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AUGUST 1973

KDN 6696 Vol. 49 No. 569

The Planter

Years of persecution have made weeds sneaky!

If you have the feeling the weeds on your estate wait until you turn your back, then take over while you're not looking.... you're right. They do.

You need the kind of help we can offer. Our experts know all the weeds here. And how to mix a chemical "cocktail" that'll knock them out cold. For a long time.

We have **Shellapon** to destroy sheet lalang and **Shell Lalang Oil** for effective eradication of sporadic lalang. Down to the tips of the roots.

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We have **Diurex 1000, Shell MSMA** and **Ronmax 312** to complete your "cocktail" cabinet.

There isn't a weed smarter than these herbicides.

Call us to advise you on the "cocktail" mixture for your estate that will be the most effective and the most economical.

If it's a chemical — call Shell Chemicals.

Shell Chemicals

Mikania and Paspalum creep over the clear space between young rubber trees.
Shell Chemicals can supply a "cocktail" for these weeds — and even the knapsack sprayer to spray it!



The Planter

KDN 6686

MAGAZINE OF THE INCORPORATED SOCIETY OF PLANTERS

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N O T E

The Planter assumes no responsibility for the statements and opinions expressed by contributors.

SENTIASA MAJU

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.

ENTRANCE FEE for new and rejoining members is $10/- and must accompany application.

ANNUAL SUBSCRIPTION RATES are as follows: —

Category A	During the calendar year in which eligibility for membership occurred and the 4 succeeding calendar years.	**Subsequently.**
Ordinary Members employed as Managers, Assistant Managers etc. and normally resident in:		
Malaya and Singapore	$ 48	$ 78
East Malaysia and Brunei	$ 44	$ 60
Category B		
Ordinary Members employed as Executive Engineers, Estate Medical Officers, Research Staff etc., wherever resident	$ 48	$ 48
Approved Overseas territories	$ 44	$ 44

Contents

August 1973

Page

Editorial

Made in Malaysia - 305

Hallo? - 306

Technical

Utilisation of rubber effluent (1)
P R Kulkarni, Peter Ho, M Ratnasabapathy and W R Stanton 307

The development of Ethrel in food crops
D L Page 318

General

Golf Competition - 307

A round-up of the 1973 RRIM Planters' Conference *W Newall* 314

Success of a Malaysian agro-industry
T H Tay and Y C Wee 322

Book review: Plus ça change - 330

The monthly crop - 337

Crop protection and the balance of nature - 339

What is Ecology? *William Bowen* 343

The changing face of food scarcity
Lester R Brown 347

Social and Personal - 353

Pulau Rice - 356

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Editorial :

Made in Malaysia

The current 'Made in Malaysia' exhibition at Stadium Negara in Kuala Lumpur does not seem to us to provide the source of national pride which it should. We found a general amateurishness and lack of showmanship about the whole affair.

Presumably the exhibition is financed by a consortium of the exhibitors taking part, to provide one giant 'live' advertisement. It seems surprising therefore that entrance is not free and that there is an almost total absence of free samples, however trivial or gimmicky. Ballyhoo is not only a traditional part of scenes like this; it is, as any advertising man will tell you—absolutely essential.

We wonder why it was not found possible to group the exhibits in various departments so as to avoid wasted walking time. For example, one would have liked to see, collected in their own areas: products made from tin, from rubber, from Malaysian timbers, from oil, locally made plastics, fruits and so on.

Many of the attendants we spoke to were unable to give any useful information about the produce on display. Price tags were conspicuously absent, except on some TV sets, which weren't 'working'. Another brand of TV set, said to be locally-assembled, wasn't working either, though this was because the exhibitor had nowhere to connect it. (Full marks however to the locally-based Japanese company which had a whole battery of sets going perfectly, with a video demonstration of colour TV as well.)

The exhibition includes much that is 'assembled in Malaysia' or 'refined in Malaysia from imported raw materials'. Where then was the motor show of the makes and models assembled in this country? The largely bare centre floor of the stadium cried out for such a show.

A display of all the different types of wood available for house-building, of attap for roofing, perhaps a model house, in fact a Malaysian 'Ideal Homes' exhibition albeit on a modest scale, would have drawn the public in droves.

The Stadium Negara is rather a sordid place at the best of times. It is insufferably hot, and the smaller exhibitors must have collectively spent a fortune on the hire or purchase of pedestal and table fans. Many of the stalls had no fans at all—and no customers. A smell of stale urine pervades most of the building and some sort of air freshener which was being released during our visit was fighting a losing battle with the noisome atmosphere. But there is one fault with this building which is frighteningly obvious, especially during the current exhibition, and that is the risk of fire. We saw no extinguishers. They were probably there somewhere, but they must be few and far between. The temporary staircases and sagging 'pavements' round the galleries are made of dry, unfinished wooden planking and

timbers. Exits at the high level are blocked by turnstiles and getting out at the lower levels, even without persuasion, is difficult and confusing. All this, coupled with the design of a building which lends itself to a 'chimney' effect, seems to us to make Stadium Negara a fearful fire hazard, and we wonder if the present layout was passed by the Fire Department.

These are severe strictures but we think they are valid. What we would most like to see 'Made in Malaysia' is a new, well-planned exhibition centre; attractive and comfortable for the public, encouraging to the exhibitor, and of permanent benefit to industrial Malaysia.

Hallo?

Ninety-seven years have passed since Alexander Graham Bell filed his patent for the invention of the telephone, and yet there still exists any number of otherwise intelligent people who are convincd that saying 'hallo' is an essential prelude to any telephone conversation.

This time-wasting and totally unnecessary word is explained by the Oxford English Dictionary as a means of 'calling attention' or 'expressing surprise'. Can it be that after nearly a century of telephones people are still surprised that the things actually work?

We learned recently of a case where a poor man was trying to get through to a distant relation from a call box. After a long delay he was finally answered with a 'hallo' from the far end, pressed button A, and found he'd got a wrong number. It is not known, having lost his money, whether he bothered or could even afford to try again. And all because the subscriber at the other end failed to announce who or what he was.

Caution has a lot to do with it—especially from people unused to the telephone—but there is little excuse for those in business who may answer the telephone a hundred times a day. Years ago we saw a notice pasted up in front of a war-time switchboard operator:

Don't say hallo
Announce your identity
Don't say *hallo*
clarify your entity.

Sensible advice—but how many follow it?

Planter, Kuala Lumpur **49:** 307–313 (1973)

Utilisation of rubber effluent (1)

P. R. KULKARNI, PETER HO, M. RATNASABAPATHY AND W. R. STANTON*

SUMMARY

Rubber factory effluent is one of the major liquid wastes from natural product processing in Malaysia. As a means of bringing about purification of this highly polluting effluent, experiments were carried out using this as a medium for the growth of algae. Seeding the effluent with an appropriate algal culture converted the obnoxious, high-nitrogen effluent within 4–5 days into an innocuous, pleasant grassy smelling liquid, which was not harmful to fish.

Natural rubber is obtained from the latex of the tree *Hevea brasiliensis.* The latex, when ultracentrifuged, separates into rubber and non-rubber phases, whose chemical constituents have been analysed, (Bateman, 1963). The latex may be processed into rubber coagulum by any one of the methods as shown in *Table 1.*

Each of these processes gives rise to effluents which differ in their physical and chemical properties, depending upon the treatment given. The quantity of effluents discharged per day and a comparison of the properties of the different effluents are presented elsewhere (Chemara Research Stn Ann. Rpt 1968, 1969; Kulkarni, 1972.). At present, the normal disposal procedure is to discharge the effluents into a nearby stream or river, which is not really a safe procedure as far as their B.O.D., high mineral and nitrogen contents are concerned.

Various methods of utilising the effluents have been considered such as its use as a fertiliser or as a source of quebrachitol (John, 1972) but no reports are available describing the use of this effluent as a growth medium for specific algae, with or without subsequent harvesting of the cells.

The effluent which was used in this case *viz* cuplump effluent, was an obnoxious, grey colloidal suspension and generally had a pH between 7–8.5. Earlier analysis of the effluent has shown that it contains an average total N 41.104 ppm, total solids 0.08–0.31, had a B.O.D. of 97–562 ppm and P, K, Ca, Mg at 26, 28, 150, 42 ppm. respectively (Chemara Research Stn Ann. Rpt 1968, 1969). Under microscopic examination it showed presence of a variety of bacteria, short or long rods, cocci, motile, non-motile spiral organisms, single or colonial masses and very few colourless flagellates mostly with one flagellum.

