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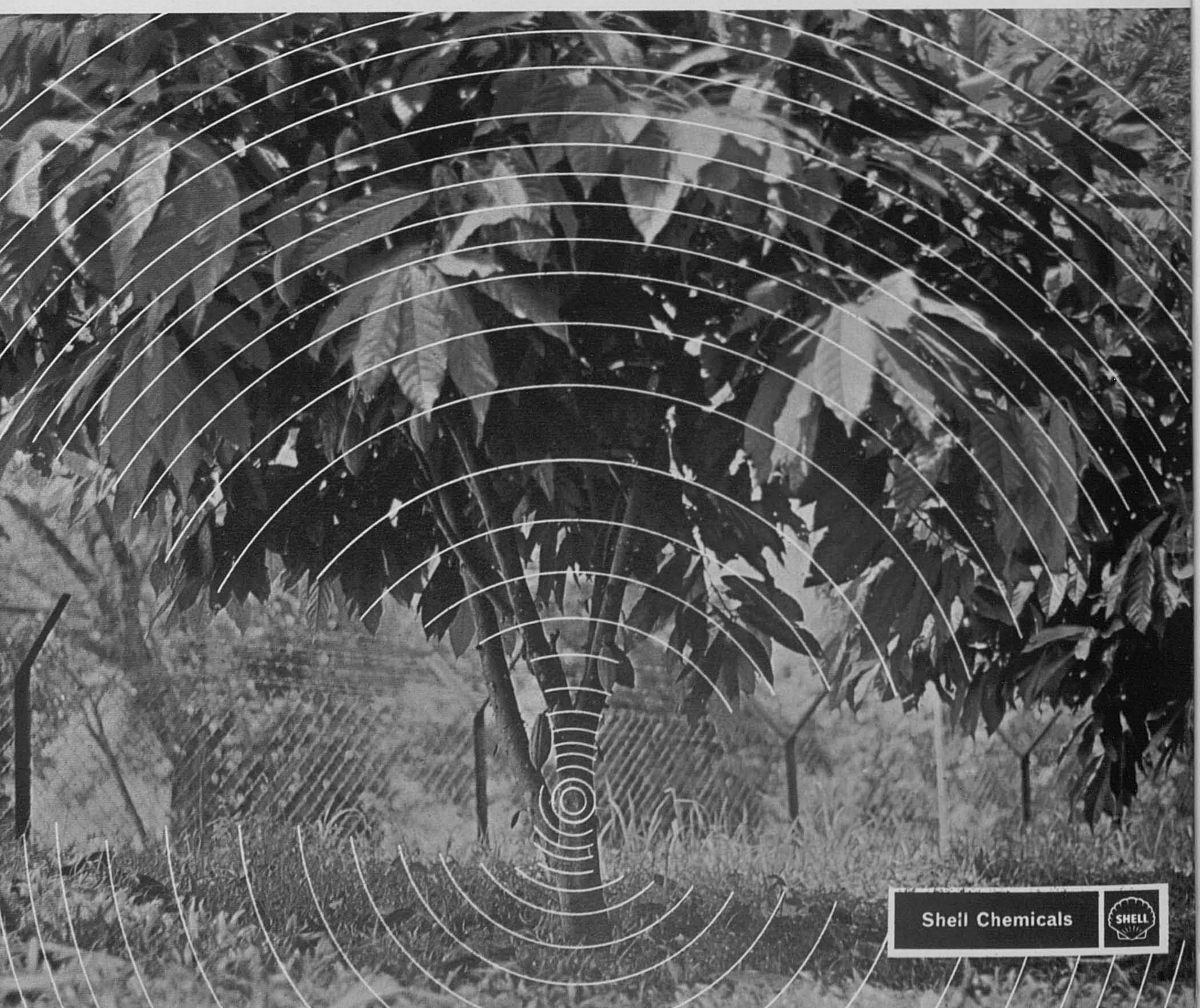

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Editorial:

CROP PROTECTION IN MALAYSIA

This is the title given to the Society's latest book, the tenth in the series of technical manuals and conference reports since regular publication began in 1967.

Crop Protection in Malaysia is the full edited proceedings of the Society's 1970 conference on this subject. Its compilation was seriously delayed by the January floods as the tapes of the discussion periods were submerged and their subsequent transcribing thereby made very difficult. This delay is perhaps fortuitous, for the appearance of this book on the eve of the Society's 1971 Conference* will serve to impress on participants, in particular those from overseas, the service rendered to the plantation industry by the I.S.P. At the same time these conferences and publications would not be possible without the excellent co-operation and goodwill achieved over the years with many planters, agronomists, scientists and research workers in both private and government sectors of the industry.

The conference on crop protection dealt with this subject under three main headings: weed control, pests, and diseases. A discussion followed each paper and the editors have paraphrased each speaker's remarks and summarised the points raised.

The book opens with a treatise on the techniques of spraying herbicides, which is likely to be a handy source of practical information and guidance for some time to come. Weed control in both rubber and oil palm cultivation is described in the remaining papers in this section.

Pest management, an enlightened ecological approach to the subject of pest control, is stressed in the middle section of the book, which deals with several major insect problems of rubber and oil palm. The cheapest practicable methods of pest management are sought, and their relevance to plantation conditions is discussed.

The final section, on plant diseases, features a paper on quarantine—which provoked an extensive and lively discussion—as well as several on practical plant pathological topics of Malaysia's two major plantation crops.

We believe this book constitutes a worthwhile addition to the list of Society publications, and we commend it to our members and to the industry at large.

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* I.S.P. Conference on Cocoa & Coconuts, 25–27 November, Federal Hotel, Kuala Lumpur.

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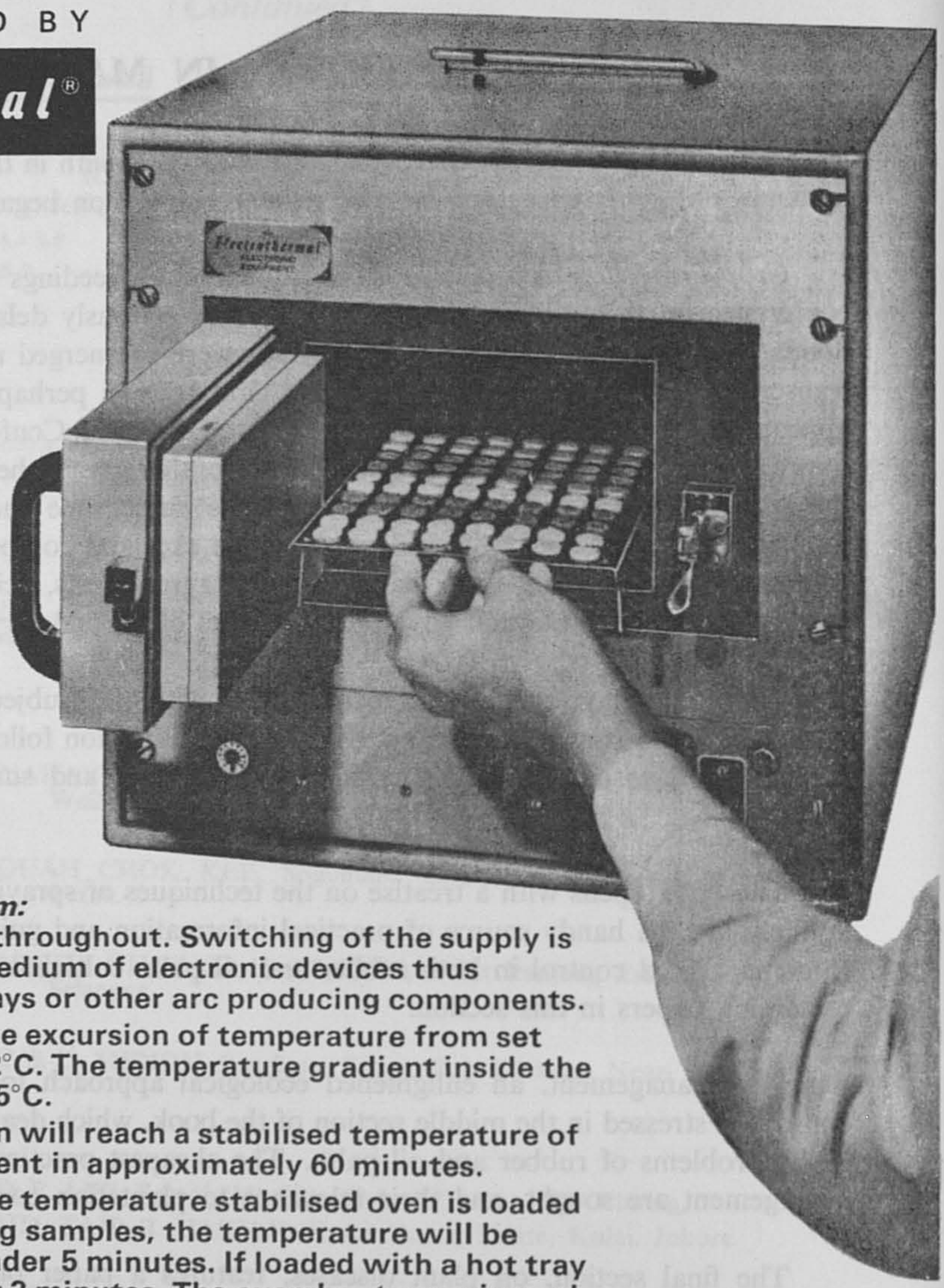

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ENVIRONMENTAL INFLUENCES AND THE IMPORTANCE OF COVERS AND SHADE FOR COCOA

by

B. J. Mainstone

Dunlop Research Centre, Batang Melaka, West Malaysia

SUMMARY

This review presents the background information which is currently available concerning the effects upon cocoa physiology of temperature, humidity, light intensity and the availability of soil water. Following on the literature relating to establishment of cocoa in association with mulches, use of ground covers and nurse shade plants is discussed. This leads to a consideration of the findings of shade experiments with mature cocoa.

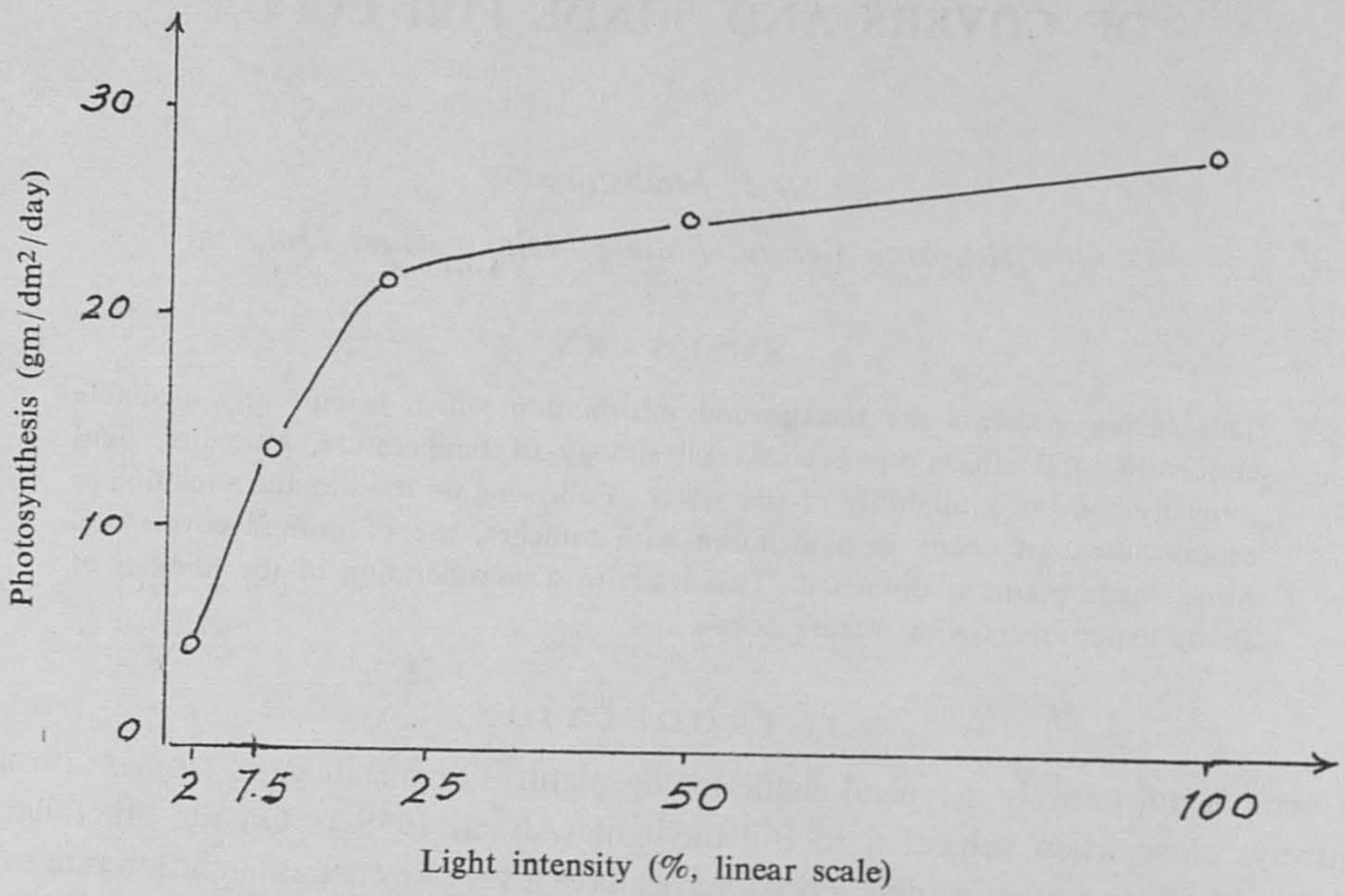
INTRODUCTION

Cocoa is not entirely a typical shade-loving plant. For instance, its stomata do not always close when subjected to full daylight (Alvim, 1958a). On the other hand, from the photosynthetic angle, cocoa leaves have a very low net assimilation rate even in full sunlight, and in this respect cocoa falls well within the class of shade tolerant plants. Even so, in full sunlight leaves are capable of the maximum assimilation. This is seen in *Figure I* (Lemée, 1955). It is a combination of these factors in some experiments that has allowed cocoa with little or no shade or protection to yield very well in relation to shaded stands. An understanding of these findings, as well as of those which are contradictory, requires an insight into the physiology of the cocoa tree and how it grows in relation to environmental conditions. Such an insight should allow an assessment of the reasons why at particular sites environmental conditions differ from the optimum. Accordingly it may be possible by cultural methods to move towards the ideal for productivity. This paper aims to assist in answering some questions that arise and, as knowledge is so far from complete, presents some suggestions for lines of experimentation.

PHYSIOLOGY OF COCOA IRRESPECTIVE OF SOIL CONDITIONS

The cocoa plant relies on daylight for the efficiency of its leaves. Thus it is appropriate to start by considering the influence of light at varying intensities. So long as water supply to leaves is not limiting, stomatal aperture increases as light intensity increases up to some 700 foot candles, after which the stomata remain fully open (Alvim, 1960a). However, when available soil water falls below 60–70% stomatal aperture is reduced. When 4.5% of the initial water content of leaves has evaporated without replenishment, the stomata close (Alvim, 1958b, 1960b). As transpiration is a way of keeping leaves cool, closing of stomata in the presence of full exposure to daylight may lead to damage.

