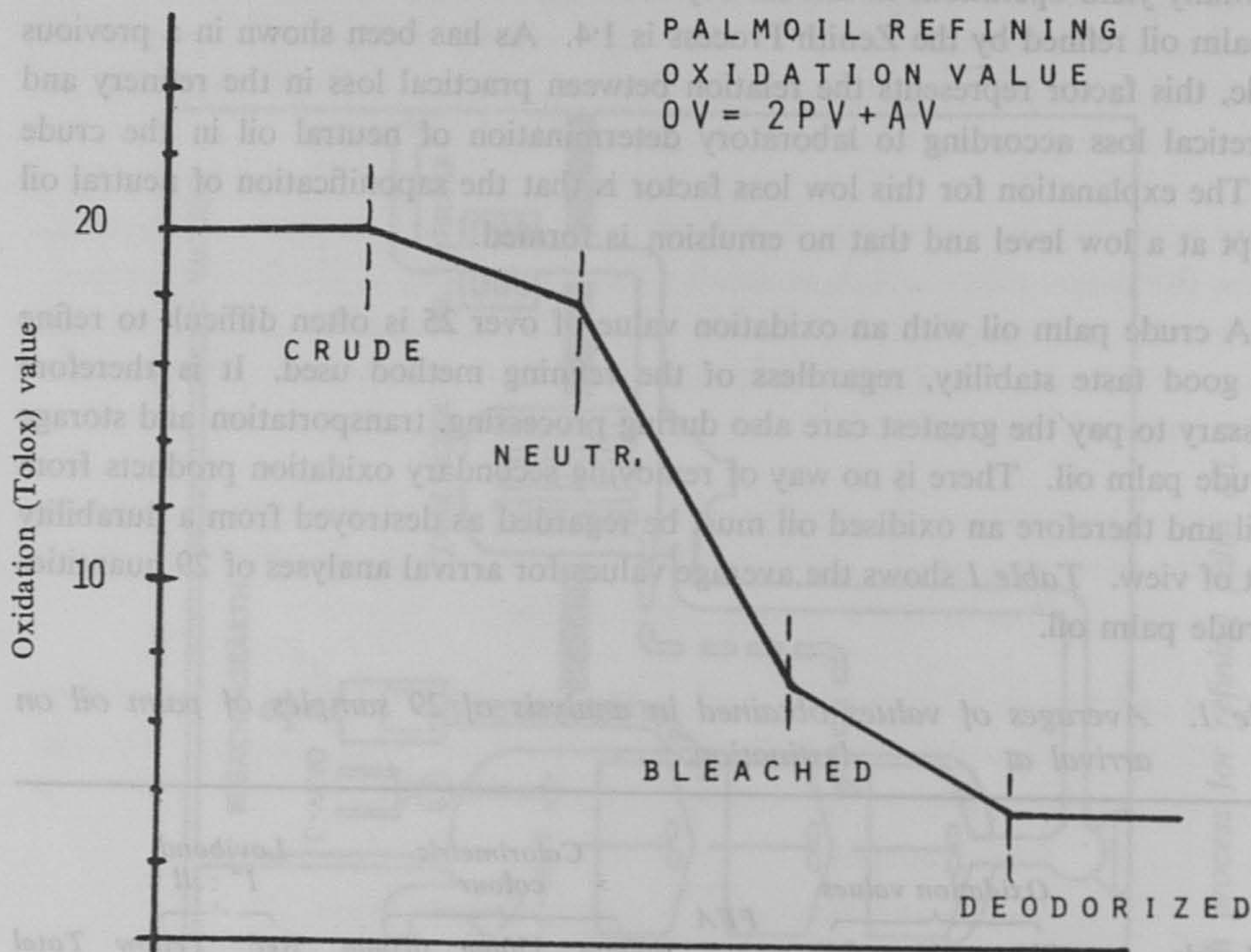


Fig. 4. Oxidation value of palm oil during refining.

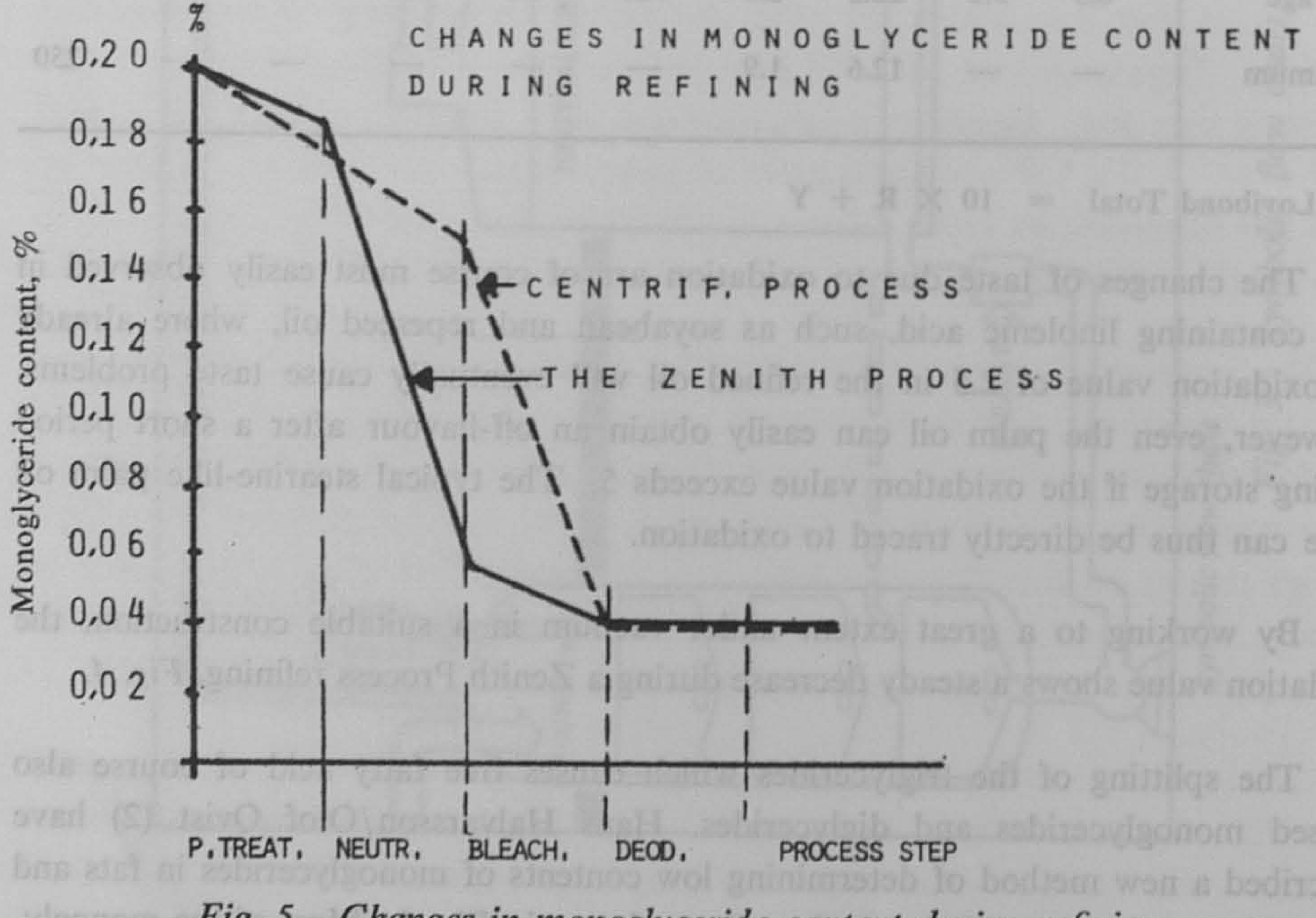


Fig. 5. Changes in monoglyceride content during refining.

cerides are removed in the neutralization step of the Zenith Process and only to a smaller extent in the bleaching stage. The strong lye neutralization in the centrifugal process does not remove the monoglycerides to the same extent. Only in the subsequent steps are most of the monoglycerides removed.