EXPERIMENTAL

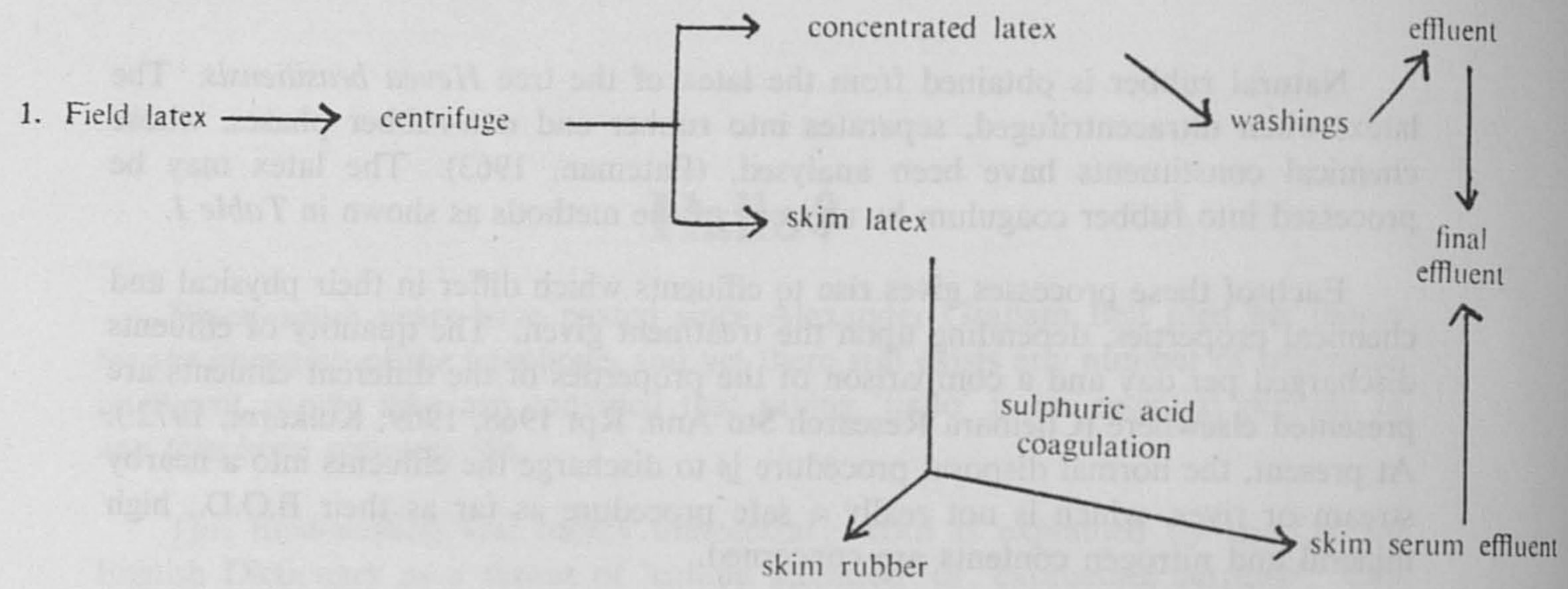
In order to discover a satisfactory method of treatment for the cuplump effluent before its disposal into the main stream, the effect of alternative conditions of light *vs* darkness, presence *vs* absence of aeration on this effluent was studied. Six-litre quantities of the effluent were stored in transparent plastic aquaria (33.6 × 18 cm., 20.4 cm deep) covered with glass sheets. These were kept outdoors in sunlight or in

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the dark, either aerated with fish tank aerators (146 c.c air/min.) or kept unaerated with a thin layer of liquid paraffin as needed. These tanks were observed for different changes at different time intervals and the results are compiled in *Table 2.*

Table 1. Methods of processing rubber latex into rubber coagulum

PROCESSES:



ISP ANNUAL GOLF TOURNAMENT

1. **VENUE & DATE :**

The tournament will be played at Kampong Kuantan Golf Club, Bukit Rotan, Selangor, on Sunday 28 October from 08.00 hrs.

2. **ADMINISTRATION :**

The Tournament Committee's decision shall be final in all matters relating to the competition and interpretation of the Rules.

Committee : Noel Thong
Khoo Khee Ming
Chew Kong Yoon

3. **ENTRIES :**

Entries are open to members of the Incorporated Society of Planters and invited players from agency and business houses. ISP members will be charged an entrance fee of $5.00.

Entries close on SATURDAY 13 OCTOBER.

4. **CONDITIONS OF PLAY :**

The tournament shall be played in accordance with the Rules of Golf as approved by St Andrews, and with local rules, and will be stroke play over 18 holes.

5. **MAIN EVENT**

Jumbo Downs Rose Bowl

The winner of the main event shall be the competitor returning the lowest aggregate net score (full handicap).

6. **ADDITIONAL TROPHIES :**

Best Scratch Score Trophy

The winner of this event shall be the competitor returning the lowest gross score. There will be no handicap allowance.

ISP Golf Tournament Trophy (presented by ICI Agriculture)

The winner of this event shall be the competitor returning the highest Stableford points. (Handicap allowance 7/8).

Shell Trophy (for invited entries only)

The winner of this event shall be the competitor returning the lowest aggregate net score.

NO COMPETITOR MAY WIN MORE THAN ONE TROPHY. THE ORDER OF PRIORITY IS AS FOLLOWS:

Jumbo Downs Rose Bowl
Best Scratch Score Cup
ISP Golf Tournament Cup

In the event of a tie the winner shall be determined by a count back.
The best first 9 holes (if the winner is not determined then)
The best first 6 holes (if the winner is not determined then)
The best first 3 holes, and so on.
Winners will retain trophies for 6 months *before returning them to the ISP in Kuala Lumpur.*

7. **BALL SWEEP :**

Ball sweep will be catered for on each 9 on optional basis. (Entrants 2 balls).

8. **PLANTERS versus AGENTS :**

Integral with the competition there will be a match between Planters and Agency Houses for the ISP Annual Golf Tournament Trophy (sterling silver). The winning team will be decided by match play.

9. **LUNCH :**

This will be provided at $5.00 per head for adults and $2.50 for children. Please indicate your requirements on the entry form.

10. **INTRODUCTION CARDS/GREEN FEES :**

The Kampong Kuantan Golf Club, while generously allowing the ISP to hold the tournament there, requires players who are not members of the KKGC or affiliated clubs to pay a green fee of $5.00. Entrants are asked to produce their clubs' introduction cards.

(See over for Entry Form)

ENTRY FORM

(Entries close 13 October 1973)

Date:

The Golf Secretary ISP
P O Box 262
Kuala Lumpur

I wish to compete in the ISP Golf Tournament on Sunday 28 October.

I am a member of the ..... Golf Club, membership no.....

My handicap is ..... USGA and the SSS of my club course is .....

I require lunch for ..... persons and enclose my cheque for $..... being entrance fee* and lunch cost.

(sgd).....

Name .....
(BLOCK LETTERS)

ISP membership no......
(where applicable)

Address.....

.....

.....

(See over for Rules)

Table 2. Effect of light, aeration on cuplump effluent

Period of expt (days)	—	*10*	*10*	*10*	*10*	*17*	*17*	*17*	*17*
Condition of expt									
Light	—	+	+	—	—	+	+	—	—
Aeration	—	+	—	+	—	+	—	+	—
pH	8.3	8.15	7.65	8.3	8.1	8.7	8.8	9.1	8.8
Colour	Pale grey green	Grey	Dark grey green	Yellowish brown	Greyish green	Pale soil colour	Yellowish brown	Brown	Greenish brown
Suspended matter	Present	Highly suspended	Present	Present	Present	Highly suspended	Highly suspended	Present	Present
Odour	****	****	****	****	****	****	****	****	****
Sediment	Greyish	Absent	Absent	Absent	Absent	Soil	Brown	Greyish	Buff
Total solids %	1.451	1.621	1.472	1.515	1.782	1.674	2.052	1.637	1.839
Settleable solids %	0.029	0.0486	0.0588	0.0604	0.0712	0.051	0.0815	0.0623	0.0732
Microscopic examination	Short rods, non-motile, separate or colonial, quite abundant. Longer rods, 10 to 30 times longer than wide. Colourless uniflaggellates few. *Clathrochloris*—like colonies 10–15 % of total pop., greyish masses.	As in previous column. Longer rods more abundant.		Results of microscopic examination very similar to 2nd column. Longer rods more abundant.		Short rods numerous. A few flagellates, large rods separate or colonial. Non-motile encysts and nematodes present.	Large rods numerous, few short rods and flagellates. Non-motile encysts and nematodes present.	Similar to previous column but short rods numerous.	As in previous column. Long rods more numerous.