Figure 1. Relative light intensity (After Lemee, 1955)



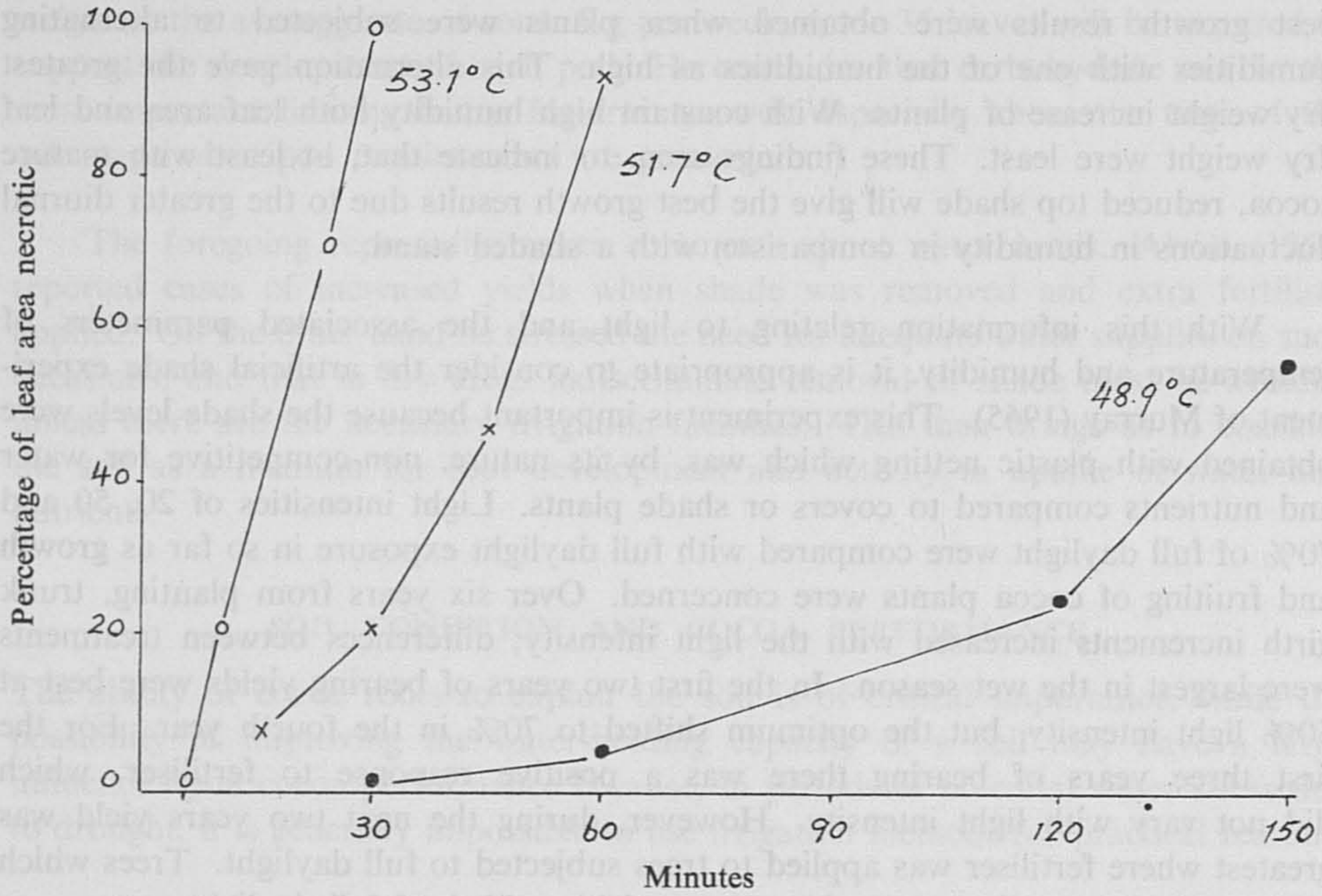
Outside this problem of stomatal closure there have been demonstrations of the effect of exposure to light upon the temperature build-up in leaves. In full sunlight Alvim (1958a) has shown that the leaf temperature may rise to some 20°C above that of leaves in the shade. His findings are confirmed by Sale (1967) who found that very high leaf temperatures are, in practice, only observed for very short periods. Occasionally leaves in full daylight will reach temperatures of 52°C, and 46°C is fairly common. However, over a period of four days Sale obtained the mean temperatures given in *Table 1*.

Table 1. Mean air and leaf temperatures (°C) within a small cocoa plot (After Sale, 1967)

	Air temperature (shaded)		*Leaf temperature*		
Hours	*Top canopy*	*Bottom canopy*	*Top canopy —exposed*	*Top canopy —shaded*	*Bottom canopy*
18.00 – 07.00	23.8	24.0	23.3	22.9	23.7
08.00 – 17.00	29.4	28.9	32.4	29.3	28.6

The temperature levels given in the table are within acceptable levels for leaf survival so long as water supply to the leaves is adequate. Hoskin & Sale (1969) investigated the influence of immersing leaves in liquid at different temperatures for varying periods. The more relevant results are given in *Figure 2*.

Fig. 2. The percentage of leaf area damaged four days after treatments for varying periods (After Hoskin & Sale, 1969)



Sale (1967) noted that the temperature of exposed leaves could fall up to 17°C in a few minutes when a cloud passed in front of the sun, especially if there was accompanying rain. The cooling effect of wind was also commented on (Hoskin & Sale, 1969).

The danger of damage to leaves in the field due to exposure to direct sunlight is not great if the supply of water to the leaves is adequate. Leaves are rarely exposed in such a manner as to give their surface maximum receptivity to sunlight, as small movements due to air currents prevent this. However, the roots of young cocoa plants may be inadequate to supply the leaves with a sufficient quantity of water for cooling by transpiration. This is one of the reasons why young cocoa plants appear to be more susceptible to leaf necrosis from exposure than older established trees. This contention is supported by Cunningham & Burridge (1960), who presented evidence that young cocoa plants can tolerate high light intensities if provided with adequate water and a sufficient nutrient supply.

Prior to consideration of a trial to investigate the influence of light exposure upon cocoa performance, a little more must be said about temperature and humidity.

Murray & Sale (1967) and Sale (1968, 1969a, b) investigated the influence of temperature on cocoa in controlled environment chambers. At 30°C it was shown that young plants lost apical dominance and that many small pale leaves were produced and quickly abscissed. Many leaves were low in chlorophyll content and were malformed. Extension growth was greatest at 30°C, but it was extension growth

per plant rather than per leaf or per flush that was controlled directly by temperature. Humidities investigated were low (50–60%), medium (70–80%) and high (90–95%), at 26.7°C (Sale, 1970a). The effect of these levels was noted over 390 days. The best growth results were obtained when plants were subjected to alternating humidities with one of the humidities as high. This alternation gave the greatest dry weight increase of plants. With constant high humidity both leaf area and leaf dry weight were least. These findings seem to indicate that, at least with mature cocoa, reduced top shade will give the best growth results due to the greater diurnal fluctuations in humidity in comparison with a shaded stand.

With this information relating to light and the associated parameters of temperature and humidity, it is appropriate to consider the artificial shade experiment of Murray (1965). This experiment is important because the shade levels were obtained with plastic netting which was, by its nature, non-competitive for water and nutrients compared to covers or shade plants. Light intensities of 20, 50 and 70% of full daylight were compared with full daylight exposure in so far as growth and fruiting of cocoa plants were concerned. Over six years from planting, trunk girth increments increased with the light intensity; differences between treatments were largest in the wet season. In the first two years of bearing yields were best at 50% light intensity, but the optimum shifted to 70% in the fourth year. For the first three years of bearing there was a positive response to fertiliser, which did not vary with light intensity. However, during the next two years yield was greatest where fertiliser was applied to trees subjected to full daylight. Trees which did not receive fertiliser showed optimum yield at 70% of full daylight.

These results clearly show that as trees become more mature increased exposure to daylight allows increased productivity but, as might have been expected, greater productivity requires an increase in nutrients. Hence there is need for more fertilisers when shade is removed if optimum tree performance is to be attained.

Referring again to *Figure 1*, one might ask how it is that these results are obtained as the level of photosynthesis only increases slowly with further increases in exposure to daylight beyond the 25% level. The answer lies in appreciating that only the leaves at the top of the cocoa canopy are in a position to receive full exposure to daylight, for those below are shaded by those above. Alvim (1967a) has demonstrated leaf area indices varying from 4.5 up to as high as 9.0 for mature cocoa, approximately equivalent to between $4\frac{1}{2}$ and 9 layers of superimposed leaf layers. Clearly the bottom leaves in a canopy receive a much restricted supply of light. When the productivity of a whole tree is considered one must calculate how much light the leaves in various positions receive and then estimate the average net assimilation.

As will be appreciated later, too many leaves may not only mean that the lower leaves are close to the compensation point and therefore have a negligible value, but these low activity leaves may be positively detrimental because, by transpiration, they may waste water at times of water stress. This is a matter that needs investigation, for it follows that there is an optimum number of leaves that a tree can efficiently carry for maximum production, depending on the ability of cocoa

plants to take up available water. However, the number of leaves a tree carries must ultimately limit the potential for fruit production. At a mean net assimilation rate of 100 mg/dm²/week, Alvim (1967a) estimates that, as a pod increases in weight at the average rate of some 5 g per week, some 35 leaves will be required to support the development of each pod. He concludes that carbohydrate can be the most important limiting factor for fruit growth, especially about the time of the wilt stage when pod requirements are greatest.

The foregoing repeatedly makes comments about water needs. Alvim (1966) reported cases of increased yields when shade was removed and extra fertiliser applied. On the other hand he stressed the need for adequate water supplies on such occasions, and that in dry areas indiscriminate removal of shade must be avoided unless there are the necessary irrigation facilities. This then brings us to consider the soil as a medium for root development and activity in uptake of water and nutrients.

SOIL CONDITION AND COCOA PERFORMANCE

The ability of cocoa roots to exploit the soil is of critical importance, while the possibility of improving the water-holding capacity of a soil may have a large influence upon cocoa performance because, in periods of potential water stress due to drought, it is generally impossible to use irrigation methods for practical reasons.

It has been considered (Sands, 1955) from a study of cocoa root systems that the physical structure of the soil can be a limiting factor to production in many areas. It has been emphasised (Hardy, 1960) that cocoa is not an aggressive rooter; root tips have a diameter of 0.1–0.5 mm, so in uniform sandy soil a particle size of 0.33 mm is necessary for the easy growth of small roots, while the particle size must be increased to 1.67 mm for larger roots. Thus fine sands and closely packed clays are too closely packed for easy root penetration. However, soils with mixed particle sizes which include a high proportion of silt and clay can cement into water-stable aggregates which usually have a loose, friable consistency and allow roots not only to penetrate easily but also to grow in thickness. Such soils also have good aeration and water retention. Such a soil would generally have a high organic matter status, and van Amson & Lems (1963) have shown that production is positively correlated to organic matter. This importance of O.M. is touched upon by Hardy (1969) who produced the data for *Table 2*.

Table 2. Cocoa soils in Trinidad: analysis of top 6 in. after removal of litter and crumb (After Hardy, 1969)

Quality of cocoa soil	*Organic matter %*	N%	*C/N*	*N% in leaf dry matter*
Good	7.0	0.38	10.5	2.18
Medium	3.1	0.18	9.8	2.28
Poor	2.8	0.20	8.1	2.45

McKelvie (1955) in detailed root studies showed that trees growing on heavy clays or in sands with a high water table had long thin tap roots, superficial lateral roots and a well-worked surface mat. On the other hand, on well drained soils, trees have a short thick tap root, deeply set lateral root systems and a mass of well distributed fibrous roots that do not form a mat. Boynton & Sands (1954) add that in addition shallow rooting can be associated with compacted gravelly clay. These observations agree with the conclusions of Hardy & Bazan (1966), who noted that cocoa dieback can follow extremely wet weather and can be associated, at least in part, with inadequate root space being further restricted in wet weather. Lemée (1955) has observed that in waterlogged soils, necrosis of root systems brings about the same physiological symptoms as drought, and that even if drainage is improved there is not a rapid return to normal growth. Zevallos (1969) concluded that the depth of the water table largely influences the productivity of cocoa. Too high a table restricts rooting and too low a table results in reduced availability of water.

As the quality of the rooting medium can be influenced by the methods of establishment of cocoa in the field, establishment techniques involving different ground covers and lateral nurse shade species become important. However, before going into the details of trials it is appropriate to consider work on water relations in cocoa soils. Soil can be modified by cultural approaches in the period of cocoa establishment.

Already it has been reported how water availability influences stomatal responses to light, and that in a trial extra light for cocoa eventually allowed greater yields so long as the nutrient supply was boosted. Smith (1964) emphasised the need for water in regard to cocoa growth and performance. He reported a 2-year trial with Amazon cocoa grown with three irrigation regimes. The irrigation increased growth rate and flower production though it did not influence cherelle wilt. Sale (1970b) applied water to field capacity when it had become depleted to 85% (wet treatment), 50% (medium treatment) and 15% (dry treatment). The results over 20 months showed that the dry treatment resulted in vigorous flushing but that many flushes of leaves subsequently died. The other two treatments resulted in continuous vigorous flushing, except that at the end of the trial the trees receiving the wet treatment ceased flushing. With the wet treatment the quantity of water seems to have been excessive. It was noted that cherelle set was best with the medium treatment. This work tends to indicate the need for soil aeration; also Gavande (1968, 1969) has this emphasised and has done work on the importance of oxygen diffusion rates. From a pot trial he concluded that volcanic ash soils, as compared to latosolic and alluvial soils, retained more water and diffused more oxygen and consequently cocoa plants showed better growth on volcanic soils.

Wessel (1968, 1970a) examined two associated soils, one clayey and one sandy, and found that the clay soil was less subject to drought. The difference lay in the rates of water release from the soils, for water was held in the sandy soil at a lower tension. On the sandy soil he found that 86% of available water was released in the range pF 2.5 to 3.5 as against only 54% in the clay soil. Thus on a sandy soil water is more easily available to vegetative growth and is consumed in a shorter

period. Any attempt to conserve water in a sandy soil is likely to provide better conditions for cocoa growth and performance, and any means of obtaining more efficient rooting in heavier soils will also produce better cocoa.

It is relevant here to mention an observation by Alvim (1967b) in relation to water stress in shaded and unshaded cocoa. He observed in Costa Rica that soil moisture in a shaded cocoa area was reduced a little by top shading relative to no shading. Thus with shaded cocoa there was less water in the soil. However, he comments that it is the water stress in the plant that counts, and that shaded plants showed less stress symptoms than unshaded ones, in spite of the lesser quantity of moisture in the soil. He therefore stated that transpiration in relation to the rate of water absorption is important. Thus we again return to the importance of root development in the soil, and it is appropriate to review some of the work on methods of cocoa establishment as these influence root development.

A REVIEW OF WORK ON ESTABLISHMENT IN CLEARED AREAS

Murray & Maliphant (1966) carried out work on a soil in Trinidad where poor growth could be related to waterlogging. This work has particular significance, for it confirms their earlier observation that soil disturbance depresses yield. In their trial they compared the results of two treatments with a control. The two treatments were a) cultivating or ploughing to a depth of six inches, and b) the construction of cambered beds 24 ft wide and 3–4 ft high. This second treatment was aimed at overcoming the problem of a high water table. *Gliricidia* shade was planted, and in addition the effect of fertiliser was tested in relation to a control. The findings are presented in *Table 3*. It will be seen that there is a general lack of response to cultural treatments, which were thought to have disturbed the soil structure. Murray & Maliphant (1966) concluded that root development and water relations are among the most important problems in the growth of cocoa.

Table 3. Mean yields in lb dry cocoa per acre per year over 6 years in land preparation and cultivation experiment (After Murray & Maliphant, 1966)

	Control	*Forked*	*Cambered*	*Mean*
Control	516	529	640	562
N P K	729	614	720	687
Mean	622	571	680	625

LSD (P = 0.05):
Cultivation means — 65 lb
Fertiliser means — 136 lb

One of the problems in a clearing is the loss of organic matter from the soil and also the separation of soil particles according to size in the upper layer of soil. Both these influences reduce the ease with which cocoa can be established. Also,

in clearings, the baring of soil results in exposure to the sun. Hardy (1961) showed that litter and mulch or grass cover can almost eliminate the daily temperature fluctuations in the underlying soil. Increases in temperature due to direct sun exposure have a detrimental influence upon the establishment of roots of young plants. Accordingly, when the literature is scanned, there are many reports of trials on the value of mulching.

Longworth (1963), Acquaye & Smith (1965), Murray & Maliphant (1965) and Jordan & Opoku (1966) all agree that mulching can be of great advantage, and investigated different classes of mulch. However, mulches are expensive, and on an estate scale probably impractical. Wessel (1969), referring to Nigerian conditions where the influence of the Harmattan puts plants under great water stress, considered the influence of slashing regeneration of weeds in newly planted areas. This is somewhat similar in effect to mulching. He showed that in the dry season soil moisture was highest under mulch and lowest under grass and weed growth, that the moisture content in monthly slashed plots was significantly higher than that in regrowth plots except for the top 15 cm, and that mulch treatments increased the amount of water held at field capacity.