An essential condition for good taste durability is that the iron and copper values are kept low in refined oils. In crude palm oil there should not be more than 10 ppm Fe and 0.2 ppm Cu. In refined palm oil there must not be more than 0.1 ppm Fe and 0.05 ppm Cu. We have not had any difficulties in reducing the metal content to these levels with the Zenith Process. *Table 2* shows some normal values for some metals. This shows that the salts formed to a great extent are transferred to the weak alkali.

Table 2. Average contents of some trace elements in palm oil refined by the Zenith process.

Stage of oil / Trace element (p.p.m.)	Ca	Mg	Fe	Cu
Crude			10.9	0.22
Neutralized	1.0	0.5	1.5	0.10
Bleached 1.5%	0.1	0.01	0.1	0.05

Table 3. Colour removal during Zenith process of refining palm oil.

State of oil	Lovibond			Colorimetric		
	Cell	Red	Yellow	460 nm	550 nm	670 nm
Crude	1″	26	28	135	1.26	0.097
Neutralized	1″	24	20	133	1.22	0.068
Bleached (1.5%)	5¼″	10	30	38	0.33	0.034
Deodorized (240°C)	5¼″	1	15	0.18	0.03	0.006

Planter, Kuala Lumpur **52**: 139–145 (1976)

Water conservation

L. R. HERTSLET, AISP

INTRODUCTION

West Malaysia has just experienced a drought, the severity of which has varied from State to State. According to Press reports from Singapore, it has been the worst dry period experienced for over 100 years and very similar conditions applied to a very large section of Johor.

There is every probability that, with the massive exploitation of our Jungle Reserves for Timber and the subsequent conversion to agricultural enterprsies, the incidence of dry periods or droughts will increase. In addition, disregarding this probability of climatic changes brought about by changes of Malaysia's natural habitat, another factor of possibly greater importance related to this exploitation is that many of the major natural catchment areas are being logged and cleared with complete disregard for future water conservation.

The decrease in water reserves as noticed by the writer is portrayed in the following example.

During the 1960's, anyone travelling along the main roads in Johor only saw water storage containers placed along these roads for a limited period during the usual January/February dry spell. Now during the 1970's, it is a common sight to see these water storage containers remaining at the roadside for months on end, even in kampungs adjoining large rivers (possibly because the river is polluted) but, of greater significance, there is an indication that the normal water table has receded to below the average well depth. Such deficiencies are made good by Government hauling water for these areas and the cost of this service must be very significant.

This reduction of our total water reserves affects everyone, whether a city dweller or rural kampung villager. The main essence of this paper is how it affects the estates and what measures we can adopt to ameliorate the consequences of probable future droughts, if and when they occur whether to a lesser or greater extent than the drought just experienced in early 1976.

Most urban water supplies are drawn from major reservoirs or rivers, whereas the majority of estates have to rely on minor streams, swamps, in some cases rather doubtful wells, tube or otherwise.

THE PROBLEM ON ESTATES

Water consumption on estates may be divided into two categories "A" domestic supply, and "B" production supply. In the writer's opinion, category "A" is of paramount importance to maintain the well-being, health and good relations of our workers on any estate. Category "B" is of major significance to achieve acceptable financial returns in the production of the various commodities, and labour relations are very relevant to this aspect as well. If the production department is forced to have periodic closures or restricted shifts, it is likely that the field production will similarly be forced to follow suit, with the resultant problems of endeavouring to find alternative work for tappers or harvesters. To aggravate this problem, it is not unusual that during a prolonged dry spell, most weeding programmes are more than brought up-to-date, manuring schedules temporarily held over or restricted, and the difficulty arises of keeping the field workers fully employed let alone providing extra harvesters or tappers with alternative work.

An estate with a SMR factory or palm oil mill situated on it can be classified as a heavy utiliser of water, even an RSS factory requires a large quantity of water. The respective quantities of water required to produce one ton of processed rubber or to process one ton of ffb for rule of thumb estimate purposes are as follows: —

One ton RSS requires 4,500 gallons water.
One ton SMR requires 4,000 gallons water.
One ton ffb requires 200 gallons water.

A palm oil mill with a production capacity of 30 tons ffb per hour which is not uncommon, will require per shift of 8 hours approximately 240 tons of good water or 48,000 gallons. This is a significant amount of water.

During the latest drought, many palm oil mill water reserves in Johor reached absolute critical levels and in some instances temporary closures were enforced. In others, water was transported in by tankers. Rubber factories were similarly affected. These water problems encountered by the various production departments were aggravating to say the least, but in the writer's opinion, the major concern from information received from many estates in central Johor was the daily problem of providing sufficient water for domestic use, in many cases every gallon had to be transported to the central pump station or delivered to each house with the resultant disputes between families.

CATCHMENTS AND EARTH DAMS WITHIN ESTATES

As mentioned earlier, it is envisaged that these problems in regards to maintaining an adequate water supply for our estates will probably increase in the future. It is the writer's contention that these water problems can be reduced and in some cases eliminated completely by the construction of earth dams wherever possible.

Most estates have small streams contained within their boundaries which could be utilised as future water reservoir areas. A few acres of rubber or oil palm would have to be sacrificed, but the benefits will, over the years, well outweigh the loss in crop from these areas.

Prior to discussing the actual proposals and our procedure in the construction of dams, it must be noted that the law provides that no major water course may be blocked in such a way that it would reduce or prevent water users on the downstreams of the blockage of obtaining their just share of the water.

It is therefore recommended that small streams, as far as possible having their source contained within the estate, be selected if any consideration be given to the construction of a dam or dams on the estate. Another major reason for this recommendation is to eliminate the risk of the water reservoir becoming contaminated or polluted from areas outside the estate's boundaries. As regards the question of "what comprises a small stream?", the answer to this is any stream having a flow rate of 50 gallons per minute during the usual yearly dry period. This quantity of water flowing through an estate would amount to approximately 26,280,000 gallons per year. In addition to the above, should a dam be constructed on such a water course, there will be the added advantage of the underground water arising from subterranean seepage from the dam which would improve the downstream water flow.

ACTUAL EXPERIENCE WITH EARTH DAMS

Our experiences in respect to the above proposal are based on the situation we have on Kekayaan Estate, which forms part of the KLKB jungle complex, originally 28,000 acres in extent, now almost fully planted with oil palm. The main points of interest describing the initial steps taken to start this scheme of which the water supply formed the most important consideration are contained in Mr. J. E. Duckett's paper "Planning a New Estate Village in a Development from Jungle" presented at the ISP Estate Engineering Conference in 1975.

Apart from ensuring that the village would always have an absolutely permanent supply of domestic water, a further consideration requiring a semi-permanent water supply had to be ensured for the large oil palm nursery covering 52 acres in extent. Water flow tests were carried out on a small stream adjoining the area, the flow rate over a period of fairly dry weather indicated a mean flow rate of 480 gallons per minute (details of how to carry this out are contained in Edgar's Manual pages 543 and 544). This obviously was barely sufficient to cope with the nursery which was geared to pump 400 gallons per minute, let alone provide unrestricted water within reason for the village. The village comprising 500 houses once fully occupied would require a minimum of 30,000 gallons per day.

There are other streams flowing through the estate having a larger flow of water, but at the time of the investigations, the headwaters of these streams were not contained within the estate, subsequently KLK took over the additional jungle blocks and now the larger streams are contained completely.

We estimated that once the primary jungle was felled, the flow rate of the stream under investigation would probably be reduced, but we calculated that provided a large dam, of not less than 10,000,000 gallons, was constructed, this stream would serve our purpose.

Dam site investigations then commenced. A site where the two sides of the ravine or small valley narrowed was selected; at the same time due consideration was given to the area eventually to be flooded to ensure the maximum quantity of water could be retained over the minimum acreage.

By this stage, the jungle had been felled and burnt, it now remained to clear the actual dam area. The whole area which would eventually be under water was as far as possible cleared of jungle logs, these were winched out as the soft ground would not permit bulldozing. The reason for requiring the extraction of these logs was to reduce water contamination from decaying timber and, as a very secondary feature, reduce snagging for future fishing. At the actual dam wall site, the area was thoroughly cleared, all jungle stumps and debris were removed by hand, even the sand in the stream and friable top soil taken away. This was done to reduce any dam wall seepage between the filled earth and original soil base to the absolute minimum.