Table 2 — *(continued)*

Period of expt (days)	*31*	*31*	*31*	*31*	*38*	*38*	*38*	*38*
Condition of expt								
Light	+	+	—	—	+	+	—	—
Aeration	+	—	+	—	+	—	+	—
ph	8.5	8.2	8.5	7.9	8.5	8.0	8.5	7.9
Colour	Soil	Greenish	Chocolate	Chocolate	Chocolate	Pale brown	Chocolate	Pale cream
Suspended matter	Highly suspended	Highly suspended	Highly suspended	Highly suspended	Highly suspended	Highly suspended	Highly suspended	Highly suspended
Odour	****	***	***	***	**	***	***	***
Sediment	Soil	Black	buff	Brownish white	buff	Black	buff	White
Total solids %	1.826	2.708	1.713	2.365	1.853	2.723	1.739	2.381
Settleable solids %	0.0643	0.0973	0.0697	0.0803	0.0661	0.0997	0.0721	0.0823
Microscopic examination	A large number of rod-shaped bacteria, short as well as long, some as colonies or separate, many encysts, eggs of nematodes, nematodes, a few flagellates also.			Same as in the previous column excepting the number of individual types of organisms.				

Odour **** Strongly disagreeable
*** Offensive
** Less offensive

In another set of tanks an algal inoculum was added to the medium, consisting of a mixed flora containing *Chlorella* as the dominant species, which was obtained from the Wardieburn Sewage Oxidation ponds, Kuala Lumpur. The inoculum was added at a level of 20% by volume of the medium where each ml of the inoculum contained about 1.5×10^6 cells. After inoculation, the seeded tanks were subjected to the conditions of light, aeration *etc.* as mentioned above and the tanks were observed for a period of 5 days. The results are shown in *Table 3*. Similar treatments for skim effluent however did not give any growth of *Chlorella*.

Lastly, to study the effect of this algal growth on the nature of the effluent, harmlessness of such effluent to the fish *Lebistes reticulatus* (family Poecillidae) was tested. For this, four fish were introduced into 1 litre of the original cuplump effluent, four in the 5-day-old effluent containing algal growth, four in the supernatant obtained by centrifuging the algae, and were allowed to remain there for a period of 5 days. The results are shown in *Table 4*.

RESULTS AND DISCUSSION

When subjected to alternative conditions of light, dark, and aeration, the cuplump effluent changed in different ways as seen from *Table 2*. All the tanks developed extensive bacterial populations which were mostly long or short rods, motile as well as non-motile. Over a period of 30 days, the effluent developed a number of flagellates nematodes with or without eggs and non-motile cysts. The dark unaerated tanks were richer in these contaminants compared to other tanks. When subjected to continuous aeration and daylight, the pH of the cuplump effluent showed a rise up to the 17th day and then declined up to the 38th day of observation. Unaerated, dark tanks also showed a similar trend in pH but the final pH here was much lower *i.e.* 7.9 as against 8.5 in the previous case. All tanks were equally obnoxious but the dark unaerated had .the most putrid smell. In all these treatments there appeared to be tremendous bacterial activity, giving rise to a secondary crop of flagellates with the displacement of much of the original bacterial population. In general, the dark tanks appeared chocolate in colour while the lighted had a buff appearance. Unidentified transformations occurred in all the tanks, all resulting in obnoxious alkaline liquids. The degradation was unsatisfactory, giving rise to foul smelling liquors within 5 days and suggesting that none of these treatments would be useful as a method of purifying the effluent before discharge.

As shown in *Table 3*, unlike the above experiment, the addition of an external algal inoculum proved to be beneficial in many respects. There was a rapid transformation and the obnoxious, raw effluent when given sunlight and aeration changed into a pale green soup with a grassy smell, within 5 days. Microscopic examination revealed the presence of abundant green *Chlorella* cells together with other algae such as *Chlamydomonas*, colourless flagellets, *Vorticella*-like cilliates, protozoan cysts, in addition to the bacteria originally present. Aeration favoured the growth of *Chlorella* although these algae also survived in unaerated tanks. The unaerated lighted tanks did not show this change as rapidly as the aerated and the

Table 3. Effect of inoculation, aeration and light on cuplump effluent

Period of expt (days)	*0*	*5*	*5*
Conditions of expt			
Light	—	+	+
Aeration	—	+	—
Inoculum	—	20%	20%
pH	6.5	6.8	6.8
Colour	Pale charcoal	Pale green	Reddish brown
Odour	Strongly disagreeable	Tolerable grassy odour	Strongly disagreeable
Total solids %	0.321	0.075	0.562
Settleable solids %	very small	very small	very small
Microscopic examination	1. A few large, some short rods present as individuals or in colonies. 2. Some colourless flagellates.	1. *Chlorella* in abundance. 2. A few *Clamydomonas* also present. 3. Motile, colourless flagellates. 4. Filamentous bacteria forming colonies or single. 5. Non-motile and motile spiral bacteria. 6. Rod-shaped bacteria. 7. Vorticella-like cilliates. 8. Cysts also present.	1. *Chlorella* very few as compared to the previous sample. 2. So also *Clamydomonas*. 3. Spherical motile colonies. 4. Spiral, motile, non motile bacteria. 5. Rods, Euglenoids, cysts and Vorticella-like cilliates present.

disagreeable odour was still prevalent even after 5 days. Seeding the effluent with algal flora and maintaining the tanks aerated or agitated in the sunlight were thus effective in promoting a rich algal growth and concomitant effluent degradation.

The suitability of the seeded effluent for direct discharge into a stream was tested by using fish. As shown in *Table 4*, the raw cuplump was found to be lethal to the fish as they died within $\frac{1}{2}$ an hour after introduction. However in both the algae-containing and algae extracted 5-day-old effluents, the fish survived very well for at least the period of 5 days over which the observations were carried out, suggesting that algal growth did change the original nature of effluent beneficially.

To conclude, subjecting the cuplump effluent to aeration and daylight along with a seeding with an inoculum containing *Chlorella* as dominant species could bring about sufficient purification of the effluent so that it was dischargeable without any harm.

Table 4. Effect of algal grown effluent on fish survival

Time of introduction	*Fish introduced into*		
	Untreated cuplump	*Treated effluent with algae*	*Treated effluent with algae removed*
0 hr	All in satisfactory condition	All in satisfactory condition	All in satisfactory condition
$\frac{1}{2}$ hr	All died	No death	No death
24 hr		,,	,,
48 hr		,,	,,
72 hr		,,	,,
96 hr		,,	,,
120 hr		,,	,,

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A round-up of the 1973 RRIM Planters' Conference

W. NEWALL

An unusually tentative conference this year; it seemed as though the progress of *Hevea Brasiliensis* and its product over the past few years could be likened to a flat race which suddenly changes into a steeplechase in mid-course.

A disappointing conference, too, in many ways. The distribution of question forms, probably intended to encourage those who are microphone 'shy' seemed to inhibit the quality of the discussion periods, compared with former years. Not all chairmen gave the impression of being in full command of the subject of their sessions and this too could have influenced the quality of the discussions.

Once again we suffered from overcrowded photographic slides; surely these tabular slides should be used only to emphasise points from the tables already available in the preprints. The position of the screen in relation to the 'front table' and the audience prevented a clear view, even with a 'horizontal' slide; vertical slides gave an image about twice the depth of the screen. Projection discipline was well below the RRIM's self-set standards; one unfortunate speaker reaching almost the altercation stage with the projectionist before getting things right.

As to the preprints, typographical errors and unclear English were uncharacteristic of the conference organisers, and in the matter of the content of the papers, there was a hastily-put-together look about some, especially in the Stimulation and Agronomy sections. This might have been due to lack of adequate proof-reading by authors, if in fact the printing was a last-minute affair.

Leaving aside organisational 'beefs' and passing to the subject matter of the conference, the main emphasis seemed to be threefold: processing and packaging of NR to consumer requirements; shortening of the tree's immature period, and smallholder organisation and economics.

And mention must be made of a suggestion canvassed at the conference which could prove to be prophetic: the concept of a 20-year tapping life, with yield maximisation by use of Ethrel from the earliest years of tapping.