An interesting trial with mulching involved the use of banana leaves (Wessel, 1970b). The trial was planted in 1961 Amazon cocoa which was not shaded. The initial planting density was high—2 040 trees per acre. However, the stand was thinned in two stages in 1963–1965 to 1 020 trees per acre. The trial involved various fertiliser treatments, and the yields over the period 1963–1969 are given in *Table 4*, which shows not only the advantage from mulching but also appreciable responses to applied fertiliser.

One of the problems with mulches, and to a lesser extent with shallow rooting plants, is that they do not influence the soil to any extent in depth, and so it becomes important to consider the results of trials with planted cover types—either

Table 4. Effect of mulch applied twice per year in the 1st and 2nd years and of fertilisers on the yield of young Amazon cocoa planted in 1961 at Araromi (After Wessel, 1970b)

Treatment	*Yield in lb/dry beans per acre*		
	Total 1963/69	*Average*	*As a percentage of control*
Nil	2 899	483	100
Mulch	4 505	750	155
Np + mulch	5 691	949	196
$(NP)_2$ + mulch	5 912	985	204
KMg	3 686	614	127
$(KMg)_2$ + mulch	4 438	740	153
NPK Mg + mulch	6 105	1 018	211
$(NPK\ Mg)_2$ + mulch	6 411	1 069	221

plants which simply cover the soil, or plants which, in addition to soil coverage, can act as nurse shades for cocoa, protecting the young plants from sun and drying winds.

There have been many reports upon the use of different shade plants and ground covers for the establishment of cocoa. These include the work of Cunningham & Smith (1961) who made comparisons between bare soil, *Tripsicum laxum* mulch and covers of *T. laxum, Crotalaria striata, Stylosanthes gracilis* and a natural regeneration of indigenous species. Though they observed the best results of cocoa growth with *C. striata,* it did not nodulate and died out too quickly, thus resulting in a loss of organic matter from the soil. Freeman & Wessel (1963) working with Amazon cocoa found no early differences between the influences of various treatments involving tree cassava, plantains, pigeon-pea and plastic covers laid between rows. They did however show that there was less moisture in the soil where there were living shade plants, and that these plots had the highest percentage losses of cocoa plants. This stresses the need to consider the competitive nature of covers where water stress may be encountered. Other rather similar work is reported upon by Smith & Akrofi (1963), Iweama (1964) and Freeman & Wessel (1964).

However, the most instructive results of trials come from Opoku (1963–64) and Opoku & Jordan (1968) in respect of trials at Kade in Ghana. These trials have a very special interest because they are detailed and were continued to show the influence of treatments upon production. Those who are acquainted with the work on the use of covers with rubber know that in the early period after field planting covers can be very competitive with rubber, but that later there will be a reversal of that picture so that an advantage may be shown from having used a specific cover policy. It seems to me that this sort of situation may well exist with cocoa, so the work at Kade, being long-term, deserves special note.

In the work at Kade, Amazon cocoa seedlings were used and different approaches to top shade employed. Initially tree cassava (*Manihot glaziovii*) was used in trials CC6 and CC7 mentioned below, but *Terminalia ivorensis* later replaced the cassava in CC6. Results from three trials, CC6, 2 and 7, are presented below in *Tables 5, 6* and *7* respectively.

Table 5. Yields from a trial with creeping covers where cocoa was planted in 1961 (Code CC6) (After Opoku, 1971)

Cover treatment	*Yields in lb/acre†*								*Yields relative to control—1–8 yrs*
	1962/63	1963/64*	1964/65	1965/66**	1966/67	1967/68	1968/69	1969/70	
Mulch	145	1 067	651	1 203	755	1 030	716	612	137
Calopogonium mucunoides	46	805	576	1 157	819	1 072	918	712	135
Pueraria phaseoloides	31	738	491	1 089	712	883	737	808	121
Centrosema pubescens	32	648	408	1 136	726	922	744	765	119
Mimosa invisa	26	687	527	1 143	808	990	790	755	126
Natural regeneration = control	1	297	392	1 068	651	861	676	566	100

* 1 423 plants/acre ** 870 plants/acre † 12 pods = 1 lb

Table 6. Yields from a trial with various erect covers where cocoa was planted in 1962 (Code CC2) (After Opoku, 1971)

Cover treatment	*Yields in lb/plot*				*Total yield in 4 yrs*	*Yields relative to control 4 yrs*
	1964/65	*1965/66*	*1966/67*	*1967/68*		
Moghania macrophylla	488	899	1 657	2 762	5 806	144
Pennisetum purpureum	283	534	1 363	2 936	5 116	127
Leucaena glauca	141	304	1 154	2 439	4 038	100
Cajanus cajan	128	352	892	1 804	3 176	79
Tithonia diversiflora	35	100	546	2 029	2 710	67
Natural regeneration = control	83	194	1 038	2 719	4 034	100

N.B. Spacing 10 ft × 5 ft

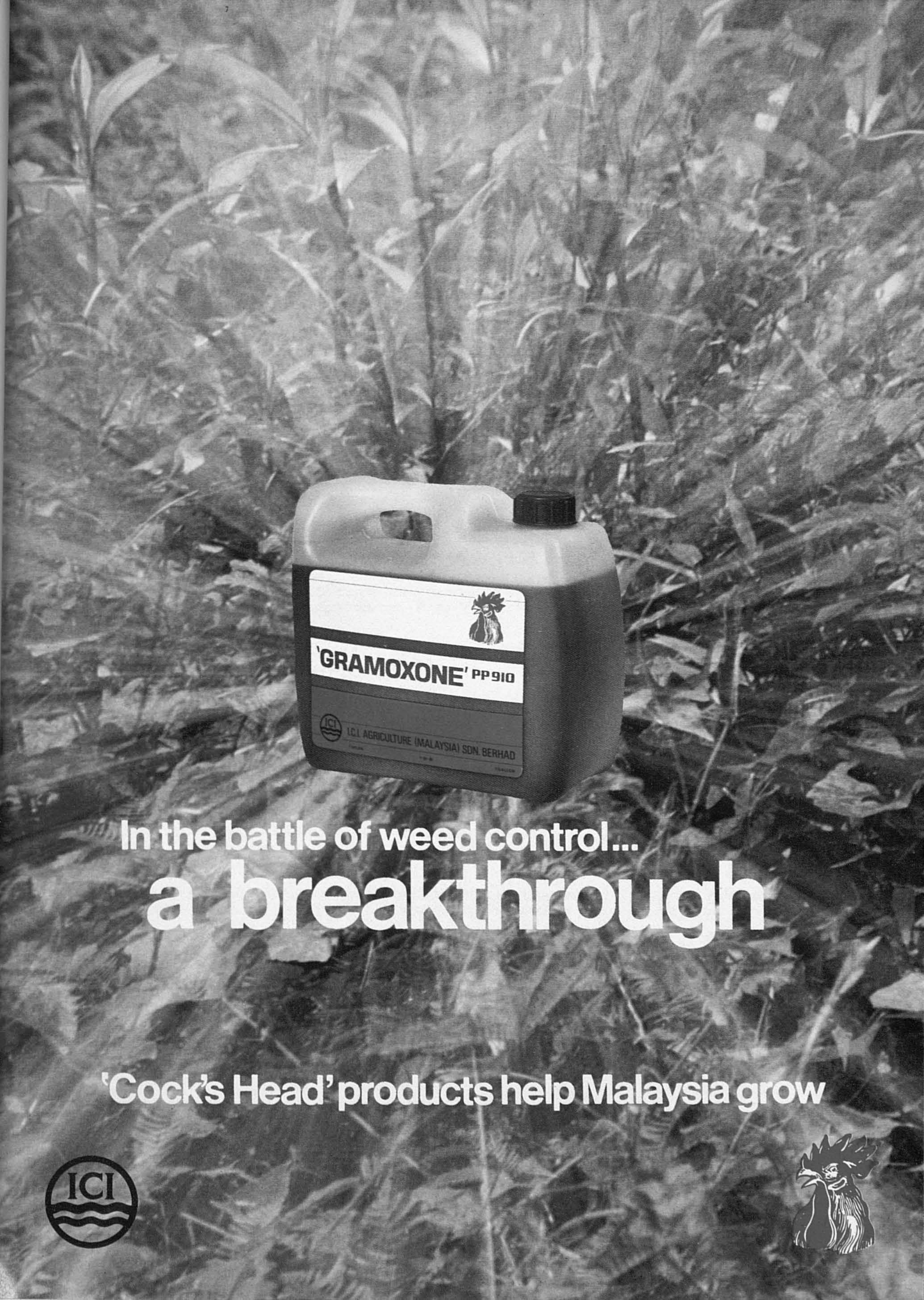
Table 7. Yields from a trial with various covers where cocoa was planted in 1962 (Code CC7) (After Opoku, 1971)

Cover treatment	*Yields in lb/acre†*						*Yields relative to control— 6 yrs*
	1964/65	1965/66	1966/67	1967/68	1968/69	1969/70	
Tephrosia mixture	258	1 155	1 132	1 420	682	983	127
Indigofera sumatrana	297	1 010	895	1 064	511	809	104
Moghania macrophylla	276	995	1 060	1 310	629	846	115
Cassia tora	175	932	926	1 132	747	939	110
Desmodium asperum	235	912	1 036	1 207	670	660	106
Indigofera spicata	219	829	888	1 075	583	834	107
Mimosa invisa	146	817	930	1 356	744	812	108
Crotalaria longithrysa	173	805	864	840	620	781	95
Tithonia diversiflora	12	267	576	1 004	555	790	72
Natural regeneration = control	119	704	789	993	620	778	100

N.B. Spacing 10 ft × 5 ft

† 12 pods = 1 lb

Table 5 shows an initial advantage from creeping covers, but Dunlop experience is that such covers are very costly to control because of their habit of encroaching into the planting rows and of growing onto the young cocoa plants. Thus for practical purposes they cannot be used. However, with bush covers these problems do not arise, and reference to *Tables 6* and *7* shows that *Moghania macrophylla* and *Tephrosia* mixtures are excellent. Unfortunately, data indicate that the advantages last for only the first three years of bearing. Opoku (1971) suggests that the residual effect of "shaded out" cover plants is temporary, and ceases to be important when leaf canopies close and leaf litter provides a carpet cover. However, where soil conditions require improvement to assist cocoa rooting, it is conceivable that, assuming nutrient supplies were ideal, residual effects would have been much more drawn out. On the other hand, even allowing for the loss of any significant residual effect from use of either *Tephrosia* or *Moghania* as shown in *Tables 6* and *7*, it would be economically justified to plant these cover species.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It will be noted from *Table 6* that the grass *Pennisetum purpureum* has done well; mention will be made later about the importance of grasses under certain circumstances.

(to be continued)

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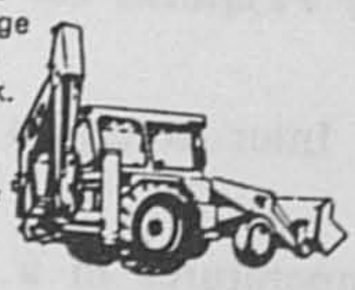

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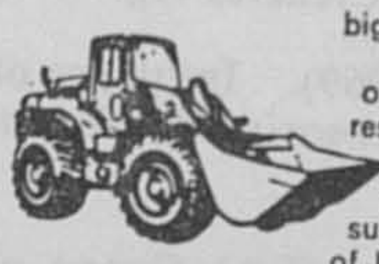

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"The object of drying is, of course, to reduce the moisture content of the beans to such a level that they will be safe to store. The moisture content of the wet fermented bean is about 56 per cent and a dry bean should contain 6 to 7 per cent moisture. Therefore beans lose half their weight during drying. If drying is too slow, as sun drying may be during periods of bad weather, the beans are likely to become mouldy. Similarly, if beans are incompletely dried and stored with a moisture content of 8.5 per cent or more, moulds will be able to develop. On the other hand, if beans are dried more thoroughly, to 3 or 4 per cent moisture, they become very brittle and are likely to be in a very broken condition by the time they reach their destination."

This was written in 1957 in a review[11] of artificial drying. It remains true, but there have been many technical developments since then. This paper will look closely at platform dryers, describing the drying conditions they should provide and the effects of drying methods on flavour and quality.

METHODS AND EQUIPMENT

Sun drying

Most of the world's cocoa is dried in the sun. In West Africa the bulk of the main crop is sun dried and it is only in certain areas, particularly West Cameroon, that artificial drying has to be resorted to. This general practice reflects the favourable climate during the main crop in West Africa and the fact that practically all the cocoa is produced on smallholdings. On these small farms cocoa is only harvested a small number of times each year and there is adequate family labour available to turn and sort the beans during drying and to cover them in the event of rain. The drying time may amount to ten days but there is no case for any other method.

Sun drying has also been the common method of drying on estates in the West Indies and many South American countries, although most estates in Brazil have some form of artificial dryer as well as sun drying platforms. The typical drying platform in Trinidad is 60 × 20 ft and has a sliding roof; such a platform will produce up to two tons dry beans in a drying period of 7–10 days. It has been estimated that one worker would be fully employed in raking and turning these beans, which would make the labour cost $59 per ton of dry beans[5]. This

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* This paper is one of seven presented at the Cocoa Seminar organised by the Sabah Planters' Association at Tawau, 20–21 November 1970. The paper is reproduced here with the permission of the Author and of the Association. A full set of preprints of the papers can be obtained from the S.P.A., P.O. Box 1204, Sandakan, Sabah, price $7.50.

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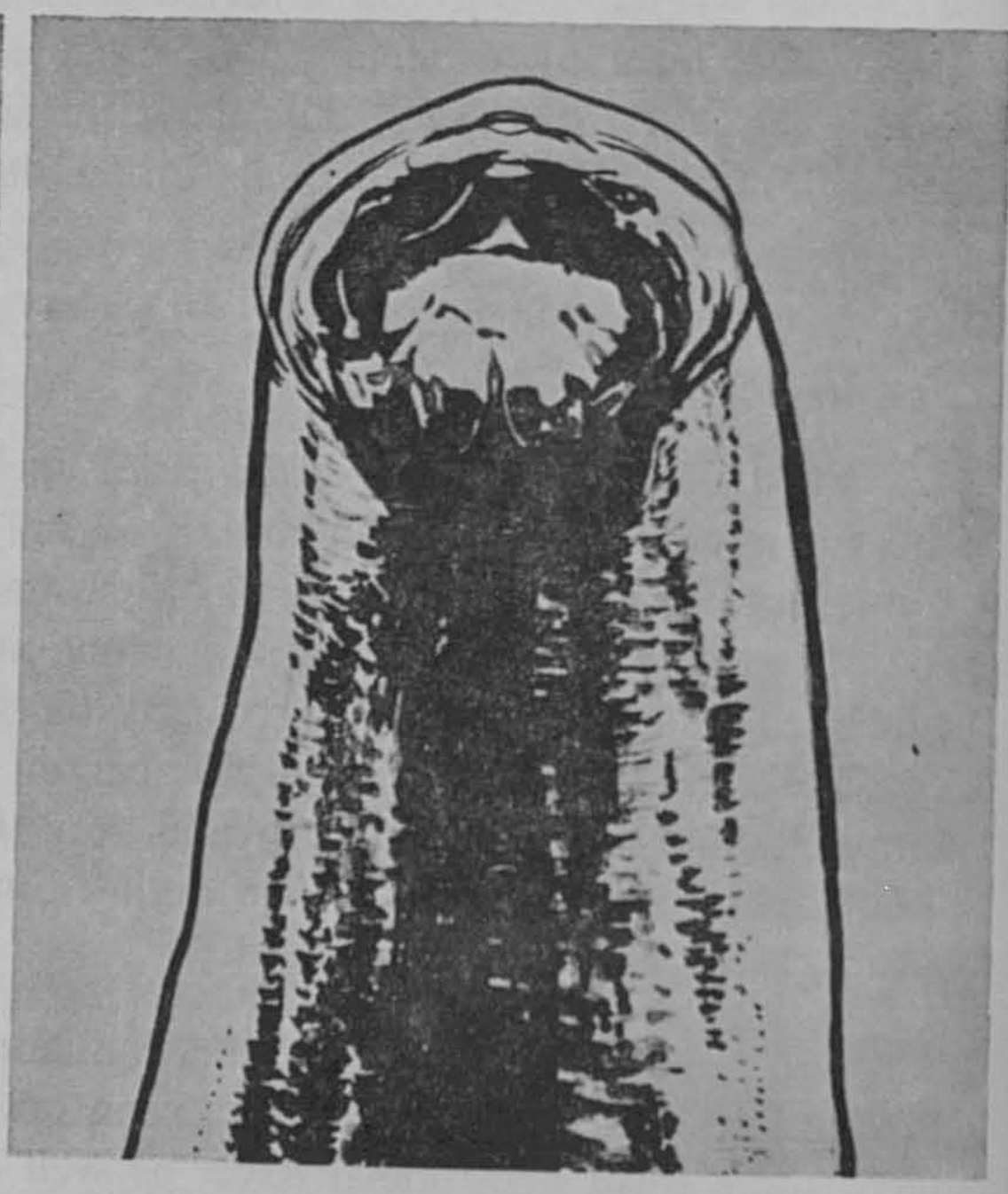

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cost is not high, but on a large estate of say 1 000 acres producing 500 tons per annum, and 25% of that in the peak month, twenty such platforms would be needed. They would cover a considerable area and involve considerable capital expenditure. At Tafo, Ghana, it was estimated that sun drying required 30 man-days per ton*—a much higher figure than that for Trinidad—and artificial drying showed a saving in costs, space and labour and ensured good quality[1]. These costs for sun drying were for experimental batches of beans so it would be unwise to draw firm conclusions from them but unfortunately no other figures are available to make a proper comparison of the costs of sun drying and artificial drying.