A 6″ steel pipe complete with 6″ gate valve 100 feet in length was laid on firm ground at the deepest point of the base. This pipe is laid for eventual silt removal and water control in the event of the normal overflow being reduced to an insufficient amount to supply the estate's requirements. We now realise this pipe is too small as in the event of us ever having to drain the dam, it would take weeks unless this operation was carried out during a drought which of course will be unthinkable. However, with the catchment area now fully covered over, it is in fact unlikely that a silting problem will arise.

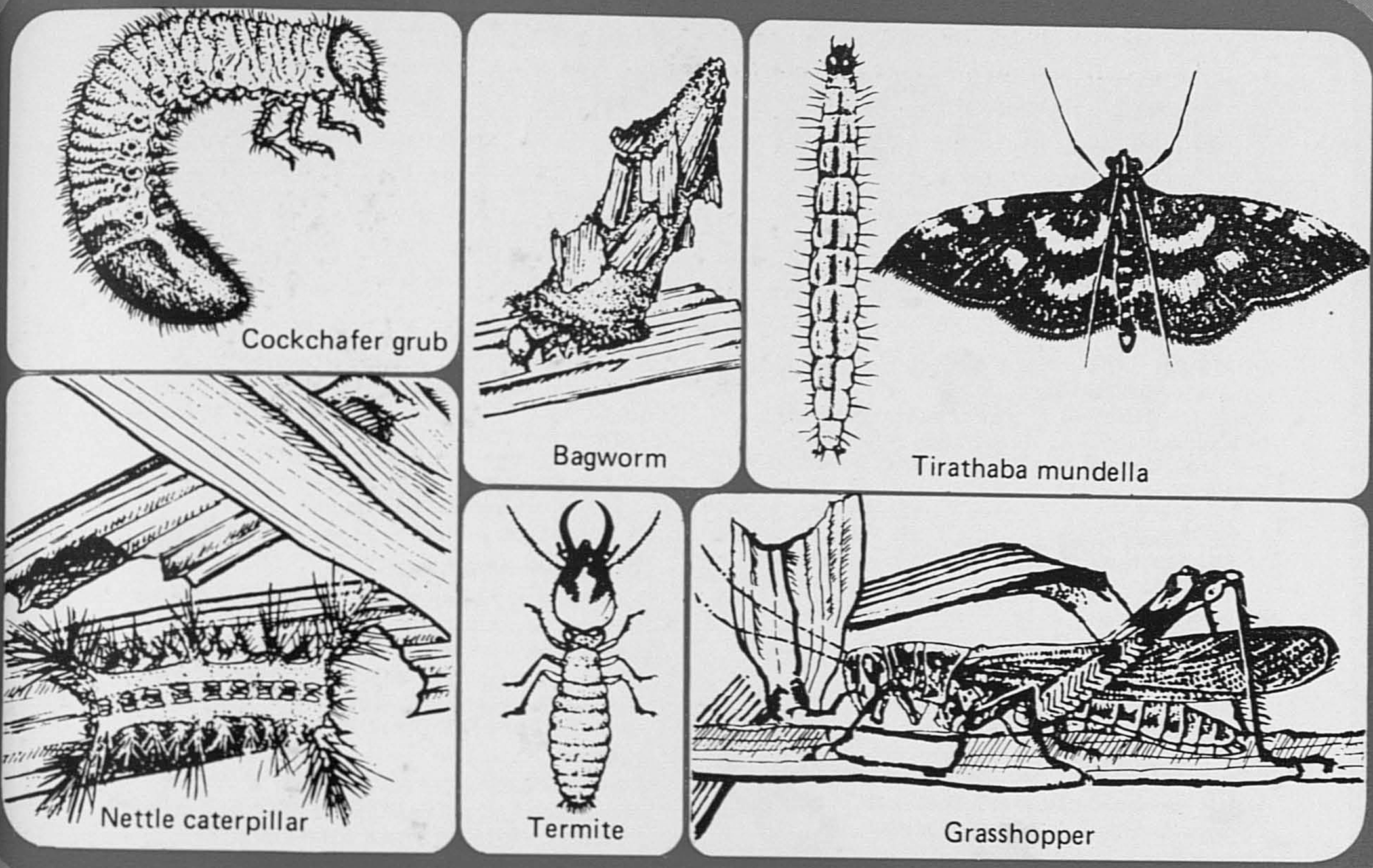
The stage was now reached when earth filling could commence. Prior to discussing this work, the actual earth wall dimensions of the completed dam were calculated to be as follows: —

1. Length at the base	...	70 feet
2. Length of top inclusive of the spillway	...	210 ,,
3. Width at the base	...	80 ,,
4. Width at the top	...	18 ,,
5. Height from the average deepest point	...	17 ,,

The filling of earth was carried out using a Caterpillar D6C, starting at one side progressively widening and raising the wall, eventually excavating from both sides to complete the wall to the dimensions stated above. Care was taken that the driver progressively compacted the wall as it was raised. This was essential as otherwise cracking and soil slip would have occurred at the soft sides of the wall.

Of paramount importance is the spillway to allow excessive flood waters to by-pass the dam wall without fear of breaching the wall. This spillway was excavated at one side of the dam wall from solid earth, the width of our spillway is 30 feet which in the writer's opinion is the absolute minimum allowed, but as our catchment area is comparatively small covering approximately 600 acres, we consider this spillway adequate. The cut of the spillway should continue on solid earth down the side of the ravine on a gentle gradient in order to lead any excessive floodwaters well away from the base of the dam wall thus avoiding any earth scouring from the area.

Finally once the soil had settled, all minor cracks were recompacted and filled. The whole dam wall to the anticipated future water level was planted with grass to avoid any minor soil erosion channelling.


Cockchafer grub
Bagworm
Tirathaba mundella
Nettle caterpillar
Termite
Grasshopper

The dam took almost two months to fill up, but of course this is subject to the amount of rainfall as with a heavy storm, this filling-up could be completed in a couple of days. The now filled dam covers 12 acres, having an average depth at the deepest area of 10 feet, with an overall estimated average depth of between 4–5 feet. This giving us an excellent water reserve of over 13,000,000 gallons. This average water depth could quite safely be increased by an additional foot, giving a further plus minus 3,000,000 gallons of water reserve. However, until the dam is completely grassed over and settled, we intend keeping our freeboard at about 7 feet thus reducing the pressure on the dam wall.

The actual costs of the complete operation to construct this dam were as follows: —

(a)	Felling and clearing jungle 12 acres @ $205 per acre	$ 2,460.00
(b)	Log extraction and site clearing ...	934.57
(c)	Pipe c/w valve inclusive of fixing ...	1,973.45
(d)	Earthworks ...	3,248.45
		$ 8,616.47

A total of 101 hours at $32 per hour for the hire of the D6C were taken to complete the earthworks, the cost per gallon for stored water works out at approx. 0.0006 of one cent on the total expenditure.

There is no doubt whatsoever that without this dam, we would have been in dire straits during the latest dry spell and although the water level to the dam dropped by over 2 feet, we were never forced to stop the spray irrigation of the 52 acres of our oil palm nursery although we did reduce on the frequency of the irrigation cycles. The domestic supply was not affected at all and regular supplies were maintained throughout the drought.

The writer has constructed other dams of a smaller size on Paloh Estate after the severe drought experienced from January–May in 1971 and it is pleasing to note that during the 1976 drought although their water reserves were considerably reduced the supply for domestic purposes on both divisions was maintained. We are convinced had it not been for these dams, all water would have had to be transported in to the estate.

PERTINENT POINTS IN THE CONSTRUCTION OF EARTH DAMS

1. A series of small dams down a ravine would probably be more beneficial than a single large dam. These series of dams increase the subterranean water, also the volume of water could be increased if the selected ravine were steep-sided by having dams of depth instead of the water being spread over a large area.

   The cost of a series of dams would probably be more expensive particularly in respect to outlet pipes and valves.

2. The valuable possibility of gravity feeding the estate water should not be lost sight off. Therefore, if possible on inland estates, the dam should be built well up the water course if there is any chance of thus having the dam constructed higher than the estate's existing water tanks or reservoirs.