PRICE

In both the opening and closing speeches, it was pointed out that a year ago the rubber price was artificially low and that it was now artificially high. This does seem to reinforce the argument for a fixed price but it is unlikely that we shall hear any more of this unless and until the price goes artificially low again. If the recent IMF deliberations in Washington lead to a renewed realism of international currency exchange rates then perhaps the price of rubber, together with all major commodities, will settle to a realistic level and, let us hope, remain there.

Holden The Great Way to Move

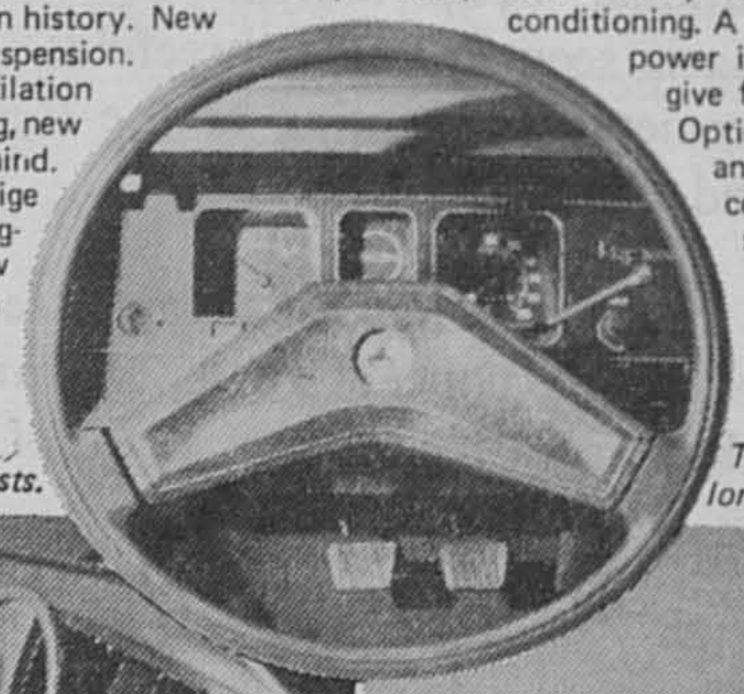


"Sydney Sun" Road Test reports on fuel consumption

Highway driving	28 m.p.g.
Economy driving (50 m.p.h.)	30 m.p.g.

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The big new Kingswood station wagon with long wheel base — an exclusive chassis design.



THE PRODUCT AND ITS PACKAGING

It was brought home forcibly to producers that the RRIM Esemar inspectorate will visit stern measures on those who ship sub-standard or contaminated rubber under the Esemar badge. Ridding Esemar of foreign matter should not be difficult, nor should the elimination of unpleasant odours, complained of particularly in SMR 20.

What does present a difficult problem is contamination from the disintegration of pallets. A number of pallet designs were suggested which might prove damage-proof and these seemed to boil down to using more wood; but at the rate the price of wood is increasing, it seems that the cost of a damage-proof wooden pallet would soon equal the value of the rubber inside it. Perhaps with this is mind, it was suggested as a possible solution to the problem of pallet disposal that pallets be made of high-quality wood which could subsequently be sold to furniture-makers, but this was thought impractical. This disposal problem is particularly acute in the USA, where anti-pollution laws circumscribe the burning of anything, and comparatively huge sums have to be spent in transporting the pallet and packaging trash to the disposal site.

This suggests that shrink-packing is the long-term solution; long-term because there is it seems a worldwide shortage of the shrink-packing material.

A short term palliative would be containerisation, but here again, we were told that there is insufficient container shipping to cope with even Peninsular Malaysia's Esemar production—notwithstanding the new container terminal at Port Klang.

The layman is tempted to ask whether, if we had shrink-packing, containers would be necessary? He is also appalled at the photographic evidence produced at the conference, of damage to pallets—all of which occurs while they are in the hands of the shippers, including stevedores, at both ends.

Apart from a few cases where inferior timber is used, the pallets reach the quay at the despatching end in fair condition. The sort of damage we saw can only be caused by inept crane or derrick operators who 'crash' the cargo into the hold or on to the quayside, or because of the cargo not being made fast in the ship's holds. Is there no redress of complaints against rough handling of cargoes? Don't our SR competitors have similar problems and, if not, can we learn anything from them?

By seeking to make pallets ever stronger and therefore more expensive, aren't we giving in to considerable irresponsibility in the stevedoring world? As one speaker said, there are ports which would damage even cast-iron pallets. And haven't tigers and other wild animals been shipped safely over thousands of miles in crates hardly more substantial than the average Esemar pallet?

Passing to another consumers' complaint—SMR being packed when it is too hot, leading to 'internal' water damage through condensation. For what it is worth,

we offer the suggestion of a dehumidification chamber between the crumb-drying and packing operation. Existing air-conditioning equipment should be adaptable to this purpose, perhaps biased towards dehumidification rather than cooling.

SHORTENING THE TREE'S IMMATURITY

Contributions under this heading were, at least to this observer, the most disappointing of all. There was a renewed avowal of faith in the established premise that 'the better the canopy, the better the girthing'. The paper on branch induction made the most inconclusive conclusions and the one on stumped buddings was 'old hat'.

A comprehensive survey of all the processes which have been or are being tried towards shortening the period of immaturity would not have been impossible and would have been very welcome.

Although tissue culture was coyly introduced, no mention was made of cleft-grafting (so enthusiastically reported on a year ago); the RRIM's discovery of a reputedly genetic dwarf; possibilities with genetic mutants; effects of planting density and pattern upon canopies and girthing, *etc.*, *etc.*. And what about three-part trees and such entities as dear old planting under shade?

Even if processes have been discarded after due investigation, it would be interesting to hear about it. There is so much scope for an imaginative mind to translate all the possibilities into practical experiments which could be carried out by the estate sector that, to use the well-worn phrase, the mind boggles.

In spite of all this, the subject received rather superficial treatment.

THE SMALLHOLDERS' SECTOR

It is now generally accepted that this sector is far too important to leave in the hands of the small landowner/tapper. The recommendation that the future should be with the managed 'scheme' and profit-sharing tenant farmers appears to be the right one. This sector will be dominant in all NR producing countries, and can no longer afford to lag 10 years behind the estates in the application of the fruits of research and development.

STIMULATION

The consensus of opinion on a very basic aspect of Ethrel stimulation is probably best conveyed by a quotation from Paper No. 1 "……single-cut tapping with stimulation is more attractive than double-cut systems with or without stimulation. Although yield per hectare is about equal, the yield per tapper is considerably higher from single-cut tapping which involves less labour and cost."

Divergent views from one other contributor were not so convincing or statistically well supported.

There seemed tacit agreement that low intensity tapping with four or five Ethrel applications per annum was more profitable than high intensity tapping with two or three applications.

A new method of applying Ethrel: to the tapping cut itself (the groove method) was introduced. Applied at 16-day intervals, results were comparable to those from bi-monthly applications on scraped bark below the cut, and the saving on scraping cost enabled the method to compete economically. As the treated bark would be soon tapped away, it is claimed to be a safer method than application on the panel above the cut when the panel is to be tapped again. It was emphasised that the method is not recommended with 2,4-D or 2;4,5-T—based stimulants.

THE FUTURE

Dr Sekhar's closing summary contained a well-founded forecast of a robust future for NR provided that producers can establish and maintain much tighter discipline in factories than at present and that processing keeps pace with consumers' requirements.

Mr C J A Heal of Dunlop Ltd., UK, expressed the hope that all NR would soon be viscosity-stabilised as a matter of course, and without any premium. Reference to this was strangely omitted from Dr Sekhar's prognostic picture; it appears however to be an inevitable development.

We must assume that Dr Sekhar's statement that the NR industry is non-polluting refers to atmospheric pollution and hope that there is no complacency in the matter of factory effluent treatment and disposal. The paper by Muthurajah *et al* unequivocally stated "the effluents from rubber-processing factories are highly polluting" and it would seem to be a matter of the utmost urgency that all NR factories install effluent treatment facilities. Quite apart from altruistic ecological considerations, and at least as far as Malaysia is concerned, the Waters Enactment Act 1971 has to be complied with.