Artificial dryers

The last paragraph has suggested that there may be an economic case for using artificial dryers on large estates but the usual reason is, of course, the climate. In many countries rainfall is too frequent or sunshine is inadequate for sun drying to be practicable. Many forms of artificial dryer have been developed, most of those in use depend on conduction or convection to convey heat from a solid fuel fire to the wet beans. These I refer to as non-mechanical dryers. There are also a growing number of dryers using fans and heaters to blow hot air through a layer of wet beans. These mechanical dryers usually employ a drying platform, but rotary dryers also come under this heading.

Non-mechanical dryers

There are many varieties of non-mechanical dryer. A few work by conduction; these include the slate dryers used in Cameroon and Fernando Po. Most work by convection and these are more efficient and more uniform in operation. Most estates in Brazil have dryers with a single platform or a series of trays through which a convection current passes. In Western Samoa the large 'Martin' dryer was used on several estates; its drying platform was made of closely-spaced slats over a plenum chamber with a U-shaped flue. This dryer and other non-mechanical dryers have been described elsewhere[11].

The 'Samoan' dryer is a small simple dryer similar in principle to the 'Martin'[12]. This dryer was first built at Bournville and subsequently a large number were built in West Cameroon, where a simple reliable dryer was needed to eliminate 'smokiness'. In this it was successful. In its simplest form the 'Samoan' dryer can be built for locally available materials which are easily transported—by head, where necessary—and easily built and operated. 'Samoan' dryers with platforms 12 × 10 ft can produce 500–600 lb dry beans within two days.

The 'Samoan' dryer can be built in various sizes but a maximum length of platform of 18–20 ft is suggested in order to ensure uniform drying. One vital

* $90 per ton at labour costs then operative.—*Ed.*

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feature that many have not appreciated is the need to provide an inlet for cool air; a gap around either end of the flue is the usual answer. It can be built in a more permanent manner than has been suggested and a significant modification that was initiated at Balung Estate is the fitting of electric fans to plenum chamber walls. This speeds up drying and ensures more uniform drying. At Rumidi dryers fitted with fans have produced 1 700 lb dry beans in 56 hours.

These dryers are wood-fired but trials have been made with simple oil and water burners. These trials were not very successful and similar experiments at Quoin Hill ran into difficulty with smuts and smoke.

The 'Samoan' dryer has been described in some detail not because it is thought to be the best dryer for estate use but because a combination of some mechanical dryers with Samoan dryers seems to be the best way of dealing with the peak crop. In the peak month an estate may produce 25–30% of its annual production; it is unnecessary and uneconomic to install expensive equipment to cope with this quantity; it is better to have mechanical dryers for say 15–20% of the crop and Samoan dryers to cope with the short-lived peak.

The advantages of the 'Samoan' dryer, together with non-mechanical dryers generally, are low capital cost, simple maintenance, and fuel that is generally available; on the other hand there is little control of drying conditions so that drying time and output tend to vary; they require more labour for stoking and gathering fuel, a factor which becomes important with the size of the estate.

Mechanical dryers

These consist of a fan and source of heat providing a current of hot air which blows through the wet beans which rest on a drying platform or are held in the drum of a rotary dryer. I will dispose of the latter first.

Rotary dryers. In these dryers the hot air is blown through a central tube and passes out through the beans and the perforated skin of the dryer. The advantages claimed for rotary dryers are evenness of drying and the improvement of appearance. The action of the rotary dryer is not the same as the traditional polishing done in Trinidad but the result is similar. I doubt whether these claimed advantages can be substantiated, but there is no doubt that rotary dryers suffer from grave disadvantages that prevent their use for drying beans straight from the fermentary. First, the remaining mucilage clogs the holes in the dryers; this will reduce airflow. One model, the A.S.P. rotary, has specially designed holes which reduce clogging. Second, it is obvious that the drums must not be filled to capacity as the beans must be able to move; on the other hand the beans shrink as they dry and a drum initially three-quarters full will be only half full during the later stages of drying. This will affect the airflow, most of which may escape without doing useful work. For these reasons rotary dryers cannot be used for complete drying. They can

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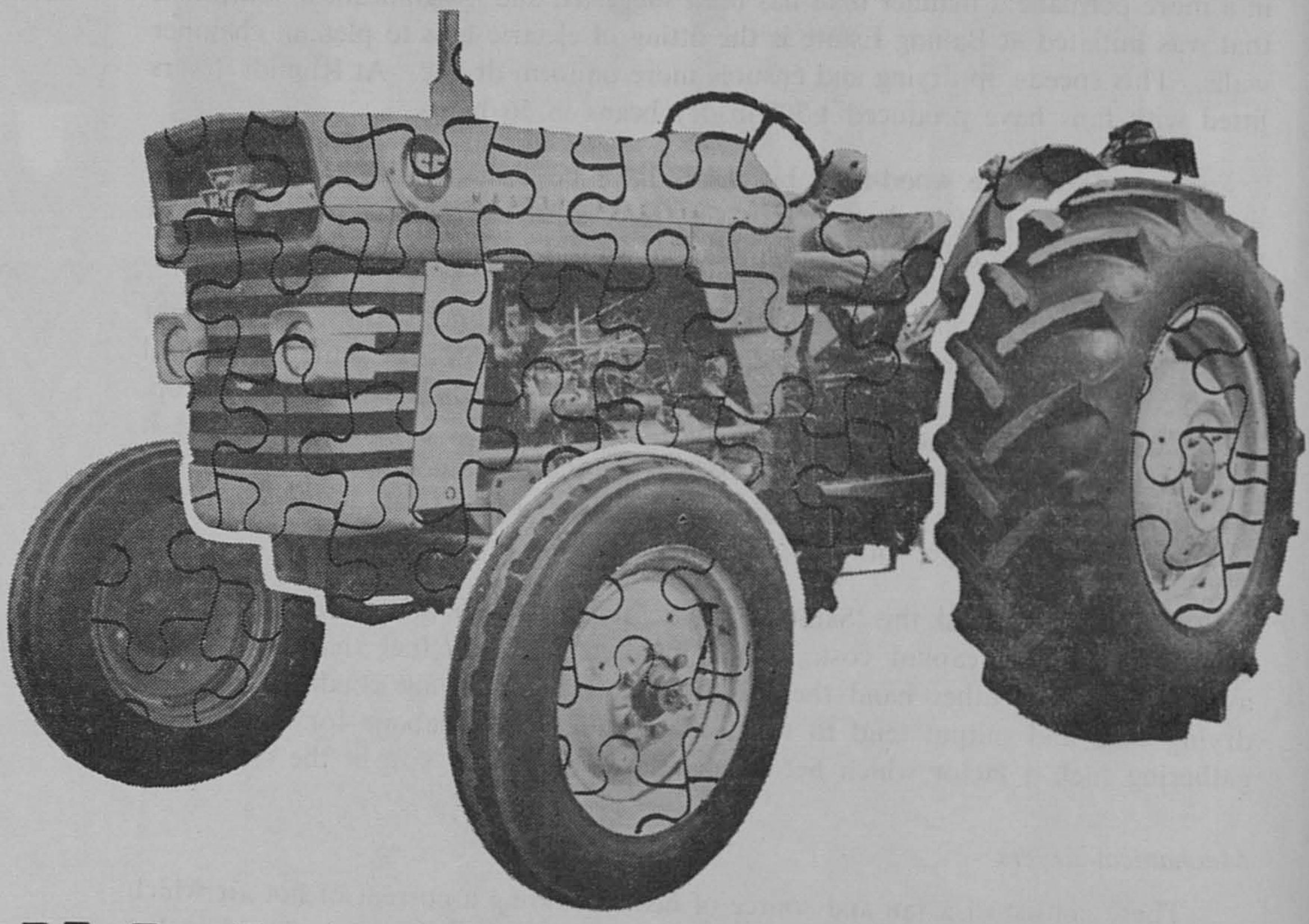

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however, be used for the later stages of drying and two stage drying, first on a platform, second in a rotary dryer, is common practice in New Guinea. Newton[7] tested the Bentall rotary dryer in New Guinea. Apart from supporting these conclusions he stated that the drums should not be fitted with any internal baffles and that the drum should revolve at $\frac{1}{4}$ rev/min for final drying. Whether two stage drying is worthwhile is another matter. The system requires more capital and the tasks of filling and emptying rotary dryers are either laborious or require elevators and conveyors.

Platform dryers. Platform dryers consist of a fan and heater unit which blows hot air into a plenum chamber below a platform on which the wet beans rest. A typical unit has a platform 30 × 8 ft and $2\frac{1}{2}$–3 ft above the floor. The width and height are relevant to the job of raking and turning the beans and it is suggested that the platform should not be wider or higher than the above dimensions. The platform consists of an angle-iron frame on which perforated aluminium sheet or nylon-coated expanded metal rests.

The fan and heater unit is coupled to the plenum chamber by means of a tapering duct; the unit will usually have a thermostat to maintain a uniform hot air temperature and may also be fitted with a damper so that the rate of airflow can be varied.

The first reported trials with such a unit were conducted in Cameroon[12]. In these trials a fan and heat exchanger unit producing a maximum output of 2 500 ft^3/min of air at 90°F above ambient temperature was coupled to a platform 20 × 9 ft. The depth of beans, temperature of hot air and rate of airflow were varied and the conclusion was drawn that deep layers, up to 5 in. when wet, high temperature and low rate of airflow gave the most economical results. This unit was capable of producing one ton of dry beans in 36 hours at a consumption of 39 gal fuel per ton.

Similar tests were made at Tafo[1]. In this case the equipment was enclosed in a small building enabling some re-circulation of the air. Possibly for this reason rather better results were obtained, one ton of dry beans being produced in 24 hours at a cost of 34 gal fuel per ton.

Six dryers of this type have been used at Ikiliwindi Plantation, West Cameroon for the past ten years, and considerable experience has been gained. It will be noted that in the initial trials the depth of beans was no greater than 5 in.; this is too shallow, deeper layers are difficult to mix properly but are essential for economy of operation. The system evolved is to load two or three dryers to a depth of 10 in., dry for 24 hours and then transfer all onto one dryer. By this means $6\frac{1}{2}$ tons of beans can be dried in 60 hours at a cost of 35 gal per ton. This is the optimum performance and the average fuel consumption for the crop as a whole will be higher. This type of equipment has been used at Quoin Hill and

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Wyrley-Birch has reported similar findings with regard to depth of beans and better figures for fuel consumption[14]. His best result was to produce 3.3 tons dry beans in 44 hours at a fuel consumption of 24 gal per ton. The low fuel consumption may be due to the dryer being enclosed, as this raises the temperature around the dryer.

One obvious conclusion to be drawn from these experiments and general experience of drying is that deep layers are necessary for economy. It follows from this that sun drying and artificial drying cannot be carried out efficiently on the same dryer.

The fan and heat exchanger units used in these various trials were made by Woods of Colchester. Several other manufacturers, mostly Australian, make similar equipment which has been used in New Guinea. The major difference is that the A.S.P. and other Australian suppliers use much faster rates of airflow of 60 ft/min as compared with 10–20 ft/min in the West African trials. In order to utilise the heat content of such a high rate of airflow deep bins are employed holding up to 24 in. depth of beans. Mixing and turning of the beans is necessary in order to prevent them sticking together and to ensure uniform drying. The deeper the layer, the greater will be the difference between top and bottom and the greater the need to turn the beans, a task which is quite difficult with layers 12 in. deep and will be even more so if a 24 in. layer is used.

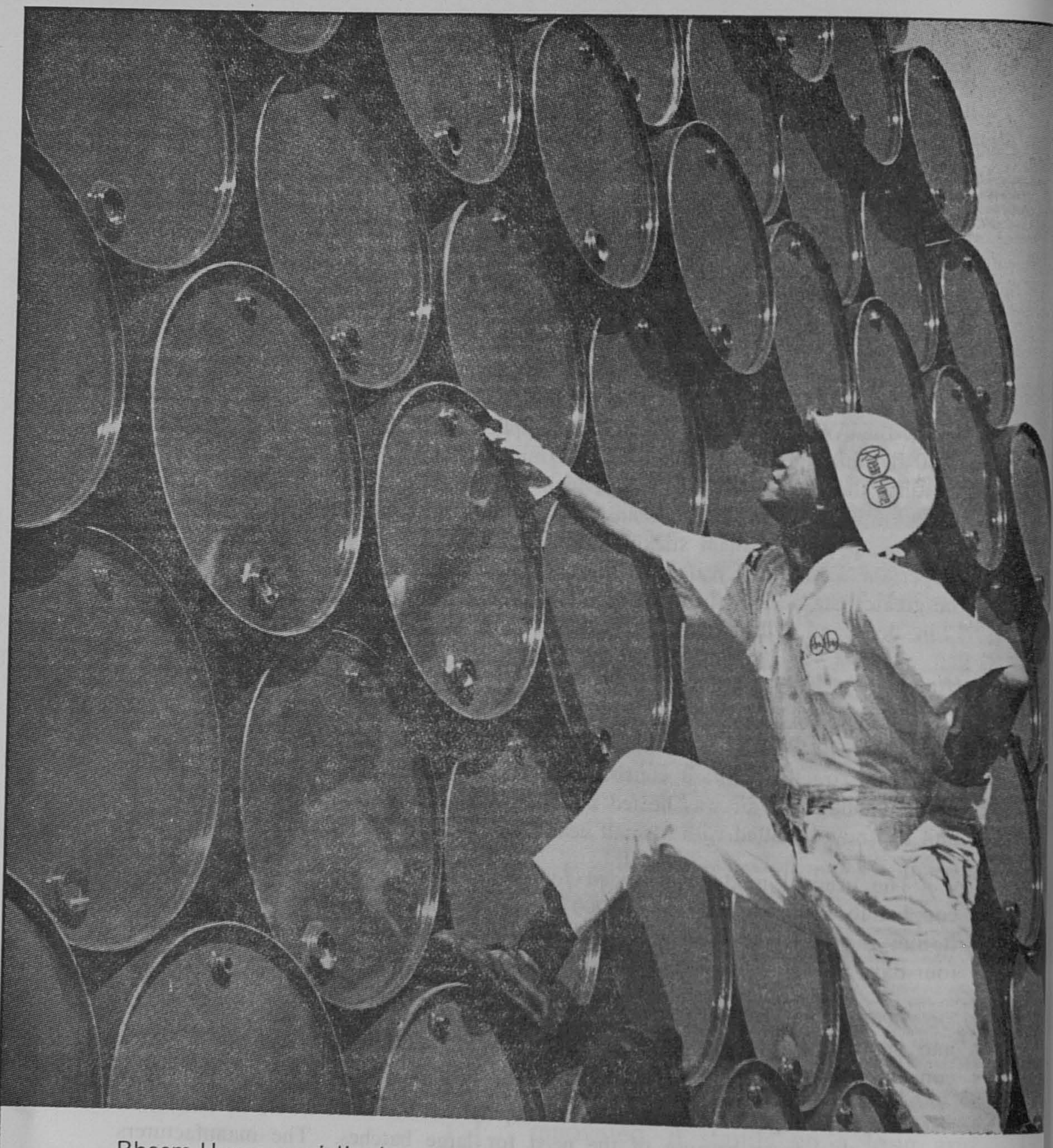
High-volume low-temperature drying

Another possible approach to cocoa drying is to use a large volume of air at temperatures 10–20°F above ambient. This is the approach used by the Lister moisture extraction unit; it consists of a large diesel engine and fan, and in the original model the air was heated solely by waste heat from the engine, but the unit can now be fitted with a small heater unit to raise the air temperature.