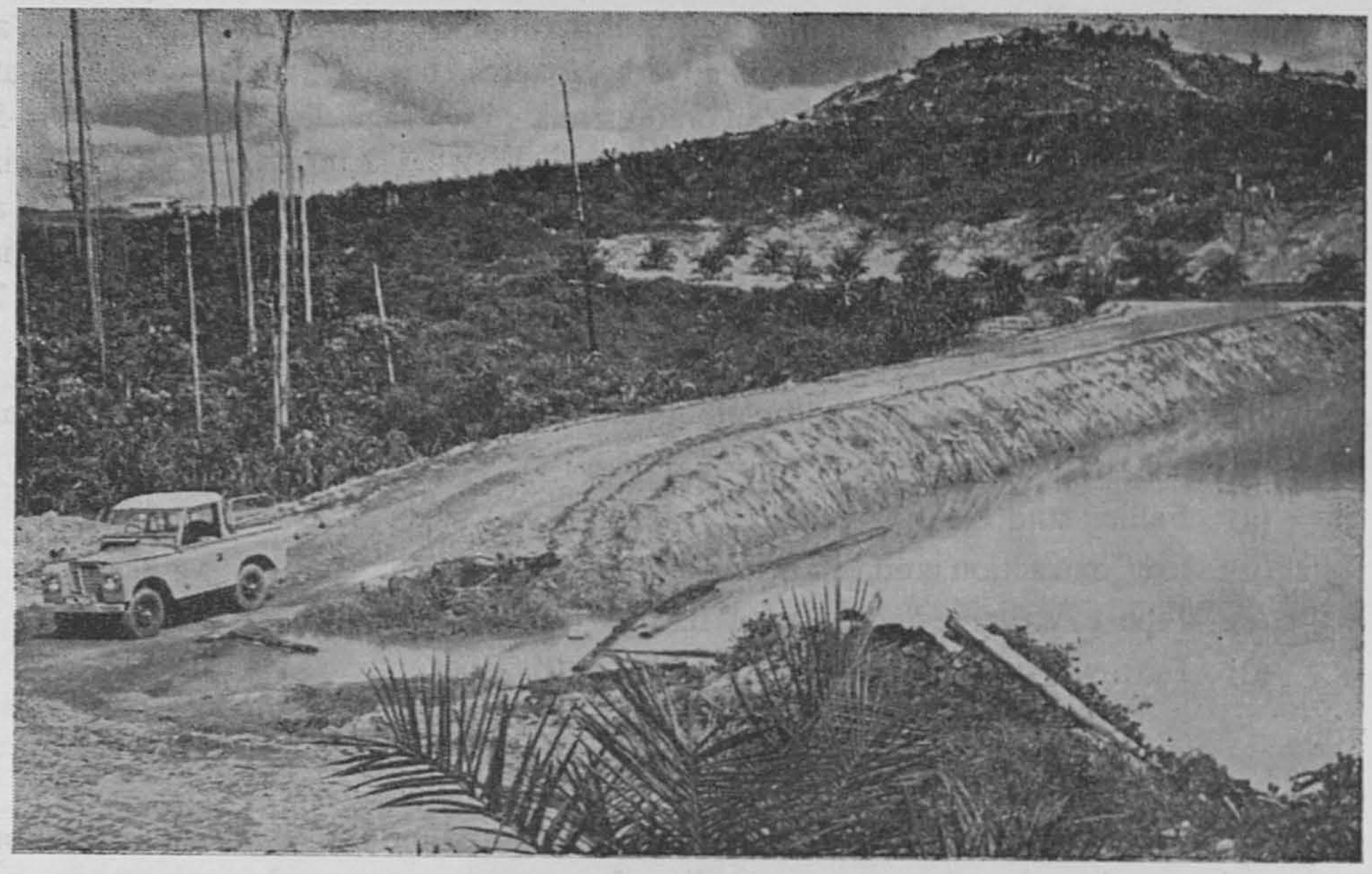


Figure 1. The dam at Kekayaan Estate with spillway at left of picture.

Figure 2. The reservoir contained by the dam at Kekayaan Estate.

A pipeline can then be laid connecting the dam directly to the bulk tank and no further pumping will ever be required. This of course would not be practicable where filtration plants are required and in this respect, it would appear that in the future, these may become a standard requirement.

3. It is advocated that the dams width at the base should not be less than 6 feet of compacted earth for every 1 foot of water depth *i.e.* 10 feet of water = minimum 60 feet of base. The writer can only base this advice on his personal experience, probably a civil engineer could improve on this.

4. The spillway should not be less than one quarter of the overall length of the top of the dam. Only the man on the spot can decide on this important factor as the catchment area feeding the dam is very relevant to this recommendation. The larger the catchment area, the larger will be the volume of flood waters rushing down the valley during a heavy storm.

5. It is worthwhile utilising the top of the dam as a road, this assists in keeping the dam wall compacted. Should this be decided upon the spillway can be cut accordingly allowing a gradual slope down both sides. An 'Irish culvert' or ford type spillway can be cast or a small culvert be placed to allow traffic to pass without creating muddy conditions. Thus, heavy storm waters can be permitted to flow over the spillway as intended.

   It is strongly advised that a large culvert should *not* be placed to act as a spillway, as this could become blocked during the odd freak deluges which do periodically occur, with the resultant chaos if the dam should be breached.

6. The writer strongly recommends the height of freeboard between the water level and top of the dam wall should never be less than 5–6 feet. The deeper the depth of water at the dam wall, the higher should be the freeboard and wider the width both at the base and top.

CONCLUSION

The writer is reasonably confident that with the construction of more dams on estates, the now almost annual problem of obtaining an adequate water supply for both domestic and production purposes will be a thing of the past. The capital expenditure required to carry this work is comparatively small in relation to the benefits derived from having a reliable water reserve.

Additional recreational facilities for our labour can be provided by stocking the dam with fish. We have stocked our dam with 16,000 Lampan Jawa. Once these fish reach a reasonable size, the dam will be thrown open for fishing by our labour on restricted days only. In addition to the Lampan Jawa, a number of local fish varieties have naturally taken up residence in the dam as well.

The writer would thank Kuala Lumpur Kepong Berhad for granting permission to utilise the experience gained in this subject in the preparation of this paper.