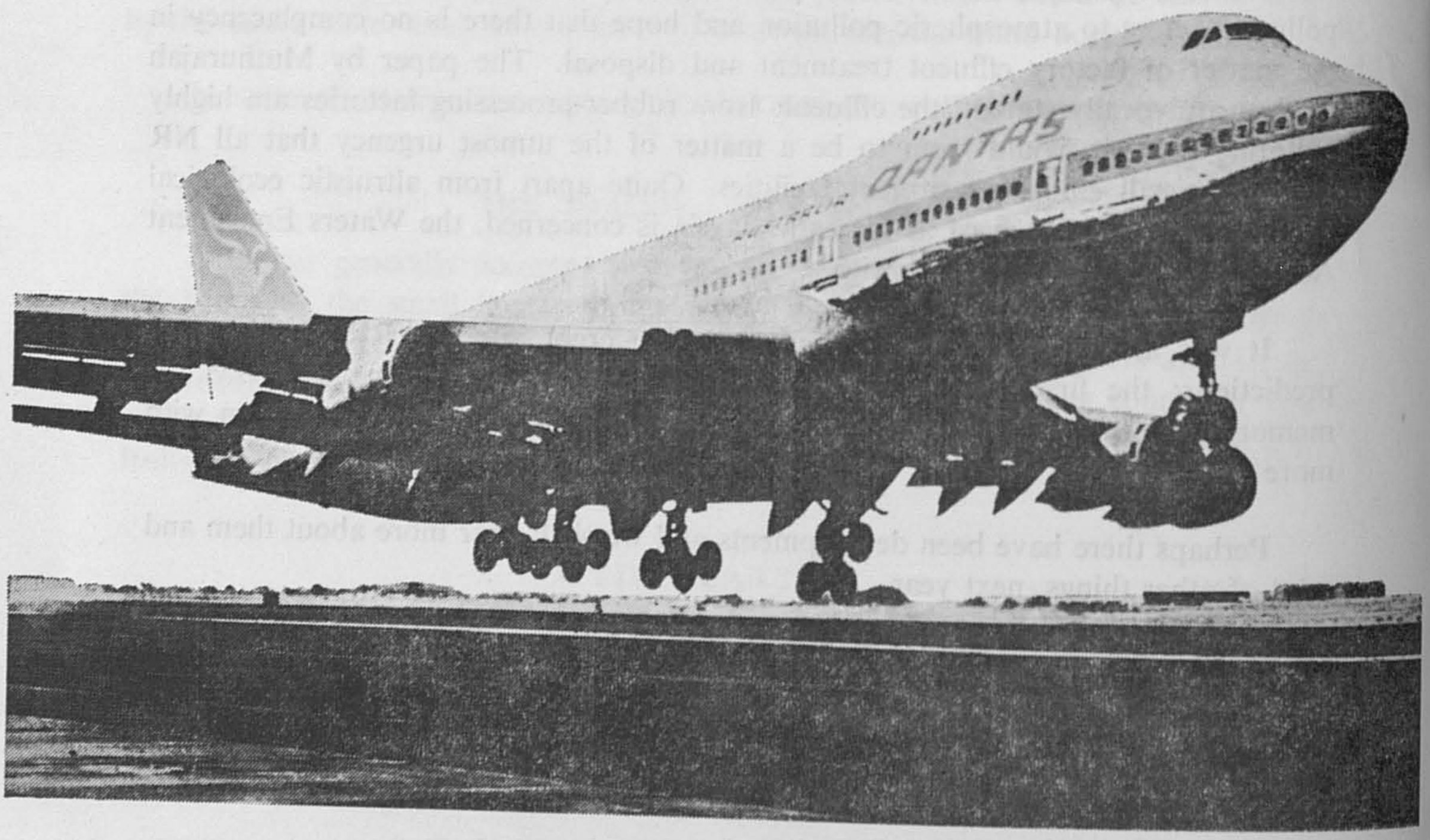
It was also notable that polybag collection crept into the RRIM Director's predictions; the first mention of the subject for some years by the RRIM. If memory serves, the last mention (in a Planters' Bulletin) saddled the system with more demerits than merits.

Perhaps there have been developments and we shall hear more about them and a lot of other things, next year.

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Planter, Kuala Lumpur **49**: 318–321 (1973)

The development of Ethrel in food crops

D.L. PAGE*

INTRODUCTION

Ethrel Latex Stimulant has now been in commercial use in Malaysia for almost three years. As was known here in this country during the early stages of its development as a latex stimulant, Ethrel, Amchem's registered trade name for 2-Chloroethyl-phosphonic acid, is a unique new plant growth regulator. By releasing ethylene directly to plant tissues, it produces many physiological effects for regulating plant development.

Depending upon the plant species to which it is applied, and the timing and rate of application, Ethrel can among other things inhibit apical dominance, stimulate lateral or basal bud growth, inhibit or stimulate vegetative growth, abscise fruit, leaves or flowers, initiate or retard flowering and/or fruiting, accelerate fruit ripening, induce root formation, accelerate or inhibit seed germination and modify flower sex. In simpler terms, many aspects of plant development can now be controlled, and the potential uses for Ethrel in agriculture are numerous.

Six years of intensive research and development

At a symposium in 1972 entitled "Pesticides and the Modern World" prepared by members of the Cooperative Programme of Agro-Allied Industries with FAO and other United Nations organizations, it was pointed out that the introduction today of any new agricultural chemical for use on food crops requires 6–8 years of research and development, plus a minimum investment of US$ 5 million ($12.5 million). Ethrel is no exception, and the past six years have been used to gather the intricate toxicity and residue data required by various government organizations throughout the world. In the United States, Ethrel has now been tested with favourable results in all the standard toxicological protocols presently required by the United States Environmental Protection Agency. These include tests on rabbits, dogs, fish and wild and domestic birds. In some of the tests, rats and dogs have been fed high levels of Ethrel daily for two years. In addition, intensive metabolism and residue studies in plant, animals, soil and water have been conducted. As a result, Ethrel has now been proven to be an essentially non-toxic compound. And once it is applied to the plant it quickly decomposes into ethylene, chloride ion and phosphate, all naturally occurring plant constituents.

New clearance for use on food crops

On April 25th of this year the US Environmental Protection Agency officially cleared Ethrel for use on tomatoes and cherries grown in the United States. Their action followed an earlier clearance granted by the Canadian Government permitting the use of Ethrel on apples, tomatoes and cherries grown in Canada. Although Ethrel had been cleared much earlier for use as a flower-forcing agent in pineapple,

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* Director Agricultural Operations—Asia, Amchem Products, Inc.

these two recent clearances are extremely important, as they attest to the safety of the product when applied to food crops up to seven days before harvesting and processing.

Increased farm labour productivity

As is now widely known in Malaysia, one of the important reasons for using Ethrel in rubber is the greatly increased tapper productivity which results. This is achieved either by simply boosting the yield per acre with Ethrel, or perhaps more importantly, by moving to reduced tapping intensities with Ethrel, thus significantly reducing labour requirements.

Much of the present interest in using Ethrel in other crops also centres around the need for greatly increasing farm labour productivity. Cherries and tomatoes are good examples.

Farm labour has become so scarce in some parts of the US and Canada that at times certain crops go unharvested. As a result, many elaborate mechanical harvesters have been designed, although the success of these machines has been limited in certain crops. Many crops do not ripen uniformly, and the machines cannot distinguish mature from immature fruit.

The use of Ethrel on cherries

Cherry harvesting machines have been in use for some time, even though the results have not been entirely satisfactory. These machines usually consist of a tractor or crawler-mounted collapsible net which is extended around the base of the tree to catch the fruit. Then a large pneumatic shaker arm is attached to the trunk or main branch of the tree, and the machine literally shakes the fruit off the tree into the net.

The pull force, or the amount of force required to remove the cherries from the tree, varies from 300–500 gm, depending on the variety and ripeness of the fruit. In order to harvest 60–70% of the fruit, existing mechanical cherry harvesters must violently shake the tree for 15 seconds, during which root damage and damage to the aerial portion of the tree frequently occurs.

However, when a special formulation of Ethrel, now sold as Ethrel Plant Growth Regulator, is applied at low rates to the foliage in a water solution about seven days before harvesting, all the fruit on the tree is uniformly ripened and the pull force required to harvest the fruit is reduced by about one half. A short three-second burst with the same mechanical harvester will now collect about 98% of the fruit without damaging the tree. Essentially the same procedure will be used for harvesting apples grown for processing.

Tomatoes

At first sight, the problems encountered in attempting to mechanically harvest tomatoes appear insurmountable. The individual fruit must be selected when it reaches the proper stage of maturity, and no machine has yet been devised which

can do this. The problem was solved however, not by altering the machine to fit the crop, but altering the crop to fit the machine.