The original model was tested for cocoa in New Guinea, the unit being coupled to a drying platform of 200 ft^2. The airflow was at the rate of 25–50 ft/min and it was concluded that three tons of dry beans would be produced in four days at a consumption of 60 gal fuel per ton[6].

In a further trial the unit was coupled to a vast drying platform of 800 ft^2 and on this $5\frac{1}{2}$ tons of dry beans were produced in 7 days at a much reduced consumption of 36 gal per ton[8].

The advantage this unit offers is low capital cost but there would be difficulties in using this dryer because of the need for large batches. The manufacturers have tried to overcome this by proposing the use of a unit with additional heat exchanger coupled to two covered finishing bins and a large open 'pre-drying' platform. The warm air would pass through the finishing bins and finally through the pre-drying floor. To-date the system has not been tested.



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Optimum conditions for drying

In order to draw some conclusions as to the most economical conditions for drying, Shelton[10] conducted some small-scale experiments in which depth, hot air temperature and rate of airflow could be varied more widely than is possible with an ordinary dryer. Depth varied from 4 to 10 in., temperature from 120°F to 180°F, airflow from 10 to 100 ft/min. The results showed that 'the highest thermal efficiencies are obtained at deep bed depth, low airflow rate and moderate air temperatures (140°–150°F).' This result refers to the drying process itself but not necessarily to the apparatus used in these experiments or to any other dryer because another factor, the heat transfer efficiency of the machine, must be taken into account. This means that if high temperatures and low rates of airflow are used much of the heat is likely to be lost through the plenum chamber and drying apparatus generally. Moderate air temperatures 140–150°F and moderate airflow 30 ft/min gave the best overall efficiency in these trials, but this cannot be taken as the optimum drying conditions for any dryer.

It is not possible to draw very firm conclusions about optimum temperature and airflow but the evidence points to moderate rates of airflow for economy. There is a further aspect to this. As the rate of airflow increases, so will the resistance offered by a layer of beans and hence the power required to drive the fan.

Interrupted drying

In New Guinea a practice of interrupting drying has come into favour. The beans are dried for 12 hours, rested for 12 hours and then finished. The purpose of this resting period is to allow the moisture within the beans to migrate to the surface; it is also said to reduce acidity and prevent case-hardening of the bean. There seems to be a possibility of reducing fuel consumption by this means but there is no evidence on this point or any of the other assumed benefits. On the other hand this interruption infers that the beans occupy the dryer for a longer period than with continuous drying, or alternatively the beans have to be moved to a separate bin for the resting period. This means more equipment and more handling.

The effect of interrupted drying on quality is untested. Keeping the beans for some time when still moist and cool will ultimately lead to mould development and the timing of the resting period will have to bear this hazard in mind.

Resistance to airflow

The resistance offered by a layer of wet beans is small in comparison with other crops. Two sets of data have been consulted[3,13]; they differ considerably as *Table 1* shows but at low rates of airflow both indicate that resistance of 1 ft

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depth is less than 1 in. water gauge. Axial flow fans are suitable for uses up to 2–3 in. w.g., but centrifugal fans requiring more power are needed where the resistance is greater.

Both sets of data show a large difference in resistance between wet and dry beans. The importance of this is that during the early stages of drying 'holes' of drier beans can develop and much of the hot air can escape through them wastefully. This emphasises the need to stir regularly during the early stages.

Table 1. Resistance offered by 1 ft depth of cocoa beans (in. w.g.)

Source of data	*Rate of airflow (ft/min)*	*Wet beans*	*Dry beans*
Haynes[3]	20	0.1	0.04
,,	50	0.6	0.20
Woods[13]	20	0.8	0.08
,,	50	2.9	0.30

Mechanical stirring

A major difficulty in achieving low fuel consumption is the thorough mixing of deep layers. This is difficult and unpleasant to do by hand; is it possible to do mechanically? In Fernando Po the thin layers on slate dryers are stirred mechanically but deep layers need more turning. An Australian manufacturer has designed a stirrer but no reports on its functioning are available.

An alternative would be to use a circular drying platform with revolving stirrers. A dryer of this design has been tested in Bahia but results showed that the stirrer caused considerable damage to the beans.

Judging the end-point of drying

It is not possible to dry beans on a rule-of-thumb basis because the load and ambient conditions are rarely the same. The end-point, when the beans have reached 6–7 per cent moisture content, must be judged on each occasion and this requires a good deal of experience.

It is not possible to use electrical moisture meters because the moisture is unevenly distributed within the beans; the judgement must be made by cutting the beans. They should be allowed to cool because at high temperatures the beans are plastic and this softness can be mistaken for dampness. A cool dry bean will break cleanly.

In our experience it is impossible to get uniformity of dryness at the end of drying because of differences of size and other factors between individual beans. Such differences will be evened out after a few days in store.

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ARTIFICIAL DRYING AND FLAVOUR

The word 'flavour' has been used rather than 'quality' which includes all those other attributes of the bean that can be measured objectively and these will not be affected by the method of drying, provided it is properly done. On the other hand, certain aspects of flavour will be affected by the drying method; I refer particularly to acidity.

During fermentation the sugars in the pulp are converted to alcohol and acetic acid. The testa is permeable to the latter so the acid passes into the cotyledon. During drying the acetic acid will tend to evaporate but more will be lost during the long period of sun drying than during the shorter period of artificial drying. This was clearly shown by Powell[9], who measured the amount of acid in sun dried beans and beans dried in 14 hours.

The presence of acetic acid in beans affects flavour. A little acid gives a pleasant fruity flavour which many people like. More acid gives a sharper flavour which can obscure the underlying chocolate flavour. These are the effects when beans are made into chocolate on a small scale without the usual conching process. In this process the chocolate is kept at a high temperature for several hours and this will drive off acid. When the beans which were dried in 14 hours were made into chocolate with full factory processing, an acceptable chocolate was made, and no appreciable difference was found between sun and artificial drying[4].

There remains one further point: the use of a heat exchanger or a direct fired unit. In a heat exchanger the products of combustion are kept separate from the hot air; in a direct fired unit they are mixed. A heat exchanger is a more expensive piece of apparatus and will use about 20 per cent more fuel for the same heat output. Is a heat exchanger necessary? The argument in favour rests on the possibility of taint or toxic residues arising. A direct fired unit functioning properly will not give rise to any taint or residue, but it is considered that a burner which is badly adjusted or malfunctioning for some reason might do so. Some experiments are in progress to try and settle this point but without further evidence our view is that heat exchangers are a necessary precaution.

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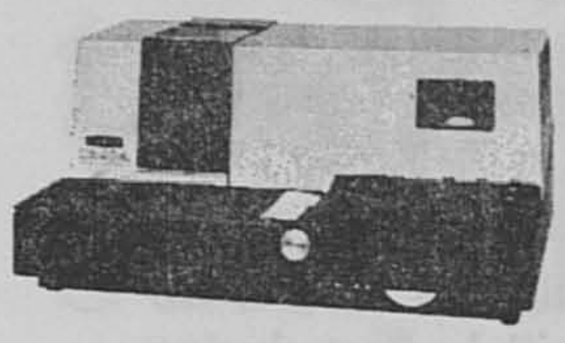

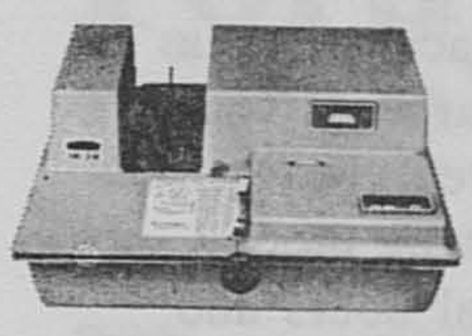

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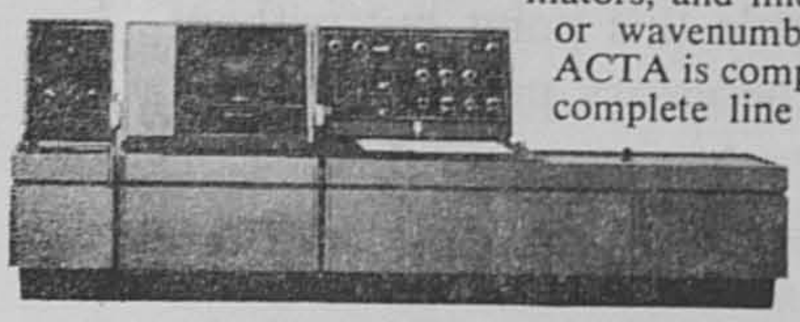

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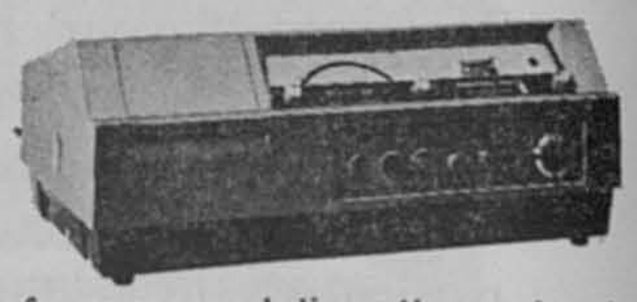

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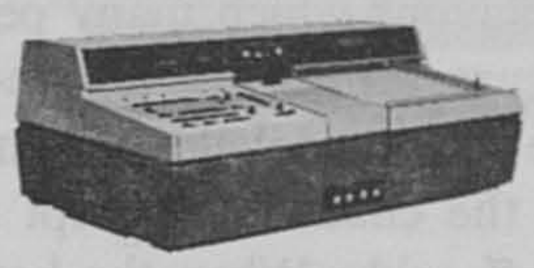

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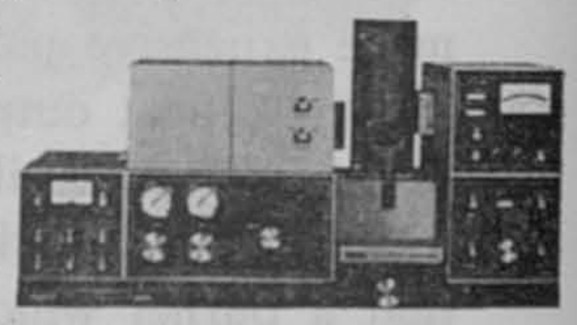

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DISCUSSION*

The wide-ranging discussion of Mr. Wood's paper raised many questions that can only be answered by practical investigations of the cocoa drying process. Some answers might be obtained quite easily and quickly—a cost analysis of drying by continuous or interrupted heating, for example. Other problems, especially those concerned with flavour, might be less easy to study. The dangers of over-heating during drying and spoiling the flavour by 'roasting' were mentioned several times.

Practical experience in Malaysia has so far been limited to sun-drying and to open-bed heated dryers. The use of direct firing in the latter should not cause off flavours in the finished cocoa although the risks arising from malfunctioning burners were mentioned. The possible effects on flavour of methods involving reversible air flow or closed bins are less easy to foresee and several speakers suggested that they would prefer to learn by the experience of others before hazarding their own produce to methods as yet un-tried in Malaysia. Recently-developed machines such as rotary dryers introduce a number of unknown variables. One speaker went so far as to allege that the equipment manufacturers were using cocoa producers to do their machinery development for them—while machinery was continually improved where was the compensation for the purchasers of the earlier models, those expensive machines that did not always fulfil the designers hopes?

---

* The Chairman of the session, Dr. J. W. Blencowe, accepts responsibility for his summary of the transcript of this paper.

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Discussion of drying inevitably turned to problems of commercial standards and acceptability of the product. Uneven dryness of individual beans at time of removal from the dryer was unimportant, after a few weeks the moisture content would have equilibriated throughout the batch. It was much more important to allow the beans to cool before packing, beans placed in bags while still hot would be slowly 'cooked' and the flavour spoiled. Concern was expressed about the general standard of preparation of Malaysian cocoa before it was bagged. Too much shell and, a high proportion of flat beans, 'doubles', etc., would give the local product a bad reputation. Arguments in favour of mechanical grading and much more 'picking over' were countered by claims that the additional cost incurred was not matched by a premium for an improved product. Malaysian cocoa processed on open-bed dryers was finding a ready market; however, whatever the present-day profit and loss situation, careful watch must be kept on standards. Much of Malaysia's cocoa is young and a large proportion of small pods with relatively small average bean size is to be expected in the immediate future. Careful grading of this product, even at some present-day expense, should provide a foundation for a good reputation for quality in the years ahead.

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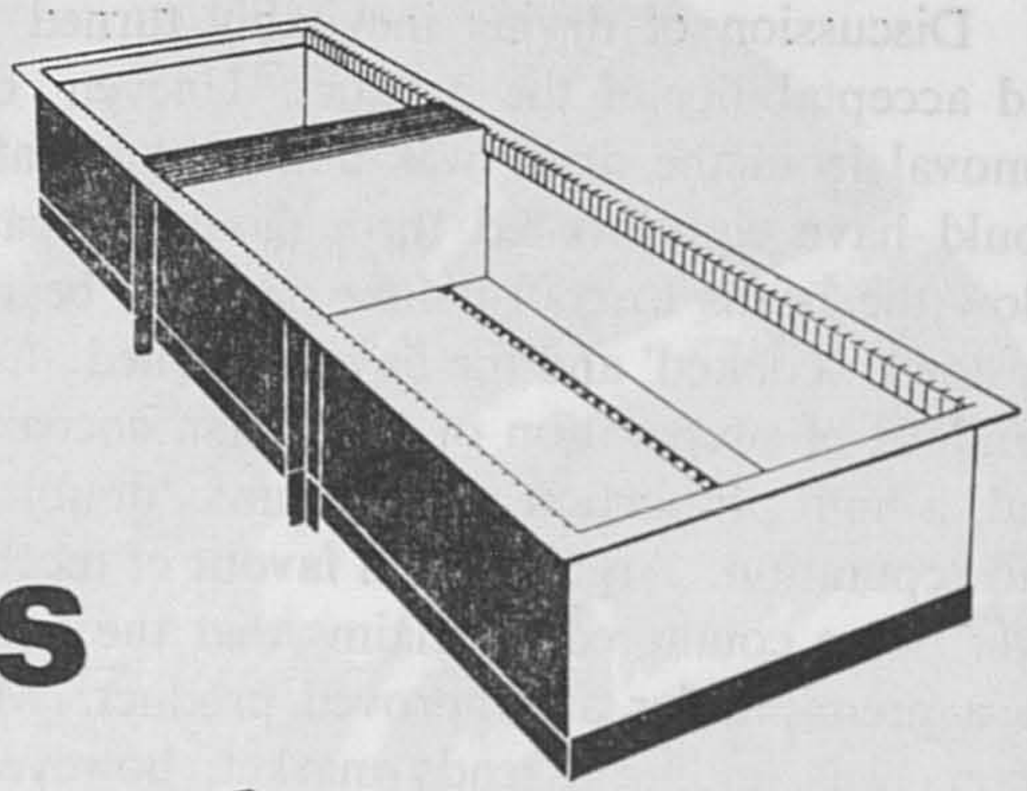