bm
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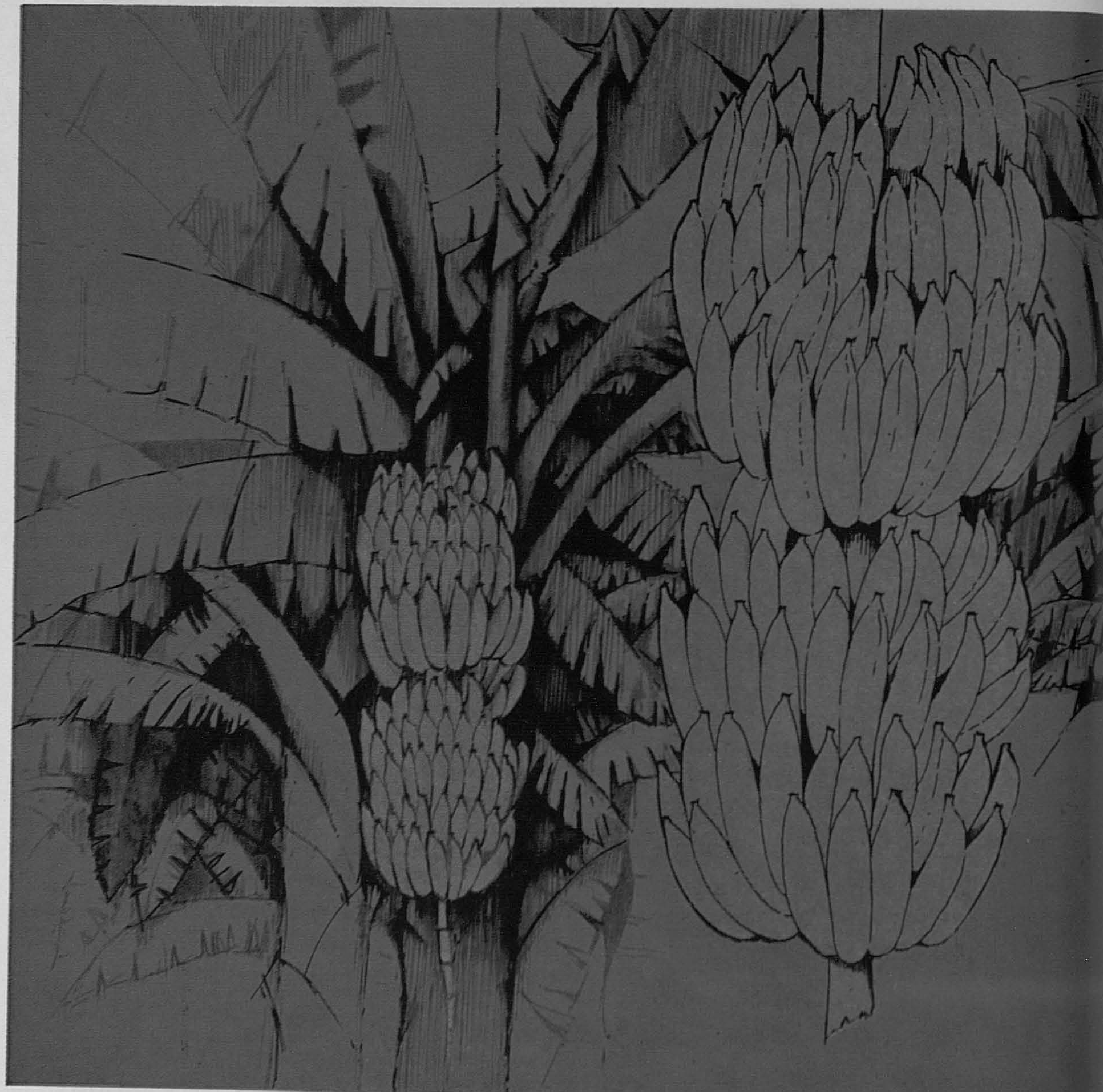


Taking Rubber into the 21st Century

(The U.S. meat processing industry long has said they used commercially everything but the pig's squeal and cattle's bellow. Natural rubber (NR) is heading that way. In a talk before the mid-September Financial Times/British Airways "Conference on Southeast Asia's Natural Resources and the World Economy." Dr. B. C. Sekhar, who as Chairman, Malaysian Rubber Research & Development Board (MRRDB), heads Malaysian NR's worldwide R & D operations, talked not only of the future of NR per se (good), but also of rubber tree by-product potential and other off-shoots of NR production. The following was adapted from Dr. Sekhar's remarks).

NR, from the closing 1970s right into the 21st century has no place to go but up, Dr. B. C. Sekhar, Chairman, MRRDB, told an international audience of top-level business executives attending the "Conference of Southeast Asia's Natural Resources and the World Economy," held recently in Kuala Lumpur.

His reasoning was pragmatic: petronomics deriving from the oil crunch, NR's qualitative and economic plusses in the NR/SR relationship, application of rubber wood to hitherto unexploited end uses, and potential development of 21st century polymeric materials not only from oil, but from the Hevea tree.

Sekhar went on to spell out just how the Malaysian NR industry was working to take advantage of these opportunities. Concerning the competitive relationship between SR and NR he noted that "synthetic isoprene rubber enjoys no technical or economic advantage over NR, rather the reverse.

"SBR has special virtues for the manufacture of car tire treads, but in most other products it has no real advantages over NR and much of its large use stems from 'captive' situations—where a fabricator is integrated with an SBR plant."

Pointing out that NR accounts only for just over 30% of the total world rubber market, as opposed to the virtually 100% held pre-1939. Sekhar stressed this was due to no inherent techno-economic weakness of NR compared to SR, but rather to the post World War II gap between world demand and NR's productive ability to fill its share.

"Since 1945", Sekhar said, "total world rubber demand has grown at about 7% annually, while NR production, constrained by the prewar years of production restriction and world depression, grew over much of the last three decades a little more than 2% per year, though in recent years it has accelerated considerably. Therefore NR's share inevitably shrank and was taken over by petrochemically produced SR."

This, though, is no sign post to the future. With an eye to determining just what that future might be, MRRDB took a definitive look at the possibilities.

"We did an in-depth global study of the techno-economic requirements for rubbers in major applications including tires (which absorb about 65% of NR/SR production)," Sekhar stated.

Accepting that an adequate supply of NR at stable prices could be made available, the study concluded that NR's potential share of the rubber market is about 60%. "After making allowance for available and committed supply of synthetic isoprene rubber," Sekhar said, "we arrive at the conclusion that the NR's *normal* share for the future could be around 50%."

"From the more practical point of view," Sekhar went on, "taking into consideration marginal processing of certain synthetics, a more conservative estimate is 42% to 43%. *Given these facts we are—perhaps for the first time since the NR industry started—in a position to make properly based long-term plans for the future growth of the NR industry.*"

WORLD ELASTOMER REQUIREMENTS

Knowing what NR's share of the future world rubber market should be, the size of that market becomes a factor. "For the 1980s figures have been quoted ranging from 14,000,000 to 17,000,000 tons," Sekhar said.

The world consumption spectrum shows current *per capita* usage going from some 0.3 kilograms/person/year in China, to approximately 14 kilograms/person/year in the U.S. In general, the industrialized Western countries have high rates of per capita consumption, with China, Russia, East Europe, India, and similar countries at the low end of the scale.

Sekhar said that all indications were that developing country *per capita* consumption "will be significantly greater. There is thus every likelihood that total usage of elastomers in the early 1980s would be of the order of 16 to 17 million tons. "To fulfill NR's 42%/43% techno-economic potential would require production of "not less than 6 million tons, double NR's present total production capacity."

PRODUCTION POTENTIAL OF NR

Can NR production meet the 1980's projected isoprenic rubber demand? Sekhar is sure it can. Using the Malaysian scene as "an example of things to come," he stated, "in brief, production potential can be assessed by the technological innovations available for implementation in the immediate future.

"These are: (1) Availability of precocious high-yielding planting materials: (2) reduction in immaturity period; and (3) availability of exploitation systems which will enable planting materials to express their full genetic potential." The status in each of these areas is good.

(1) *Availability of High-Yielding Planting Materials*

"Through genetic upgrading of planting materials, the yield capacity of Hevea has been progressively increased from 500 kg/ha/yr before World War II to over 2,500 kg/ha/yr commercially available today.

"New planting materials in the pipeline at various stages of development are providing yield levels in excess of 3,000 kg and displaying yield patterns that can only be described as 'precocious.'

"Plant breeding based on mean yields of popular planting materials estimated over a 15 to 20 year production period, raised kg/ha/annum yield as follows: 1920s—560; 1930s—980; 1940s—1120; 1950s—1460; 1960s—2350; 1970s—3360.

"Beyond this rise in output, the newest high-yielding planting materials are precocious in that they not only produce more, but start younger. Their yield pattern provides markedly higher yields in the early years of tapping."

Comparing these figures with Malaysia's current national average yield of 1,000 kg/ha/yr, Sekhar stated "there is therefore the proven potential of doubling the national average." He stressed, though, that "achievement of this is dictated by the rate of replanting."

(2) *Rate of Replanting*

"Malaysia has had from 1953 an organized replanting program for both estate and smallholder sectors. This has enabled the industry to achieve a fair measure of economic viability through the years."

"While the estate sector has achieved over 90% replanting efficiency, the smallholder sector in 1973 reached some 67%. Intensive efforts now are under way to close the estate/smallholding replanting gap."