First, a determinant variety of tomato, or a variety where all the fruit tends to ripen at the same time, is planted. Most processing companies now plant such varieties, or have their suppliers plant them. Even so, labourers must go over the fields five to seven times, harvesting the crop as it ripens. Now, however, Ethrel can be applied at the first signs of pink colour in the fruit, and the entire field will be uniformly ripened in 14–21 days. This permits "once-over" harvesting, either with a machine or with manual labour. Since Ethrel-treated fruit can be harvested 7–14 days earlier than untreated fruit, processing companies can better schedule the harvest to make better use of factory capacities; and from a fresh market standpoint, earlier fruit always commands higher prices.

Pineapples

Pineapples tend to flower best at certain times of the year, and even during the normal flowering season, fields do not bloom uniformly. A number of chemicals have previously been used to force all the plants in the field to flower evenly, but they have been only moderately successful. It has been demonstrated, however, that Ethrel can induce 90–100% of the plants in a given field to flower at the same time. This permits the scheduling of harvesting on a year-round basis, maximizing the efficiency of pineapple processing plants. Ethrel is now being used for this purpose on a commercial scale in Hawaii, the Philippines and Thailand, and one large pineapple company in Malaysia presently has commercial-size field trials in progress.

However, even though a uniform bloom and fruit set is achieved, the fruit does not mature in the field evenly, and the harvesting crew must be sent into the same field several times. This can be corrected with Ethrel by making a second application when the fruit reaches the proper size. As a result of this development, work is presently being done in Hawaii, an area having the highest farm labour cost in the world, to develop machines for "once-over" harvesting of pineapples. Approval from the US Environmental Protection Agency for the use of Ethrel as a pineapple ripener is expected later this year.

Olives

The olive industry in Spain, Italy and other countries faces a real crisis. The cost and scarcity of the farm labour required to harvest the crop is such that part of the crop frequently goes unharvested and the rising cost of producing olive oil is making it uncompetitive on the market. Amchem began working on the problem five years ago, and developed a harvesting technique for olives somewhat similar to that used in cherries as described above. Last year Servicio de Defensa Contra Plagas e Inspeccion Fitopatologica, a section of the Spanish Ministry of Agriculture in Madrid, awarded Amchem a special prize of Ptas 100 000 for outstanding results achieved with Ethrel as a harvest aid to the Spanish olive industry. Amchem, after receiving the award, turned the prize money back over to the Spanish Ministry of Agriculture to finance further research in olives.

Many other potential uses

Clearance for the use of Ethrel on such crops as citrus, grapes, tobacco, figs, cantalopes, blueberries and cranberries is expected in the fairly near future. Additionally, extensive field development work is presently underway in many other crops some of which will be mentioned briefly here. Tea is perhaps of particular interest, and field trials have shown that Ethrel applied as a foliar spray to tea bunches following pruning can increase yields by about 30 per cent. The first flush of flowers on monoecious varieties of cucumbers tends to be predominantly male. Ethrel applied at an early stage of plant development dramatically changes the sex ratio of the flowers, producing predominantly female blooms, and increasing yields by as much as sevenfold. Most commercial mango varieties grown in India tend to bear only alternate years. An application of Ethrel during the "off" year can induce the tree to bloom, providing an annual crop. Equally promising work is underway in such crops as sugar-cane, peppers, walnuts, pears, mulberry, filberts and others.

Quality of Ethrel treated fruit

How does Ethrel affect the quality of the treated fruit? This was always the first question asked by the major food processing companies during the early days of Ethrel development. Such companies have rigid quality control standards, and closely watch such indications as sugar content, texture, acidity and colour. But the Ethrel-treated fruit has invariably passed with flying colours, and it is now generally accepted that Ethrel-treated fruit is superior to the untreated. It tends to be uniformly ripe throughout, something which is particularly noticeable in pine-apples, where the Ethrel-treated fruit is as ripe at the crown as it is at the base, a condition which does not normally occur in untreated fruit. Additionally, the colour of the treated fruit is greatly enhanced in many crops, and the taste and texture of the fruit is always at least equal to that of the mature untreated fruit.

The mechanism by which Ethrel ripens fruit is not fully understood, although it has long been known that ethylene, a natural plant hormone, plays a key role. It would appear that the Ethrel application serves to trigger the natural ripening process, enabling man to exercise for the first time a great degree of control over his harvest.

For all practical purposes, 1973 will be the first year in which commercial Ethrel applications of any significance will have been made in crops other than rubber. Its total effect on world agriculture remains to be demonstrated, but it could be a profound one.

Success of a Malaysian agro-industry

T. H. TAY AND Y. C. WEE*

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INTRODUCTION

In Malaysia, where the majority of the population depends on agriculture for a livelihood, the progress of the agricultural sector is crucial to the overall development of the national economy. This is because agriculture presents tremendous opportunities for generating increases in the national income and employment. At the same time a prosperous and rapidly expanding agricultural sector will contribute to accelerated growth in economic activity throughout the country. All these will go a long way to enhance our export capacity and increase the opportunities for viable development of agro-based industrial enterprises.

Available evidence indicates that the Malaysian pineapple industry has been successful in providing some impetus to the development of the Malaysian economy, as this paper shows.

HISTORY

Malaysia's pineapple industry was started as far back as 1888 on a modest scale. It had its beginnings in Singapore and until 1921 the crop was still largely confined to that island (Anon., 1931). The plants were mainly grown under coconuts, areca nuts, rubber and other fruit trees (Wee, 1970). With the expansion of the rubber industry the acreage of pineapple as an intercrop also increased. Due to extensive development of rubber cultivation in south Johore, the pineapple industry shifted north from Singapore. By 1925 there were 6500 ha under pineapple in Johore, 810 in Singapore and almost 1600 ha in Selangor (Grist, 1926). With further expansion of the rubber industry the acreage under pineapple continued to increase.

Towards the later part of the twenties the industry underwent a difficult and unstable period because of price fluctuations caused mainly by speculative businessmen who moved in and out of the industry, depending on the world price of canned pineapple. This led to the enactment of the Pineapple Industry Ordinance in 1934 by the Johore State Government. The industry was subsequently regulated to some extent thereby making conditions more orderly. Interest in the industry developed slowly and by 1939 there were 17 500 ha under sole cropping in Johore (Wee, 1970). The Second World War brought the development of the industry to a standstill. In an effort to resuscitate the industry, the governments of the then Federation of Malaya and Singapore appointed the Johore Pineapple Committee in 1947, the

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* Research officers of the Malayan Pineapple Industry Board's Pineapple Research Station. Both have been and are closely associated with the research and development of the Malaysian pineapple industry.

findings of which resulted in the enactment of a new Pineapple Industry Ordinance in 1951 and the Pineapple Industry Regulations in 1952. The Pineapple Joint Industrial Council, with powers to control the industry, was subsequently established in 1955.

The pineapple industry faced another crisis in 1956 resulting from an over-supply of canned pineapple in the world market brought about by rapid expansion of the pineapple industries in Australia, Formosa and Kenya after the war. Surplus of the canned product in the world market led to a drastic reduction in the prices. Prices of fresh fruits also dropped sharply. The situation was aggravated by new areas coming into fruiting. This caused strong disagreement between the canners and the smallholders, especially when the former refused to accept the latter's fruits so as to be able to process fruits from their own estates.

The Malayan Pineapple Industry Board was subsequently established under the Pineapple Industry Ordinance, 1957, with powers to control and regulate matters pertaining to the pineapple industry of both the then Federation of Malaya and Singapore. In June 1959 a Royal Commission of Enquiry was appointed by the *Yang di-Pertuan Agong* of Malaysia and the then *Yang di-Pertuan Negara* of Singapore to review the position of the pineapple industry and make recommendations for its improvements. The implementation of the Commission's recommendations led to the general improvement of the industry and to the establishment of a government-owned cannery, the Pineapple Cannery of Malaya in Pekan Nanas, Johore, to process smallholders' fruits.

Further development of the industry saw the establishment of the Pineapple Industry Marketing Corporation in 1966 with the object of providing a central sales organisation for the whole industry. This happily resulted in a more co-ordinated marketing arrangement between the canners.

Contribution of smallholders and estates

In the success of the government's rural development efforts, the pineapple industry has played no small part. In 1960 the smallholder sector formed only 31% of the industry. In 1970 this increased to 67%. During this period we also witnessed a fourfold increase in fresh fruit production by the smallholder sector (*Table 1*).

The progress of the smallholder sector can be attributed to the happy co-operation between the industry, the government and the Malayan Pineapple Industry Board. This also bears testimony to the viability of our rural population and their ability to contribute to our national economy.

While we have painted a favourable picture of the smallholder sector in the development of the pineapple industry, it should also be said that the estates played an equally important part. This is seen in the constant supply of fresh fruits throughout the years to feed the canneries (*Table 1*). The slight decline in fruit production in 1968–1970 was due to the closure of an estate as the result of labour problems.