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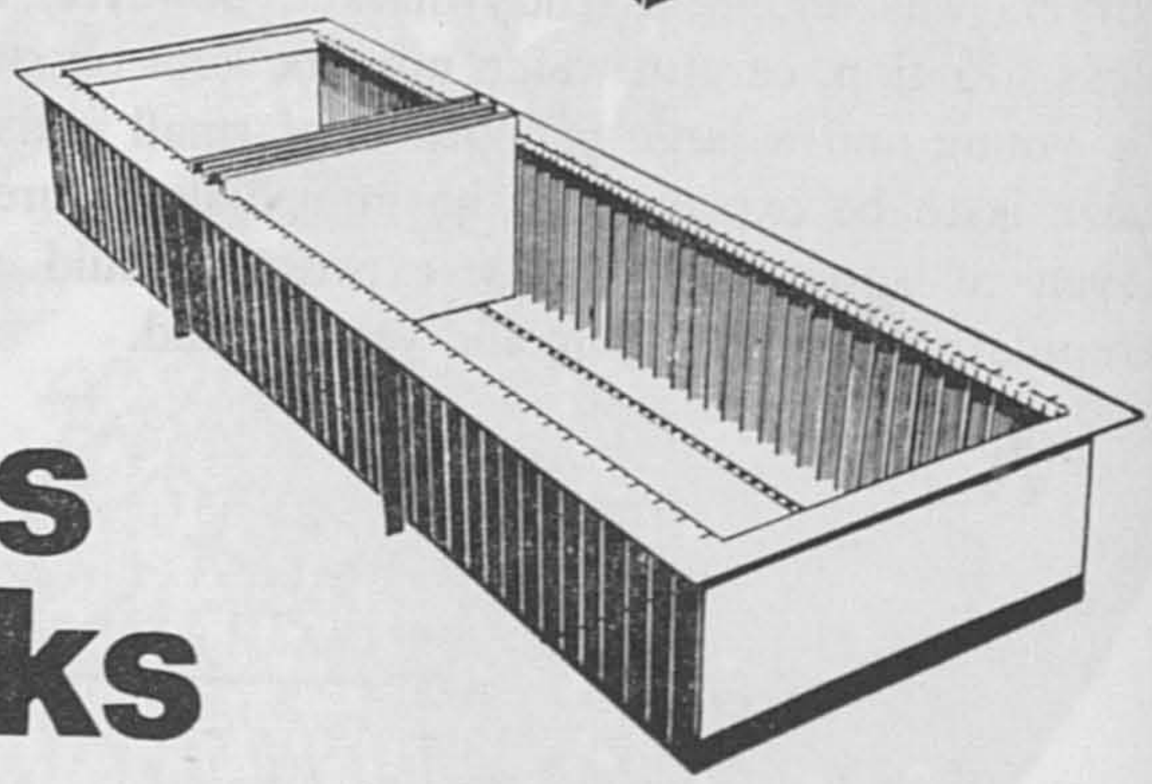

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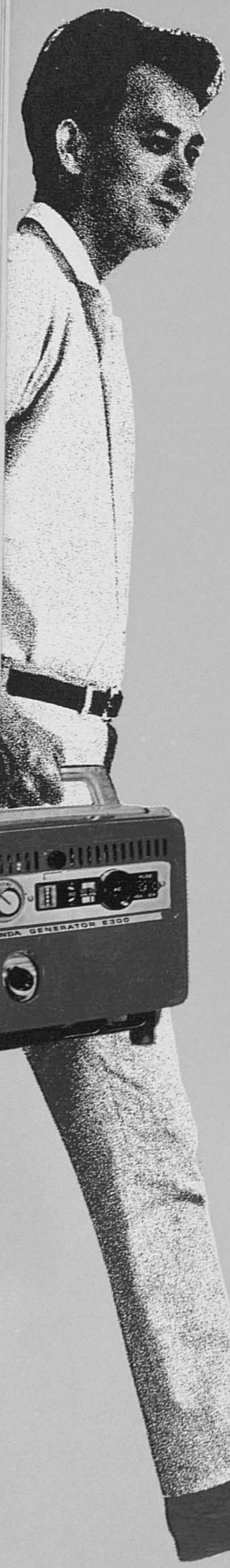

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A SELECTIVE PRE-EMERGENCE WEEDICIDE FOR GRASS CONTROL IN THE ESTABLISHMENT OF LEGUME COVER CROPS

by

Wong Phui Weng

Monsanto Far East Limited

INTRODUCTION

Alachlor weedicide, a highly versatile pre-emergence grass killer, was first tried out in Malaysia in 1968 for weed control in groundnuts, maize and tapioca, intercropped with rubber and oil palms. The product used in these trials was LASSO, manufactured by Monsanto. It was found to be highly successful in controlling all the common grassy weeds regenerating from seeds, as well as giving fair control of Cyperus spp. and certain broad-leaved weeds such as Borreria and Amaranthus.

This paper presents results of two experiments with LASSO in the rapid establishment of legume cover crops.

Experimental Details

The land in both trials was ploughed once and rotovated twice, and all existing weeds not killed were picked off by hand. Three rates of the weedicide were sprayed with a Floodjet* nozzle immediately after sowing the legume cover cropseeds. The volume of water used was 60 gal/acre. A simple randomized block design was used, with plots of 12 × 18 ft, with three replications Trial 1 and four replications in Trial 2.

Results

Trial No. 1

This trial was conducted on a low organic sandy clay loam. The legumes consisted of a mixture of *Pueraria phaseoloides* and *Centrosema pubescens* planted in drills 4 ft apart. Self-sown *Calopogonium mucunoides* was present at random over the whole trial area.

The effect of LASSO on germination of the legumes was visually observed at two weeks. The self-sown *Calopogonium mucunoides* was highly tolerant. Up to $3\frac{1}{2}$ pints/acre caused no bad effects. Up to $2\frac{1}{2}$ pints/acre was harmless to *Pueraria phaseoloides* and *Centrosema pubescens*, but $3\frac{1}{2}$ pints/acre delayed germination by about 15% of the seeds.

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Table 1. Effect of LASSO on germination of legume cover crops

Species of legume	*RATE*			
	No application	*1⅔ pints/acre*	*2½ pints/acre*	*3⅓ pints/acre*
Calopogonium mucunoides	No harmful effect	No harmful effect	No harmful effect	No harmful effect
Pueraria phaseoloides	No harmful effect	No harmful effect	No harmful effect	± 15% delayed germination
Centrosema pubesceous	No harmful effect	No harmful effect	No harmful effect	± 15% delayed germination

Grass control as assessed at two months is given in *Table 2.*

Table 2. Effect on weed incidence at two months

RATE				
No application, no weeding	*No application, handweeded twice*	*1⅔ pints/acre*	*2½ pints/acre*	*3⅓ pints/acre*
60% weeds mostly grasses *Eleusine indica, Digitaria adscendens* and broadleaf *Borreria latifolia*	No weeds	10% weeds almost grass-free mostly broadleaf *Borreria latifolia*	8% weeds mostly broadleaf *Borreria latifolia*	1% weeds

Compared with handweeding, LASSO had little effect on speeding up or retarding the rate of establishment of the *Pueraria phaseoloides* and *Centrosema pubesceus* planted within the seed drills at two months. The percentage of the soil covered by the legumes in the handweeded and sprayed plots was about 20%. However, the hand weeding removed all the self-sown *Calopogonium mucunoides* between the seed drills, while the LASSO removed the grasses, but allowed the self-sown *Calopogonium mucunoides* to develop vigorously between the seed drills. The extra contribution from the growth of *Calopogonium mucunoides* in the sprayed plots had a marked positive effect in the overall % of the soil surface covered by legumes (*Table 3*).

Table 3. Effect of LASSO, on percentage of soil surface covered by legumes at two months

RATE				
No spraying, no weeding	*No spraying, handweeded twice*	*1⅔ pints/acre*	*2½ pints/acre*	*3⅓ pints/acre*
5%	20% (from seed drills only)	90%	99% (From seed drills plus from self-sown *Calopogonium mucunoides* between the seed drills)	99%

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Trial No. 2

This trial was conducted on a high organic coastal alluvial clay soil. The legumes consisted solely of *Pueraria phaseoloides*. The seeds were broadcast over the whole area.

The absence of effect on germination and subsequent growth of the *Pueraria phaseoloides* is shown in *Table 4*.

Table 4. Effect of LASSO on germination and rate of development of Pueraria phaseoloides

Treatments	*Effect on germination*	*Percentage of soil surface covered by* Pueraria phaseoloides *at 2 months*
Selective handweeding	No damage	70%
LASSO 2½ pints/acre	No damage	57%
LASSO 3 pints/acre	No damage	50%
LASSO 3½ pints/acre	No damage	70%

The high degree of weed control obtained is shown in *Table 5*.

Table 5

Treatments	*Percentage of soil surface covered by weeds at two months after planting*	
Selective handweeding	40%	*mainly grasses *Paspalum conjugatum, Axonopus compressus, Digitaria adscendens.*
LASSO 2½ pints/acre	10%	— do —
LASSO 3 pints/acre	8%	— do —
LASSO 3½ pints/acre	2%	— do —

* In spite of one handweeding round carried out at one month.

Discussion and Recommendations

Both trials clearly showed that LASSO is highly effective in providing early weed control in the establishment of legume crops cutting down labour usage and costs. Depending on the degree of purity of the legumes desired, it is recommended to spray at 2–2½ pints/acre on low organic soils and at 2½–3½ pints/acre on high organic soils.

It is certain that amongst the estates that believe in the benefits of legume cover crops to early growth and yields of rubber and oil palms, there are some that have been discouraged from establishing legumes because of excessive costs of initial weeding or by the shortage of manual labour for weeding. The use of this weedicide would make it possible for these estates to implement the legume cover policy.

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LASSO would be particularly useful in areas with the self-sown legume *Calopogonium mucunoides*, as it dispenses with hand weeding that destroys this legume between the seed drills, but encourages the development of this legume between the sed drills, rsulting in extremely marked acceleration of cover establishment, reducing costs of the latter (*see Table 3*).

Perhaps the greatest value derived from the introduction of this herbicide to plantation crops is that it will now be possible to practice the rapid method of legume cover establishment by heavy incorporation of phosphates developed by the RRIM in 1964/1965. The RRIM showed that $4\frac{1}{2}$ cwt/acre of rock phosphate ploughed into the soil before planting resulted in complete cover establishment within two months compared with the 4–6 months required with the conventional method of applying rock phosphate in broadcast dressings of 1–2 cwt/acre. Commercial application of the RRIM method was not possible at that time because the heavy early phosphate application stimulated not only the legumes, but also the grass weeds. Weeding costs increased despite the more rapid cover establishment achieved.

For best results, LASSO must be applied on to clean weeded soil, immediately after planting of the legume seeds before weed regeneration has begun, and on the clean ground obtainable with mechanically ploughed fields, conditions are ideal for its normal use. In areas where ploughing is not possible the ground is always covered with weeds which are eliminated by early applications of 2,4-D Amine/Sodium chlorate or MSMA/2,4-D Amine/Sodium chlorate mixtures. Limited work with the addition of 2–3 pints/acre of LASSO to these weedicide mixtures has shown no signs of incompatibility. On the contrary, its addition appeared to greatly enhance the post-emergence effects of these mixtures against *Ottochloa nodosa, Eleusine indica* and other grasses. It is suggested that in non-ploughed areas, estates try adding LASSO at 2–3 pints/acre to the 2,4-D Amine/Sodium chlorate and MSMA/2,4-D Amine/Sodium chlorate mixtures to achieve the double purpose of improved post-emergence grass control plus pre-emergence grass control in one single application.

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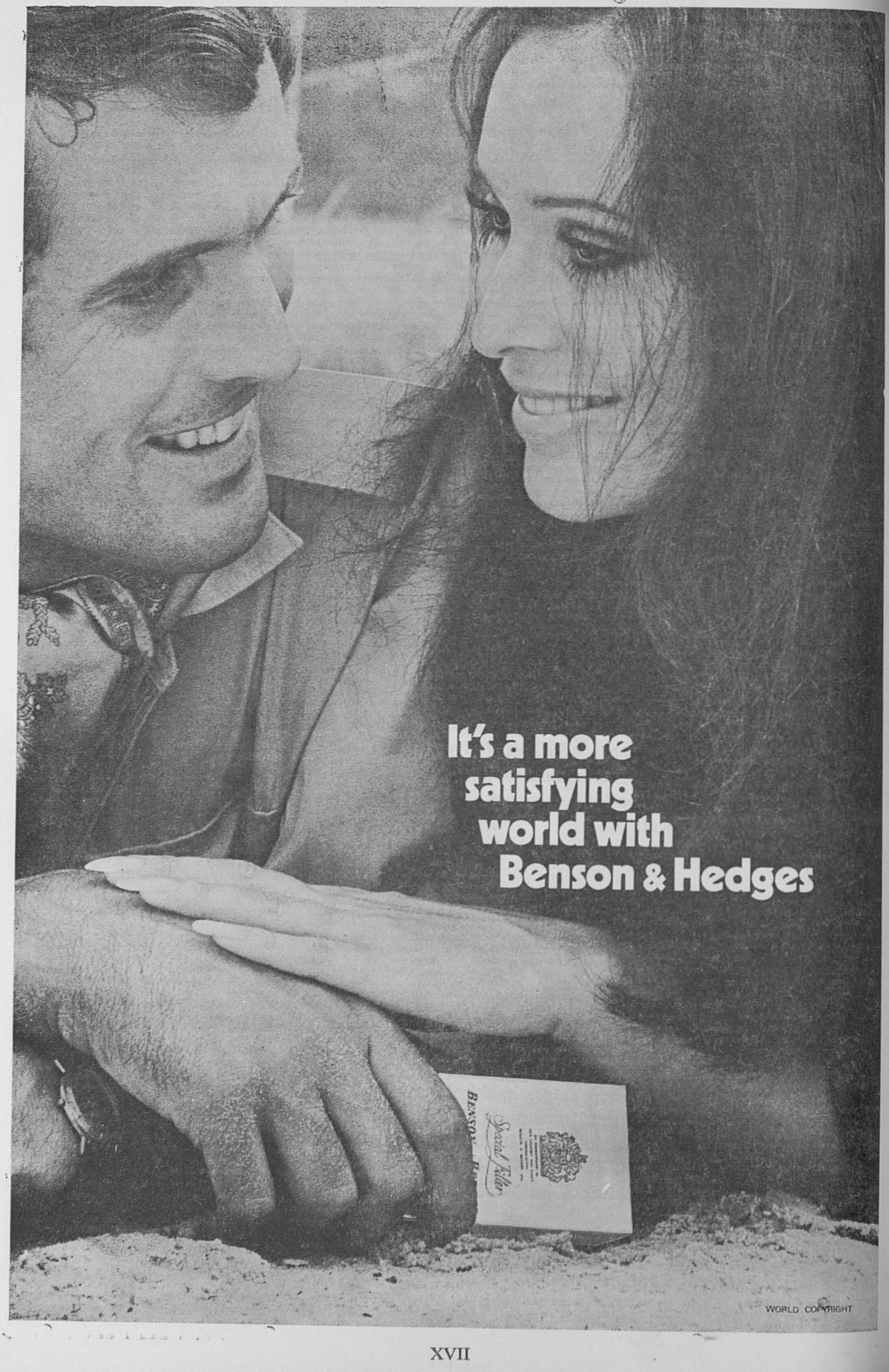
Acknowledgements.—The author thanks the Agricultural Marketing Development Department of Monsanto Company, St. Louis, Missouri, U.S.A. for permission to publish this paper. Thanks are also due to Mr. M. M. Chandapillai for assistance in conducting Trial No. 1 and to Mr. G. L. Walker and Enche Johari bin Abbas, for assistance in conducting Trial No. 2.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HEADQUARTERS AFFAIRS

Conservation in Malaysia — a manual on the conservation of Malaysia's renewable natural resources, was reviewed under the title of "Saving Malaysia for Man" in our August issue. We have now been informed that copies of Dr. P. R. Wycherley's excellent monograph can be obtained quite cheaply direct from the publishers in Switzerland, the International Union for Conservation of Nature and Natural Resources, and the Society is prepared to place a bulk order for the manual if the response from Members warrants it. An all-in charge of $5/50 a copy will be made to cover postage and packing. Please write to Headquarters before the end of November if you wish to obtain copies.

An unusual picture of senior KGSB executives working flat out, may suggest mass interrogations in a Moscow dungeon but is in fact a photograph in *The Guthrie Times* of members of their Kuala Lumpur staff—including Mr. Marcus J. Gent the managing director—lying on their backs doing leg-raising exercises. We commend their enterprise but feel that the chances of catching the staff of *this* headquarters with their legs in the air are remote in the extreme.

The appointment in North Malawi mentioned in these notes last month has been filled.

According to Tommy Trinder today's comedians are using the same gags he used thirty years ago. "Mind you" says Mr. Trinder, "they up-date them a bit. It's a wise crack that knows its own father."