(3) *Immaturity Period*

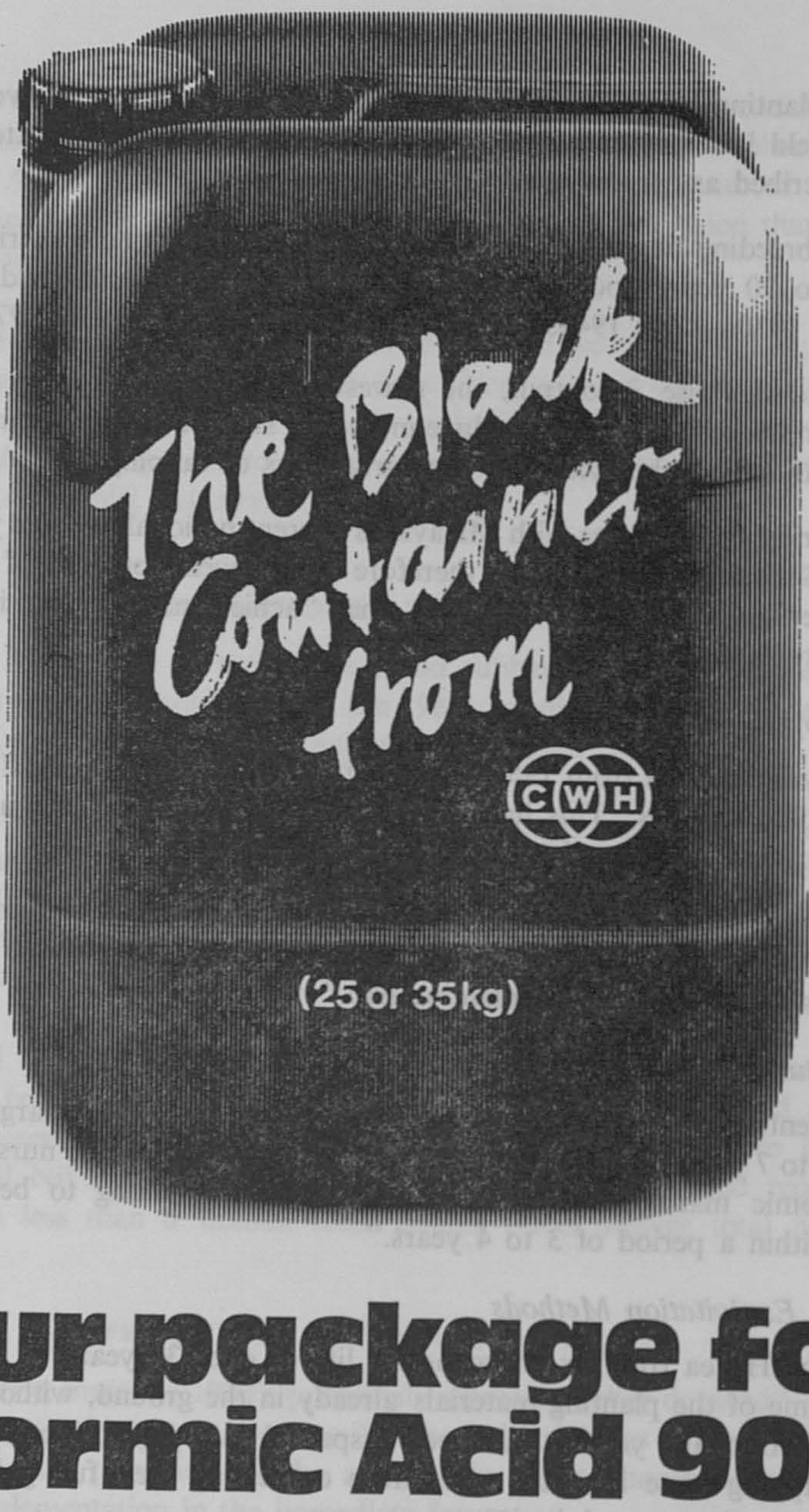
"Conventional methods of planting and propagation have largely dictated a period of 6 to 7 years for trees to be brought into tapping. Unique nursery techniques and agronomic management advances now enables planting to be brought into maturity within a period of 3 to 4 years."

(4) *Novel Exploitation Methods*

"As the Hevea tree has an economic life of over 30 years, it is necessary to upgrade some of the planting materials already in the ground, without resorting to replanting. For many years it has been suspected that physical barriers to flow of latex on tapping have inhibited trees from expressing their full genetic potential, waystopping optimum exploitation.

"New methods of stimulation using the hormone ethylene gas in the tissue of the tree during tapping has removed some of these barriers to latex flow. In effect, proper use of this stimulant in the presence of adequate fertilization has been shown to substantially increase and in many instances to double yield levels.

"The combination of these developments of faster maturity, precocious high-yielders and novel methods of exploitation of all planting materials represents a very significant potential for decidedly higher national yield averages in the coming decade. The rate at which this potential is realized obviously will depend on the speed with which the innovations are implemented."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PERCETAKAN MAJU, K.L.

IMPLEMENTATION OF INNOVATIONS

"As a product, NR represents the direct livelihood of no less than 25 millions of people in Southeast Asia. In the raw state NR has a turnover of M$5,000 million in Southeast Asia, and in the manufactured state approximately M$80,000 million in the world as a whole.

"In Malaysia, the smallholder sector represents 67% of the planted acreage, comprising some 500,000 smallholders. In Indonesia, the percentage of smallholdings is 78%, and in Thailand, 95%. Rubber accounts for 40% of Malaysia's export earnings, 30% of Indonesia's and 14% of Thailand's.

"With this heavy dependence of development and growth in this region on NR, and the non-availability of any real agricultural alternatives not facing techno-economic problems, there is a clear recognition of NR by national planners.

"While diversification of the Malaysian economy has been successfully introduced, NR continues to remain the very spinal cord of that economy. There is therefore a concerted and planned approach in Malaysia for insuring the speed of implementation of technological innovations, particularly in the smallholder sector.

"Similar actions are being taken in other producing countries in Southeast Asia. While the rate of progress of implementation will vary from country to country, there is no doubt that the new innovations will become manifest in the years to come."

NR AND THE "ENERGY CRISIS"

"So far, I have in effect made two points: (1) NR has a techno-economic potential far exceeding its present status, and (2) NR production capabilities should well be able to move towards this potential during the 1980s. Obviously, the advent of the "energy/material" crisis, plus global concern for environmental pollution adds force to the general proposition that what is needed is more NR—a lot more.

"The reason why SR was able, in the 1950s and '60s, to fill the gap left by NR's inability to satisfy world rubber demand, is that it was produced in large volume from very cheap feedstocks from oil. During that period also, the SR producers were able to take advantage of economies of scale; plants became bigger and unit costs fell.

"Feedstock costs now have risen sharply. Between 1967 and 1974, Naptha went from US$20 per ton to $130—Benzene, from $74 to $500—Butadiene from $185 to $385—Styrene, from $180 to $800—and Isoprene, from $275 to $660.

"At the same time, scale economies are at the end of the line, plant construction costs have escalated and the cost of capital has inflated exceedingly throughout the world. No longer is NR faced with one-sided competition. This situation is not simply a feature of energy shortage or energy crisis. Even when these are over, petroleum will not any more be a cheap feedstock.

"Oil is an exhaustible resource within any reasonable time scale. After all, in a time period measured in millions of years, it is sunlight energy which is stored through photosynthesis in plants which decay and end up as petroleum. This petroleum then becomes the source of petrochemicals, leading to synthesis of synthetic rubbers. In contrast, the Hevea tree photosynthetically converts sunlight energy into natural rubber everyday."

THE 1980s AND BEYOND

Noting that NR was in rising global demand for its inherent polymeric qualities, as well as being nature-clean and an ideal cash crop for the millions throughout Southeast Asia it helps support, Sekhar summarized, "Thus, NR is in the happy position of a material which is urgently needed by the consumers and can at the same time provide it producers, both as individuals and nations, with a steadily expending cash flow."

He then went into the possibilities of the Hevea tree beyond NR. "The overall materials crisis—and this is a much wider affair than the more highly publicized energy crisis," he said, "is hammering home to the world the fragility of the structure on which the world economy rests.

"Most materials in the 'exhaustible' class are running low; for many, the experts talk in terms of 20–30 years supply left. Admittedly, past experience has shown that such forecasts often are unnecessarily alarmist, but it is after all axiomatic that exhaustible materials cannot last forever.