Table 1. Fresh fruit production indices, 1960–1970 (1960 = 100%)

Year	*Smallholders*	*Estates*	*Overall*
1961	114.6	103.7	107.1
1962	131.5	125.4	127.3
1963	146.9	112.5	123.2
1964	175.9	126.3	141.7
1965	228.3	137.0	165.4
1966	274.5	115.9	165.3
1967	324.7	113.2	179.1
1968	378.8	91.7	181.2
1969	412.5	98.3	196.2
1970	437.6	97.1	201.8

Besides the direct contribution to the national economy in the form of physical products, the smallholders and estates also provide employment for about 6400 people. This figure, though small by any comparison, does help to solve in part the unemployment and underemployment problems in our fast-growing rural population.

Contribution of canneries

There are four canneries in West Malaysia which provide direct employment to approximately 2000 people with an earning power of M$100 to M$500 per month, depending on their skill.

It is gratifying to note that with the development of this sector as seen in the opening of the Pineapple Cannery of Malaya at Pekan Nanas in October 1964, the dream of the smallholders to have a co-operative cannery has been realised. This cannery, which draws its capital from the government, has contributed much to the national economy by raising the living standards of the rural population. It has also become a showpiece of success in the government's policy of rural industrialisation. Considering this, the pineapple industry at large has fulfilled a long-term objective set in the First Malaysia Five-Year Plan; that is to obtain an enhancement of the ability of the agricultural sector to stimulate development through the production of those commodities which make possible the viable development of agriculturally-based industrial enterprises. The success of this cannery, as indicated in *Table 2*, has led to the establishment of a second one costing M$7.5 million at Pulai Sabatang in Johore. This is providing employment for about 1000 people in the rural areas (*Table 2*).

The increasing importance of the canneries' role is seen in the progressive increase in canned fruit production. In a period of 11 years (1960–1970) the production has increased by 92.7% (*Table 3*).

Table 2. Production indices of the Pineapple Cannery of Malaya at Pekan Nanas. (1964 = 100%)

Year	*Production indices*
1965	730
1966	1274
1967	1598
1968	1643
1969	1720
1970	1585

Table 3. Canned pineapple production indices, 1960–1970 (1960 = 100%)

Year	*Production indices*
1961	111.6
1962	138.0
1963	127.9
1964	147.9
1965	172.2
1966	171.3
1967	187.6
1968	167.8
1969	184.7
1970	192.7

Exports and Markets

The Malaysian pineapple industry is now the world's second largest exporter of canned pineapple next to Taiwan. Since 1904, when the annual value of export was M$2.47 million, production has gradually increased and in 1939 the total export value was M$9.93 million (Teo, 1963). The industry came to a standstill during the Second World War. However, in 1946 the production began to pick up and by 1950 the value of exported canned pineapple was M$12.20 million. The importance of the canned pineapple industry to our national economy began to gather pace and by 1970 we exported M$51.5 million worth of the product.

In 1970 pineapple was the sixth largest dollar earner amongst the major commodities exported but was the fourth largest dollar earner for agricultural commodities (*Table 4*). However, from the point of view of a foreign exchange earner on a unit area basis, pineapple tops the list with a value of M$1471 per acre, with M$389 per acre for rubber and M$79 per acre for coconut.

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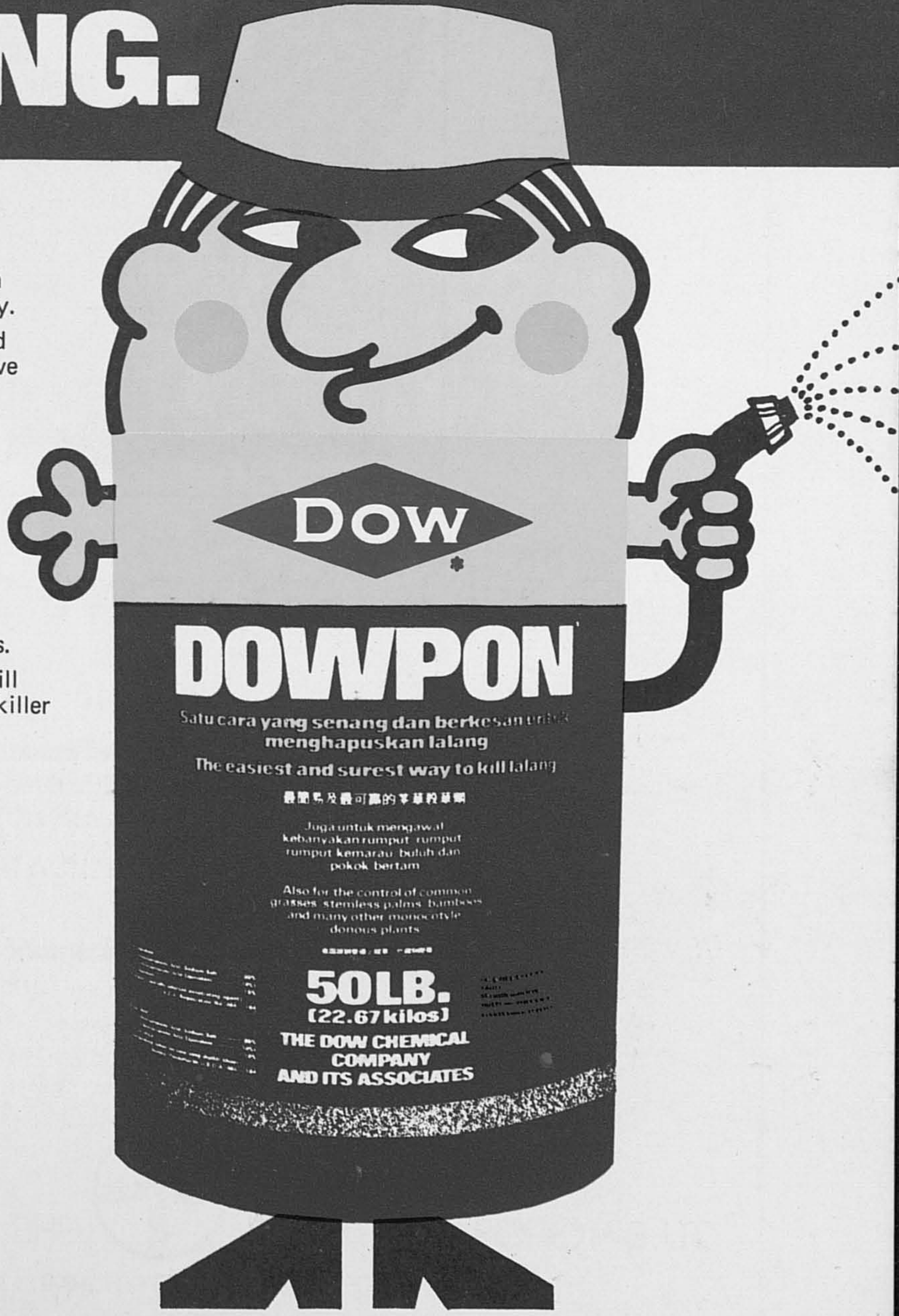
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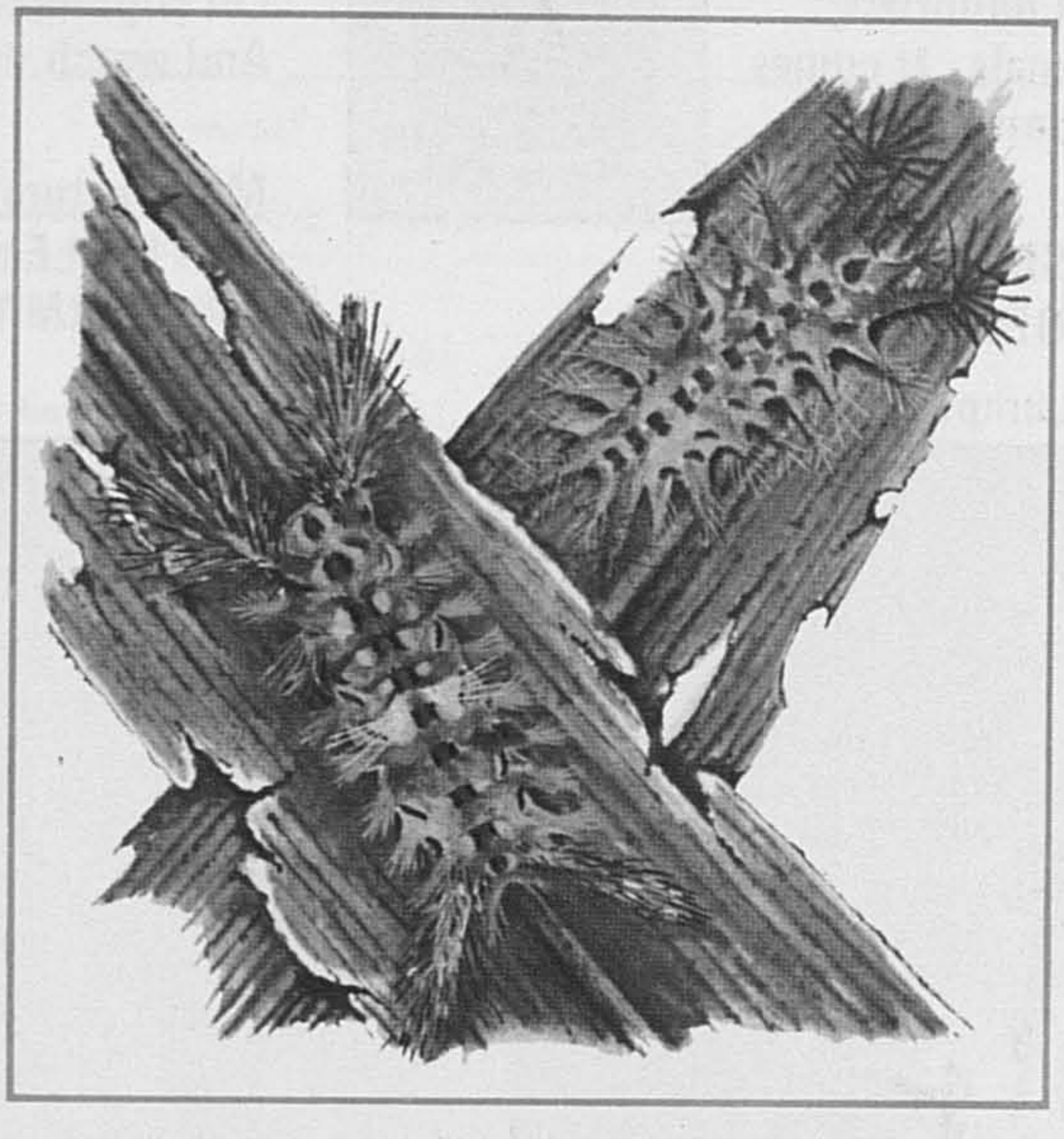