Will Members who have borrowed books from the Secretary's office during the past few months please return them promptly. Even though his back might have been turned when the books were acquired, all will be forgiven.

Our mention of the Rolls-Royce last month has reminded us of another great motor-car: the bull-nosed Morris Cowley. Lord Mancroft writes of a 1923 model owned by a friend of his at Oxford. Despite protests from the Dean this vehicle was irreverently named God, because it moved in a mysterious way. It did about two telegraph poles to the gallon if the wind was behind it, and was painted red down one side and blue down the other to confuse witnesses in the event of an accident.

Headquarters Affairs are a bit lightweight this month. This is because we have been too busy with the coming Conference to have any. Registration for the Conference remains open and we look forward to seeing you there.

Bali 2 times a week. Bangkok 14 times a week. Colombo 2 times a week. Djakarta 16 times a week. Hong Kong 14 times a week. Madras 2 times a week. Manila 3 times a week. Medan 4 times a week. Melbourne 3 times a week. Perth 3 times a week. Taipei 7 times a week. Tokyo 7 times a week. Sydney 3 times a week. And now we fly to London via Bombay, Bahrain and Rome 3 times a week.

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DATELINE KUALA LUMPUR

A certain association has been raising a hue and cry over the question of expatriates in the planting industry. Their motto apparently is "expats must go". No one is disputing the fact that Malaysianisation is inevitable, least of all the expats themselves. But the association claims that the expats have been deceiving the public and Government as to the rate of Malaysianisation in the planting industry.

Significantly, all the association's claims as to the subtle deceit employed by expats have been promptly refuted. Following a highly imaginative statement by the association's president to the press, the chairman of the Standing Committee on Malaysianisation, Inche Ibrahim bin Ali, was quoted by the official news agency BERNAMA as saying: "..... it is clear that the expatriate posts Malaysianised since 1966 were 57 per cent and not the 24 per cent quoted (by the association's president)".

The way insinuations go, it's a crime to be an expatriate. "An expat? Won't do old boy. Nothing personal really, but there's an odour about you!"

It has become a fashionable pastime, booting out expatriates. Right or wrong, show them the door as quickly as possible. Expatriates have been painted as ugly and potentially dangerous. They are apparently overpaid, over-rated, under-worked blue-eyed boys which the country would be better off without. Is proof of loyalty the ability to shout the loudest and get rid of the most number of expatriates? Perhaps the logic is a little subtle.

So much dust has been kicked up to cloud the issue and it is easy to get emotional and hot under the collar. But essentially we are faced with the choice of either opening the door politely for the expatriates to leave, or creating a scene and slinging mud.

Facts and figures show that the expatriate in the planting industry is not deliberately overstaying his welcome by "pulling the wool over the Government's eyes". So why throw imprecations, threats and accusations after the retreating figure of the expatriate? Why can't any Malaysian shake the hand of an expatriate and say: "Thank you very much for your help. Do drop in again—as a tourist"?

There's money to be had hanging around jewellers and pawnbrokers if you know what you are looking for. Although it's not half as exciting as a smash and grab there's the possibility of making a tidy sum if you have trained eyes for jewels. A geological assistant whose hobby is gemmology has picked up a $2 000 ruby for $20 from the dusty display counter of a pawnbroker in a small town. His work has taken him round almost the whole of West Malaysia. Among his "finds" are a $500 jade ring for which he paid $50 and a few sapphires and emeralds bought for a song.

"Some of these valuable stones are passed over by jewellers in this country because they are untrained," he said. "It's doubly difficult to separate the wheat from the

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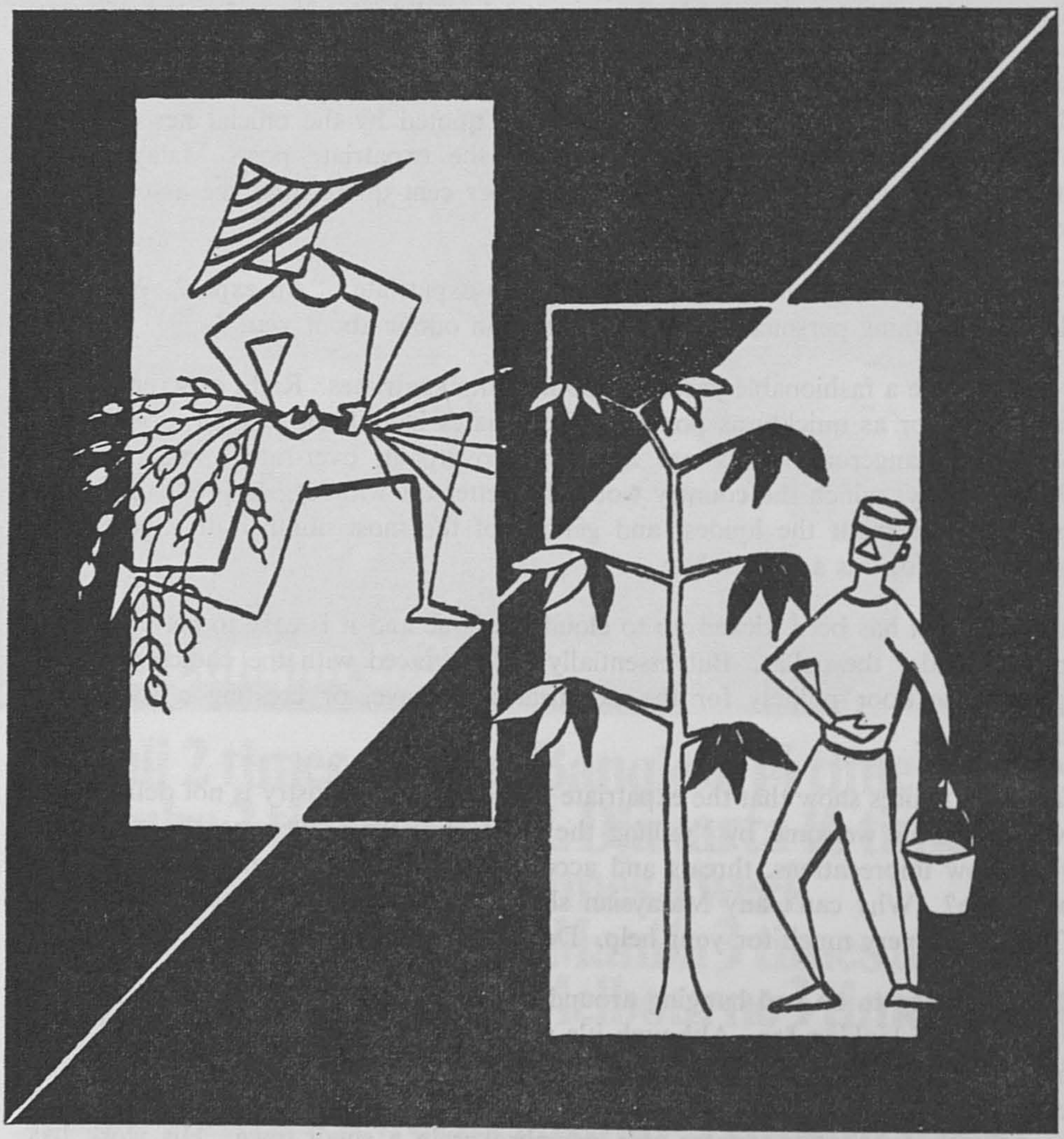

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chaff nowadays, what with the synthetics. Most rural people, especially plantation workers, prefer to hoard jewellery rather than invest in shares or bank their money. In this way, they imagine they are safe from inflation."

"But there is always the possibility" he said "that they will end up with a lemon rather than a valuable gem. Take for example jade. It's one of the most sought-after semi-precious stones today, and it's also one of the most difficult to choose. Inferior jade is sometimes injected with dye along minute cracks and sold as highly valuable pieces. The dye will naturally wash out after some time and the superstitious wearer will believe that his luck is running out instead of realising that he's been taken for a ride."

He added that soapstones were sometimes sold as jade and some plantation workers have been buying cheap alloys instead of gold or platinum. Has he found any valuable gem-stone during his work as a geological assistant? He preferred to remain evasive and noncommittal. Interestingly enough, he believed that gems had characteristic emanations or "vibrations" which could affect a person's mood.

After four intensive years fighting malaria, the Health Ministry has "formally declared war" against the mosquito (*Straits Times*, October 21). At the initial meeting of the Malaria Eradication Board here, Health Minister Tan Sri Sardon described malaria as the "No. 1 problem in rural areas" and said that the disease must be wiped out at all costs.

The entire fight against the mosquito has taken on the air of a military campaign. The silent, hidden enemy has infiltrated the ranks of rural Malaysians and they must be isolated from the people (the Briggs plan again?). The Malaria Eradication Act provides that action will taken against those who fail to report cases of the disease.

In line with this military stance, Tan Sri Sardon also announced the setting up of a task force (combined with the flying squads of old) to "strengthen malaria eradication activities at national, state and district levels".

According to the Minister, the toll so far has been 500 000 cases of malaria annually and $14 million in wasted man-hours and delays in implementing rural development projects.

The eradication campaign is the biggest single project of the Ministry under the Second Malaysia Plan. There is little wonder at this, since there are fears that malaria might seriously hamper the development of the rural areas. Unfortunately, the fight against malaria appears to be a fight against public apathy as well. There have been reports of families cleaning their houses of DDT immediately after spraying, and ignoring safety precautions. Apparently, the public will have to be educated. But isn't it time for the Ministry to be more candid as well? When the press reacted to Tan Sri Sardon's disclosure that the estimated number of malaria cases was about 500 000 annually, he was quick to point out that the number of reported cases dropped significantly in areas where eradication programmes had been introduced.

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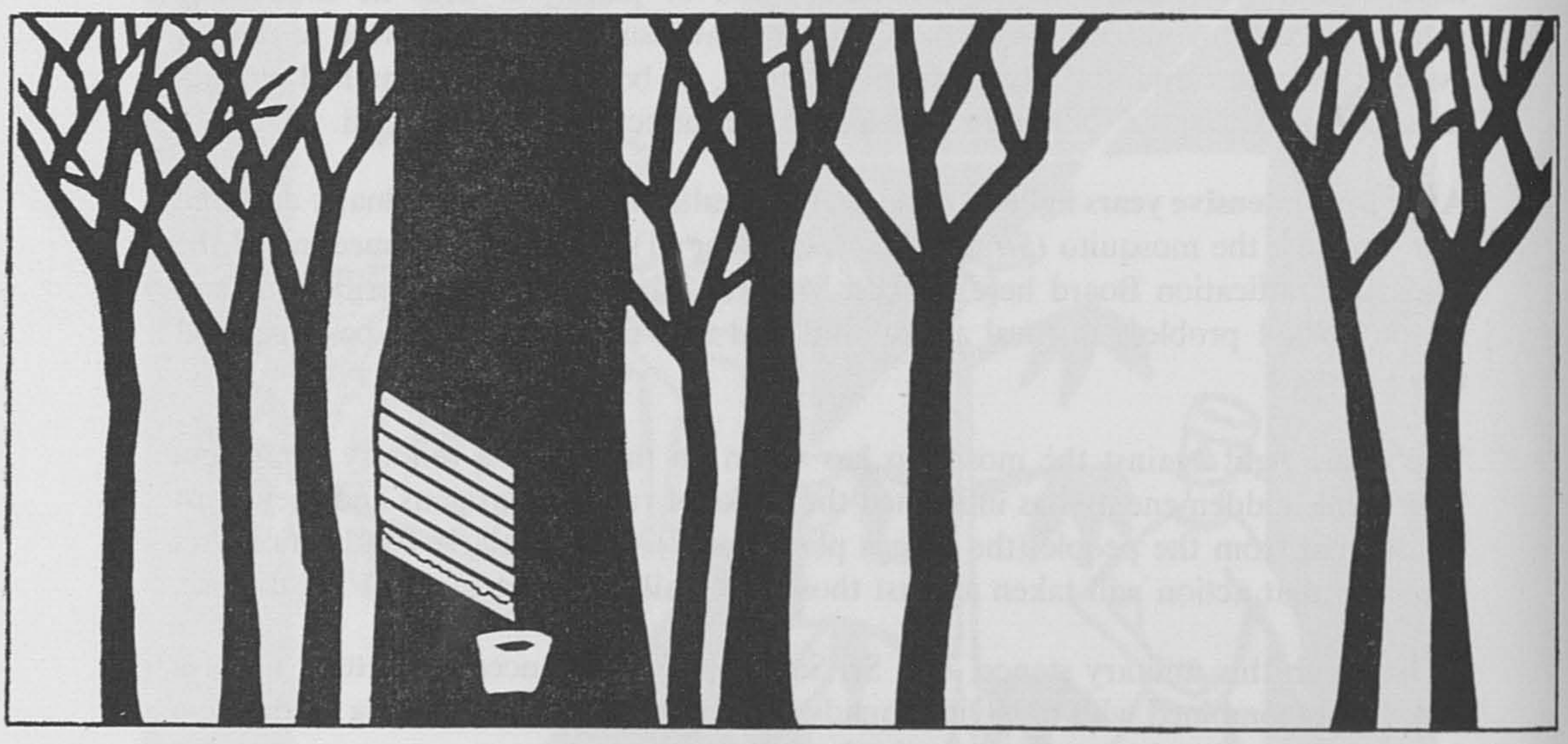

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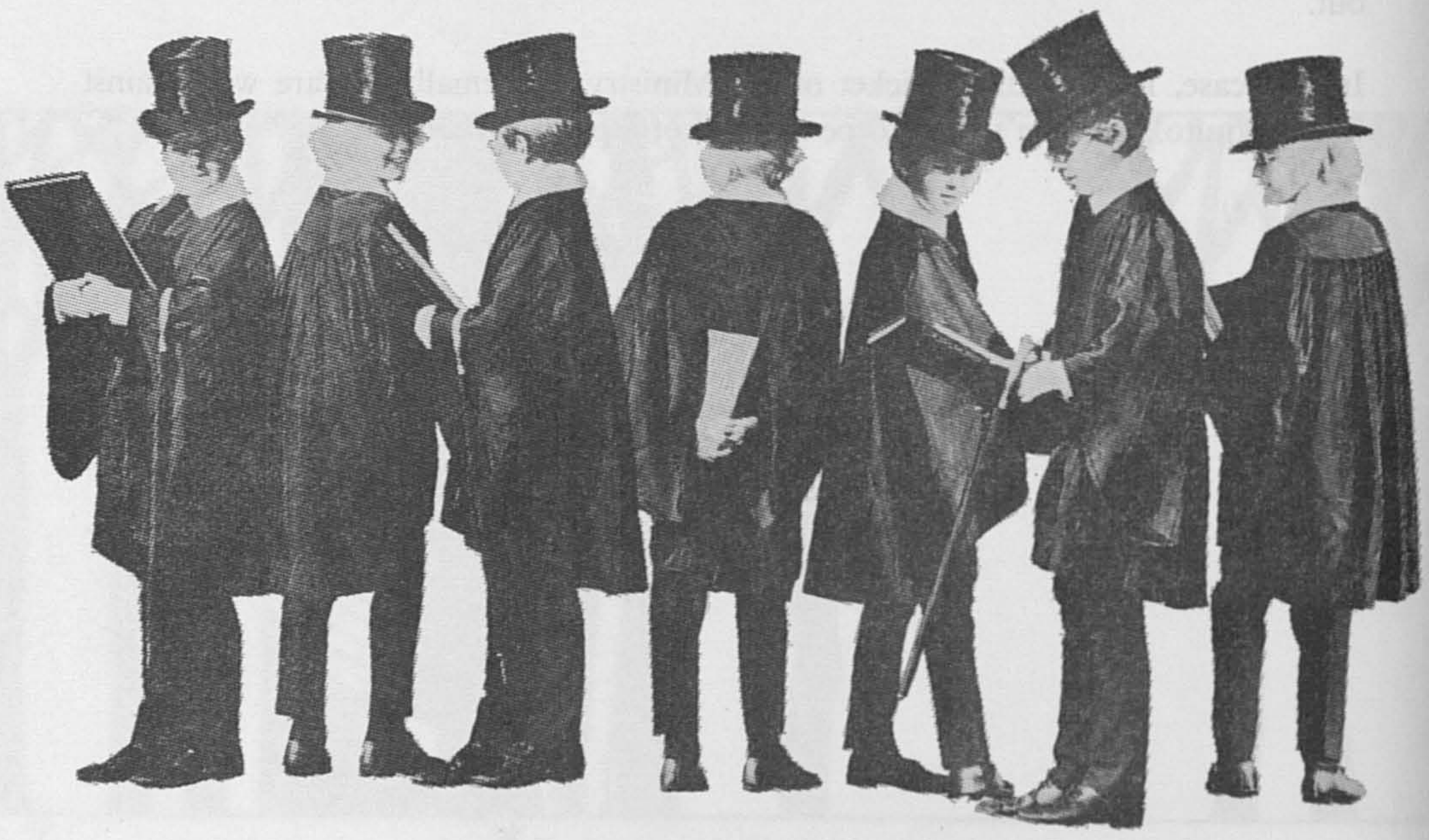
However, no one knows the actual incidence of the disease and the death rate. At best all we have are intelligent guesses. The public might be better impressed with the dangers of the disease however, if the death toll were made known. Perhaps ambiguous medical reports such as "death because of high fever" should be more explicit.