"In the case of polymeric materials—this includes plastics as well as rubbers—it is not difficult to recognize the future need for a novel supply of material coming from renewable resources. It happens of course that the rubber tree produces NR and the world has made use of this as a rubbery material for several centuries.

"But it is not necessary to stop there. One can think of the rubber tree as being simply a provider of a raw material, a 'natural feedstock'. It is possible to manipulate the chemical molecules emerging in the latex—to break these down to rebuild in different forms giving different properties.

"Some thinking along these lines has gone on in rubber laboratories for years, but it has been somewhat desultory, mainly interested in special-purpose modifications. I believe that the materials crisis must now force us to take a much wider look at the possibilities of developing the polymeric materials of the 21st century not only from oil but also from trees such as Hevea. In effect, the 'petrochemical era' is to an extent phasing out, and we shall move towards a 'biological era' for the production of petrochemical materials.

"The efficiency of sunlight energy conversion through photosynthesis can be utilized not only for rubber production, but also for vegetative growth. Rubber wood has been shown to produce very satisfactory timber for a variety of applications including furniture and panelling. The pulp also can be converted into packaging materials.

An acre of rubber can give as much as 15 tons of timber at the end of 20 years from planting. Hevea trees can therefore be cultivated as a source of timber and pulp, in a 20-year replanting cycle, with rubber being extracted for 16 years as a byproduct! This is a prospect which is being seriously looked into.

"The new 'biological era' we now are entering affords exciting possibilities for cooperation and coexistence with synthetics. I consider such complementary interrelationship imperative in the interest of world economies. Regional and international cooperation among consuming and producing countries must be forged to insure raw material supply availability to the consuming world, and equitable economic return for the producers.

"For decades the NR industry has proven as resilient as its product, and remains so—poised to meet the exciting and challenging era ahead. As noted earlier, what is needed is more NR—a lot more. The NR industry is moving to produce it."

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The monthly crop

I.S.P. Library. The need for a library at the headquarters has become increasingly evident with many visitors, both members and non-members, seeking the use of I.S.P. library.

With the aim of providing a well organised library service we have engaged a trained librarian to 'set up' a library with the existing collection of reference books and journals. Our present collection, although is sufficient to start a library on a modest scale, is far from adequate to provide borrowing facilities. To overcome this problem as well as to build up a library with a wide range of agricultural books contributions from members, in the form of books and journals no matter how old they are, are solicited and the Society will be grateful for any contribution.

Wages — Bank Negara in its Annual Report for 1975 states that owing to the decline in the price of rubber, which averaged 135 cents per kilo in 1975, compared with 179 kilo in 1974, the tapper's daily wage declined by 18% in 1975, from an average of $6.50 in 1974 to $5.30 in 1975.

In the case of palm oil, it was estimated that the average daily earnings of a team of a fruit cutter and one carrier was $11.75 or $300/- a month, about the same level as the wage received in 1974.

Control of South American Leaf Blight — Goodyear claims their researchers have developed a means of containing this fatal rubber tree disease. Three years ago, Goodyear botanist Arnold Peterson began a programme to fight the blight, including aerial spraying of the trees with standard American fungicides during the Brazil winter (July).

'Any fungicide probably would've done the job.' Riedl noted. 'The problems were timing and application. When and how do you spray such a large area and be economically practical?' The first spraying resulted in better leaf structure, Riedl said, but no improvement in rubber yield. After the 1974 spraying, the yield improved slightly. In 1975, 'the September yield was up to 75% over last year,' Riedl stated, 'and October produced a record 78% increase.'

'Our plantation near Belem never was fully planted because leaf blight set in and discouraged us from developing the whole area,' Riedl explained. 'Now we're ready to finish planting and we're thinking of expanding elsewhere in Brazil.'

Workers' right to strike. In a recent case in which the Federal Court set aside the High Court Order and restored the award of the Industrial Court which ordered the reinstatement of the workers who had been on strike and subsequently been 'locked out', the Federal Judge Mr Justice Raja Azlan Shah said "Workers organisation cannot exist if workers are not free to join them, to work for them and to remain in them." Quoting a decision by English judge Lord Wright, Mr Justice Raja Azlan Shah said the right of workmen to strike is an essential element in the principle of collective bargaining. "This is a truism," he said. "There can be no equilibrium in industrial relations today without freedom to strike. If workers could not, in the last resort, collectively withhold their labour, they could not bargain collectively." —*New Straits Times.*

"Sandy's Spice"

A. A. Sandosham

Someone who had obviously read the last *Berita MMA* confronted me with "Shame on you! Imagine writing stuff that even the naughty Editor Pius thinks should be censored! I heard you used to attend Sunday School regularly when you were young. Didn't you learn anything there?"

Sunday School

That set me thinking of what I still remembered of my Sunday School days before the twenties. One of my old students, now an eminent physician, thanked me other day for having lectured to him as a youngster at the University. I was touched. I asked him how much he had learnt at my lectures that he had found useful. He said he had forgotten everything I had taught him except the jokes! That about sums up the situation with regard to my Sunday School days.

I can't say I attended Sunday School regularly. I used to play truant except during the period when my mother was a Sunday School teacher. I always preferred, on a Sunday morning, going out into the rice fields to catch fighting fish or to play marbles or spin tops but when found out I used to get a scolding from my mother. But then she is always scolding us boys and my father used to get his share too! So, after being repremanded one Sunday for playing truant, I turned to my father with, "Say, Pop, did you go to Sunday School when you were a little boy?" "Of course, regularly" he replied. "I'll bet it won't do me any good either" was my retort.

Sunday School teachers

Not all Sunday School teachers were popular, the most unpopular ones being those that made us learn by heart long passages from the Bible. The teachers were always changing and we were happy (owing to wishful misinterpretation) to read a notice saying, "In future, the Sunday School teacher for the following week will be found hanging on the Notice Board".

At Sunday School the teachers asked many questions and must have realised that we kids had a lot of misconceptions. Some thought Sodom and Gomorah were husband and wife and that the epistle was the wife of an apostle. Often the kids were responsible for unconscious humour. Asked what he knows of the Book of Life, he said it starts with a man and a woman in a garden and ends with revelations. One girl told the Sunday School teacher that before she started attending her classes she knew nothing about sin. She now knows that we are responsible for our own sins. It is no use putting the blame on someone else. Adam blamed Eve, Eve blamed the Serpent and the Serpent had no legs to stand on. Asked to recite a passage from the scriptures one said, "And Judas went out and hanged himself." Another said, "Go thou and do likewise." Asked to recite one of the Beatitudes one said, "Blessed are the pure in heart for they shall *inhibit* the earth".

Catechism

This was a set of questions and answers which we had to learn by heart. It started with: 1. *Q.* What is name? *Ans:* M. or N. 2. *Q.* Who made you? *Ans:* God made me. I heard of a little boy who didn't know the correct answer to this question. When asked "Who made you" he replied "My father made me". The Sunday School teacher said, "Go home and ask your mother. She is a Christian woman and will be able to tell you". The following Sunday when asked he said "My mother told me it was not my father. It was someone else. She mentioned another name and I have forgotten it".

There are many questions and answers in the Catechism book and when asked how far they had got one boy replied, "I've come to original sin" and other proudly said, "I'm way beyond redemption".

"What are sins of omission?". "Those you ought to have committed but didn't."

The Ten Commandments

When the teacher asked the class what was Moses famous for, a boy said, "He was the first man to break all the Ten Commandments at the same time".

Asked to recite any one of the Ten Commandments one boy said, "Thou shalt *huhour* thy father and thy mother". Another, "Thou shalt not *omit* adultery".

Two adolescent girls walking home after listening to a sermon on the Ten Commandments commented. "At least we are not guilty of making graven images and worshipping them".

The Bishop

The arrival of the Bishop of the Diocese was a great event in Province Wellesley where I lived. When he appeared in gaiters and purple scarf we could imagine a halo round his head. It was a shock therefore to see headlines in the newspaper which read, "BISHOP ARRIVES. CLERGY IN RETREAT".

The Lord Bishop used to visit our Sunday School while in session and ask questions to find out how much of the scriptures we knew. "What did Samson arm himself with to fight the Philistines?" he asked. Someone said "The axe of the Apostles". "No, that is wrong, think again". There was a prolonged silence and to jog their memory the Bishop tapped his jaw and asked what that was. Everyone in unison shouted, "The jawbone of a jackass". On learning from the teacher that the class had just had a lesson on the prodigal son, the Bishop said, "In the midst of all the celebrations for the Prodigal Son's return, there was one for whom the feast brought no happiness, only bitterness. Who was that? A boy replied, "The fatted calf".

I was told of a Bishop asking a class in U.S.A. who was the greatest person who had lived on this earth. An American boy replied, "George Washington". The Bishop agreed that Washington was a great man but there was one who was even greater. A little Jew boy put up his hand and said, "Moses". Again the Bishop conceded that Moses was a great man, greater than Washington but there still was one who was even greater than either of them. There was a prolonged dead silence. Out of sheer boredom one boy stuck a pin into the bottom of the boy in front. Up he jumped in pain and blasphemed out loud "Jesus Christ"! "Quite right, my boy", said the Bishop and handed him a $10/- bill as prize.

Logical minds

Kids can be most logical in their thinking. Asked in what order the books of the Gospel appeared in the New Testament one replied, "One after the other". To the question, "What must we do before we can expect forgiveness of sins?" one said, "We must commit the sin first! " When asked, "What was the forbidden fruit responsible for?" the reply was, "A pretty bad jam".

"Good morning, Father", said a boy to the Protestant Priest in cassocks. "He is no Father. He is married and has two kids", said the Catholic boy.

After narrating the story of how two she-bears ate up forty-two children who teased the prophet Elisha on his way to Bathul the teacher asked what it had taught them. One boy said, "It shows how many kids the stomach of two she-bears can hold".

After listening to a theological discourse on Immaculate Conception by the Bishop, a girl asked her mother, "What is the advantage of this "maculate conception" over the normal thing?". The mother couldn't answer.

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Death

Inder Kaur w/o Dr. Jagdev Singh (Drs Young & Newton) passed away peacefully on 9th April, 1976.

On leave

4204 Campbell, T.J., 19 Stanmore Court, off New Dover Road, Canterbury, Kent, CT1 3DS, U.K.

4581 Inkster, T.G.B., SDA, c/o Capt. H.H. Sanderson, 8 Buccleuch Avenue, Clarkston, Glasgow, Scotland.

3491 Macpherson, D.A., AMBIM, AISP, Beechmount, Barrhill Road, Dalbeattie, Kirkcudbrightshire, Scotland.

Returned from leave

5261 Murthy, P.M. Sathyah, Selama Estate Factory, Serdang, Kedah.

Change of address

6034 Ahmad Tajuddin b Mohd Mustafa, Jendarata Estate, Teluk Anson, Perak.

5852 Ahmad Zaini b Mohd Tahir, Kepong Estate, Kepong, Selangor.

5140 Arulandi, K., BSC, AISP, Beradin Estate, P O Box 102, Paloh, Johore.

4850 Berwick, I.H., Broadwater, Framlingham, Suffolk, England.

6214 Bajuri bin Suhada, Ladang Ulu Sebol, c/o Wakil Pos, Sg Sayung, Kulai, Johore.

5872 Cheah Fook Wan, Craigielea Estate, P O Box 101, Bukit Pasir, Muar, Johore.

6061 Damotheran, K., P O Box 185, Sarekei, Sarawak.

4508 Dreyer, Jan, North Labis Estate, Labis, Johore.

5175 Edmonds, G.C., Escot Estate, Tanjong Malim, Perak.

6239 Hashim b Abu Bakar, Sepang Estate, Sepang, Selangor.

5410 Hashim b Haji Pilus, Ladang Bukit Cheraka, Jeram, Selangor.

6351 Hong Theng Khong, Stesyen Penyelidikan MARDI, P O Box 525, Kluang, Johore.

6255 Ismail b Hj Mohd Yasin, Malaya General (Holdings) Ltd, P O Box 104, Rengam, Johore.

5157 Ibrahim b Hj Hassan Raof, Badenoch Estate, Kuala Ketil, Kedah.

6187 Kuyor Mukau, Sarawak Land Development Board, P O Box 1012, Kuching, Sarawak.

6333 Krishnan, M.V., Bukit Sidim Estate, Kulim, Kedah.

5243 Loh Ah Mee, Atherton Estate, Siliau, Negri Sembilan.

4636 Lee, D.F., AISP, Kuala Gris Estate, Kuala Krai, Kelantan.

6100 Lee Kien Shin, Stothard Estate, Kuala Ketil, Kedah.

4824 Lee Kim Thian, AISP, Sogomana Estate, Pantai Remis, Dindings, Perak.

5338 Lee Kim Tong, Kempas Devon Estate, Merlimau, Malacca.

4995 Ling Ting Hang, AISP, Sungei Samak Estate, Ulu Bernam, Perak.

3869 Lewis, D.H.. Twitchin Estate, P O Box 103, Layang Layang, Johore.

5267 Mohd Annuar b Abdul Kadir, Ulu Tiram Estate, P O Box 710, Johore Bahru.

6032 Mustafa b Mohamad, Senawang Estate (Factory), Sungei Gadut, Negri Sembilan.

4610 Munchar b Jajuli, Lanchang Estate, P O Box 1, Lanchang, Pahang.

5113 Md Taib b Hj Hassan, Chamek Estate, P O Box 505, Kluang, Johore.

4607 O'Neil Roe, R.I.K., Seafin, Charlton Adam, Somerton TA11 7AS, Somerset, England.

6082 Omar b Dato Hj Abu Bakar, Ladang Rakyat Laka-Temin, Changlon, Kedah.

5263 Paranthaman, C., AISP, Chan Wing Estate, Kluang, Johore.

5208 Phang Sew, BSc. (Agri.), Guthrie Kimia Sdn Bhd, P O Box 2486, Kuala Lumpur.

6036 Robert, A.B.F., Budu Estate, P O Box 202, Benta, Pahang.

6252 Shaari bin Abdullah, Sungei Buloh Estate, Bukit Rotan, Selangor.

Singh, Charanjeet, West Estate, Section 4, Carey Island, Port Klang, Selangor.

5560 Tan Seng Yeang, Tali Ayer Estate, Bagan Serai, Perak.

6198 Tay Kim Yam, Sime Darby Plantations Bhd, P O Box 157, Kuala Lumpur.

5178 Thong Chow Sin, Godfrey, AISP, Bee Yong Estate, Mentakab, Pahang.

4598 Thiagarajah, C., AISP, Ladang Bukit Ridan, P O Box 10, Bukit Ibam, Pekan, Pahang,

5881 Wong Chu Meng, Bukit Rajah Estate, Klang, Selangor.

5066 Yap Pit Kwang, AISP, Mengkebang Estate, Kuala Krai, Kelantan.

5313 Yeoh Oon Tit, AISP, Perhentian Tinggi Estate, Sungei Gadut, Negri Sembilan.

6105 Yeo See Ham, Guthrie Kimia Sdn Bhd, 10-F Quayside, Malacca.

Culinary Treasure

CHICKEN BIRIYANI

Ingredients:

5 cups of biriyani rice

1 medium-size chicken

1 lb. ghee (clarified butter)

1 red onion sliced

2 small pieces of cinnamon

6 powdered cardamoms

6 cloves

2 stems of lemongrass

salt

¼ cup cashew nuts

¼ cup raisins

¼ teaspoon turmeric

Procedure: Cut the chicken in about 2″ cubes and put it in saucepan. Pour in sufficient quantity of boiling water to cover the meat and let it simmer until the chicken is cooked—but not too tender. Melt the ghee in another saucepan and when very hot, put in the lemongrass, followed by the onion and stir it until the onion is fried. Then turn in the rice (well washed) and stir for a few minutes. Add the chicken and the stock (add boiling water if stock is not sufficient for boiling the rice) and the rest of the ingredients except the cardamoms, cashew nuts, raisins, and turmeric, and boil until rice is cooked. When the rice is ready take a small portion of it separately and mix it with the turmeric powder. Then mix the coloured rice with the rest. Garnish it with fried onions, cashew nuts and raisins.

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