Malaria has a special significance for the planting industry. The industry has won a reputation for efficiency and organisation and perhaps it might be able to provide the authorities with figures for the incidence of the disease among its workers. Generally however, plantations may be considered "white areas" and it might be useful to use them as centres from which the fight against malaria could be carried out.

In any case, it was rather cricket of the Ministry to formally declare war against the mosquito. We don't want to be accused of a pearl harbour, do we?

J. N. M.

Daily to London



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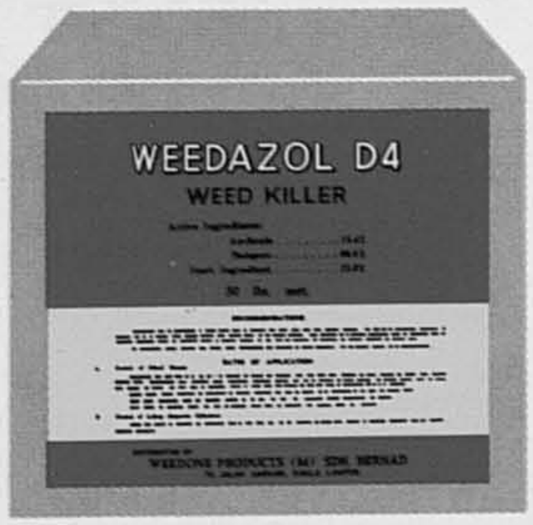

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PLANTING QUERIES

This title was that given to a booklet published by the Society in 1927 which contained Questions and Answers collected from a competition featured in *The Planter* in 1924 and 1925. We thought it would be both amusing and instructive to publish the questions with both the original answers and those acceptable nearly half a century later. This month we give two examples.

Q. *A rubber estate 800 acres area recently purchased is found to be badly diseased by* Poria *and* Fomes. *The trees are 15 years old and the average stand 75 per acre. What measures would you adopt?*

(a) *to cope with the diseases.*

(b) *to supply the vacancy.*

A. (a) To cope with the disease I would: —

(1) cut out all the diseased trees.

(2) isolate each diseased tree-space with a trench and then cut another outside the first one to include the four nearest trees, even though they do not show any appearance of being diseased.

(3) see that the laterals of diseased trees are carefully followed up and dug out and everything properly burnt.

(4) lime the trenches and all diseased patches.

(5) burn all old *Hevea* logs—*Poria* favours these.

(6) if the land is flat, put in scupper-drains between each row of trees throughout the area. This would of course take time, but it is well-worth the time and expense as a preventive measure.

(b) As regards supplying the vacancies, I would wait until six months had elapsed after the ground had been limed before I supplied. Where large open patches occur efforts should be made to improve the soil and its tilth by changkolling—if flat or undulating—and liming. Then some cover crop should be put down. Amongst that a quantity of selected seed may be planted which can be thinned out when the stumps are a year or two old. On hilly land changkolling may be inadvisable but catchment drains should be put in if not already extant, some cover crop put in and the rubber seed planted.

The questions and answers are both illuminating and interesting. The answer highlights the changes and progress that have been made over the last 44 years. These changes can be brought into focus by answering this question in a modern context.

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In order to understand the question it is necessary to bring up to date the terminology and facts used in the original publication.

Poria is the old name for *Ganoderma pseudoferreum* which at one time was also called *Fomes pseudo-ferreus* or more commonly "Wet Fomes". *Fomes* is *Fomes lignosus*.

Modern opinion on the optimum stand per acre is at variance with that current in the 1920's when a stand of 75–80 trees per acre, obtained by selective thinning over ten or more years, was considered to be desirable. Many planters today would consider an average stand of 75 trees too low and would recommend replanting of the diseased area unless exceptionally high yields were being obtained from the remaining stand. In today's economic climate the ideal solution to the problem of a ravaged stand of 15-yr-old rubber would be to convert the area to oil palms and thus greatly increase the profitability of the estate in the long term. If this course was not possible and also if immediate replanting was out of the question then the following course of action would be suitable.

(1) Arrest further rapid spread of the two root diseases by digging isolation trenches at right angles to the planting rows. These should be discontinuous and it is not expected that they would prevent further spread; only that they will slow up the progress of the disease. This type of work will cost in the region of $10.00 or more per acre depending on the chainage of the isolation drains to be dug.

(2) Stimulation of the trees should be carried out in order to increase income followed by early replanting as soon as yields become uneconomical.

The method of dealing with the problem as proposed in the original answer is obviously very expensive. Present day costing for this type of work is given below: —

(1) *Cut out all diseased trees.*

Assuming 20 trees per acre to be cut out at $3.00 per tree giving a total of $60.00. This is for digging out the tap root and does not include the laterals which are dealt with separately.

(2) *Dig isolation trenches*

Say $20.00 per acre.

(3) *Dig out and burn all diseased laterals*

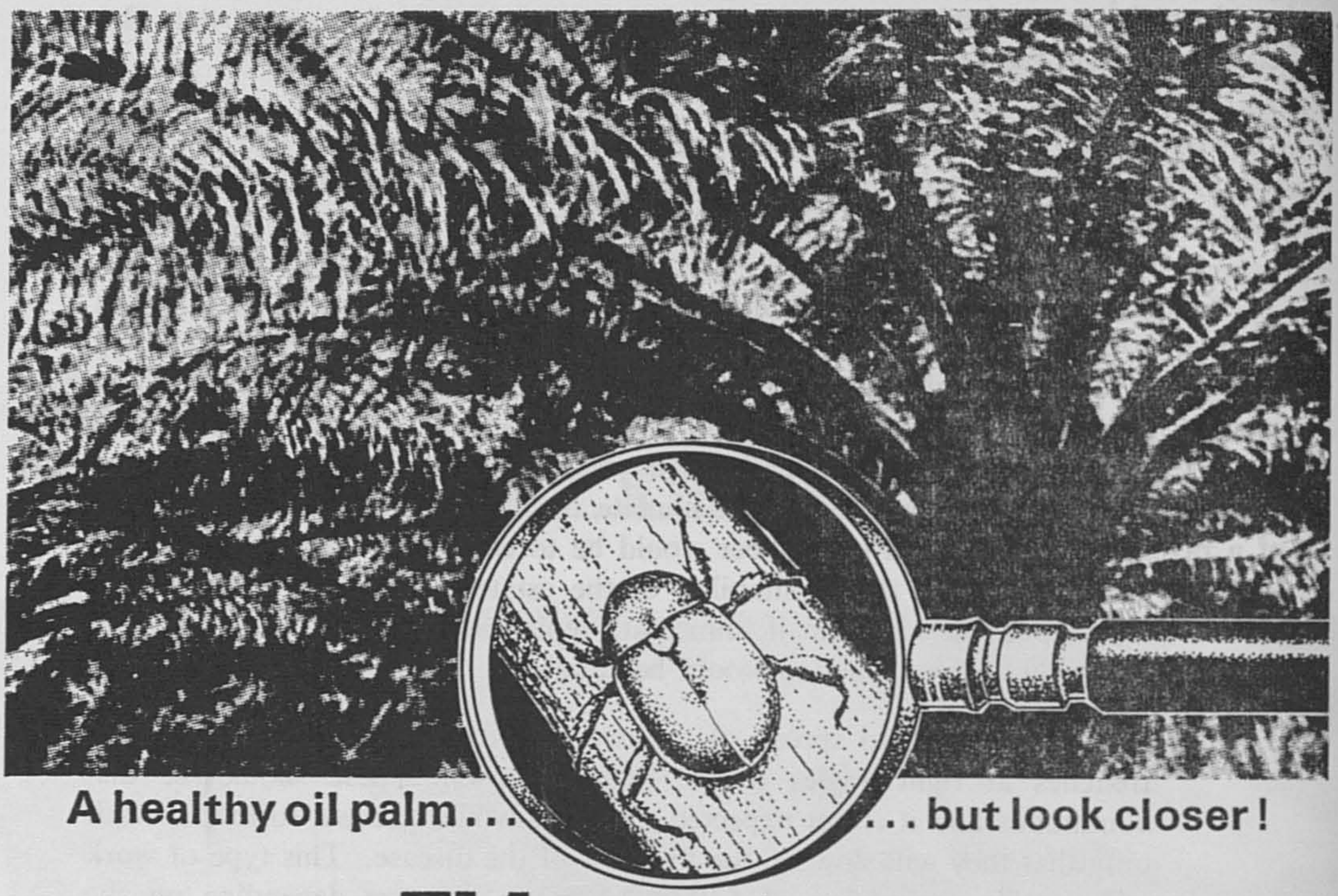
Say $10.00 per acre

(4) *Lime the trenches and diseased patches*

Say $3.00 per acre.

(5) *Burn all rubber logs*

Say $5.00



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(6) *Dig scupper drains in flat areas*

Dug by hand in 30 foot planting rows the cost per acre would be of the order of $60.00. This could be done more cheaply if a mechanical trench digger was used.

This gives a total of $158.00 per acre. With the present price of rubber this amount of work would be totally uneconomic, being equivalent to several years profit.

Finally, supplying is *not* favoured for the following reasons: —

(1) High cost of preparing the diseased patches for the growing of rubber successfully.

(2) Existing age of rubber would militate against a reasonably even and healthy stand per acre being achieved.

And now to a second question from *Planting Queries:*—

Q. *Having purchased a block of ten-year-old rubber, with a stand of 120 trees to the acre, would you thin out; if so, why, and what method of selection would you adopt?*

A. With a stand of 120 trees, ten years old, thinning out would be essential. Were this neglected the growth of the trees and ultimately the yield per acre would be certain to suffer. The foliage or head of a tree being one of the most important factors in latex production (it being through this medium that inorganic is transferred to organic matter and transpiration made possible) it is of paramount importance to encourage growth. This condition is best obtained by selective thinning to, say, 75 trees per acre.

The procedure of thinning is as follows: —

(a) Mark by means of whitewash all obvious malformed and diseased trees. These would probably number 15 per acre.

(b) By means of stencilling give each tree a number and at the same time open a yield index book containing corresponding numbers.

(c) Commence thinning out the undesirable trees and at the same time institute liquid yield tests of individual trees by means of a graduated glass. Each tree should be tested at least twice a year, the number of ounces being recorded in the yield index book. Two such tests should give sufficient data to enable one to remove ten more trees per acre.

(d) The procedure would be continued, about ten trees per annum being removed. Thinning out would be done strictly in accordance with the evidence obtained in yield tests as evidenced by the yield index book, except in the case of diseased trees which would be removed immediately.

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(e) Having thinned to 80 trees per acre no further healthy trees should be removed as, with advancing age, disease would be certain to claim a few thereafter.

Nowadays 120 trees per acre would be considered a reasonable stand for high yielding budded rubber and no further thinning out would be envisaged except possibly of any obvious runts.

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P.O. Box 475
Penang
27 Sept 1971

Dear Sir,

Esquire/Mister

I have been away on holiday for six months in New Zealand and learn only now about the "Esquire" controversial nonsense.

I look up and find that over the years you and I.S.P. always address me as G.M. Speeden, Esq., A.I.S.P. Selangor Club and others always address me "Esq." or "Esqre".

I feel that as an Executive Planter of more than 50 years ago (or less for that matter) I am entitled to be addressed *primarily by I.S.P.* as Esquire.

Probably I am not making it any easier for you (my dear chap) or for your Executive Council, but you do have *my* considered thinking on our traditional way of life.

Yours likeably,
(*Sgd.*) G. M. SPEEDEN.
No. 702

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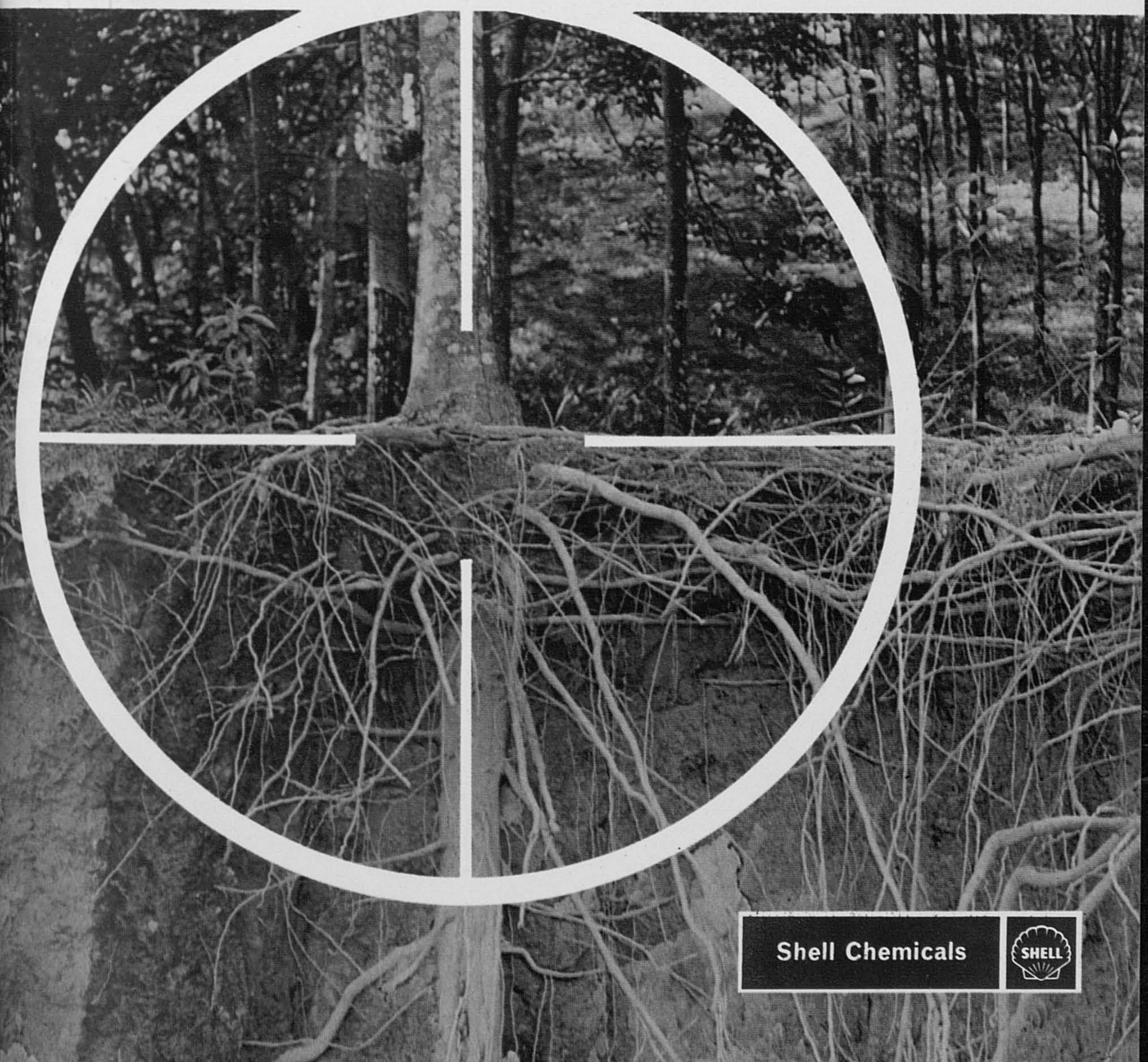

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