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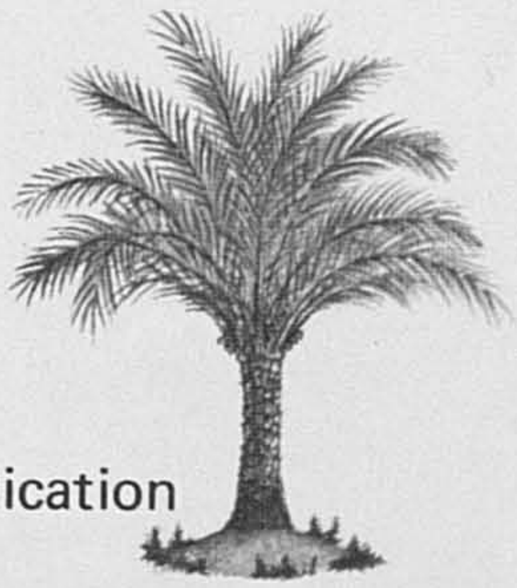


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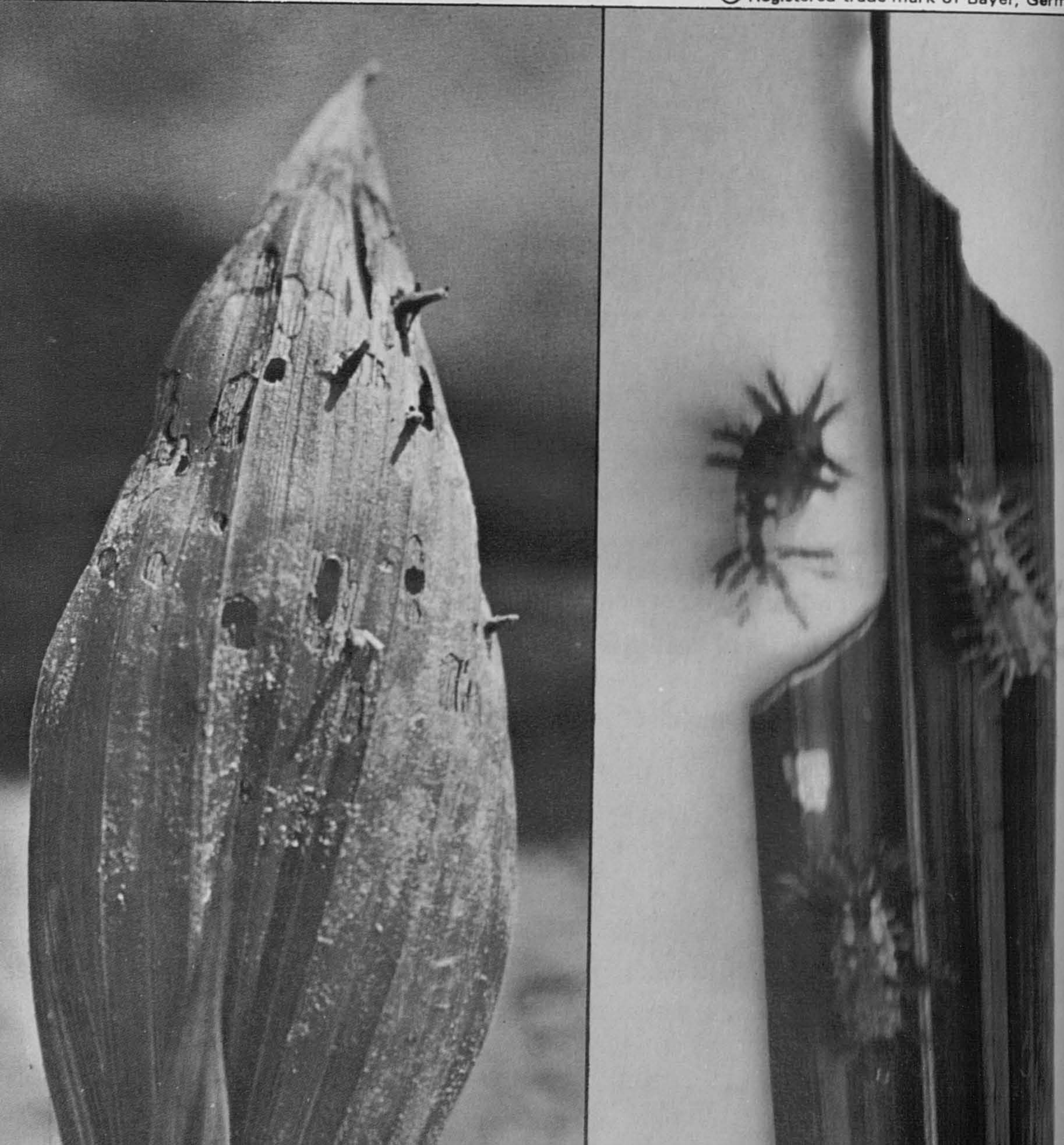
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Sixteen years ago Malaysian canned pineapple was sold to 62 different countries but by 1970 there were 18 additional markets, bringing the total to 80. The main markets are the United Kingdom, Canada, USA, West Germany, New Zealand, Spain, the Middle East and Japan.

Table 4. Exports of major commodities from West Malaysia 1959–1970. (M$ million)

Year	*Rubber*	*Tin metal and concentrate*	*Palm oil and kernels*	*Sawn logs and timber*	*Iron ore*	*Canned* pineapple*	*Coconut oil and copra*
1959	1722	299	61	33	100	22	43
1960	1829	507	72	55	140	26	58
1961	1442	553	68	41	164	26	47
1962	1368	620	72	48	166	28	32
1963	1374	624	76	65	176	29	35
1964	1303	728	87	86	162	33	15
1965	1368	872	115	100	161	40	26
1966	1396	792	127	99	136	47	27
1967	1216	755	119	129	122	46	25
1968	1301	830	131	182	111	48	40
1969	1940	940	155	218	115	49	22
1970	1663	1013	255	249	107	51	39

Source: West Malaysia annual statistics of external trade.

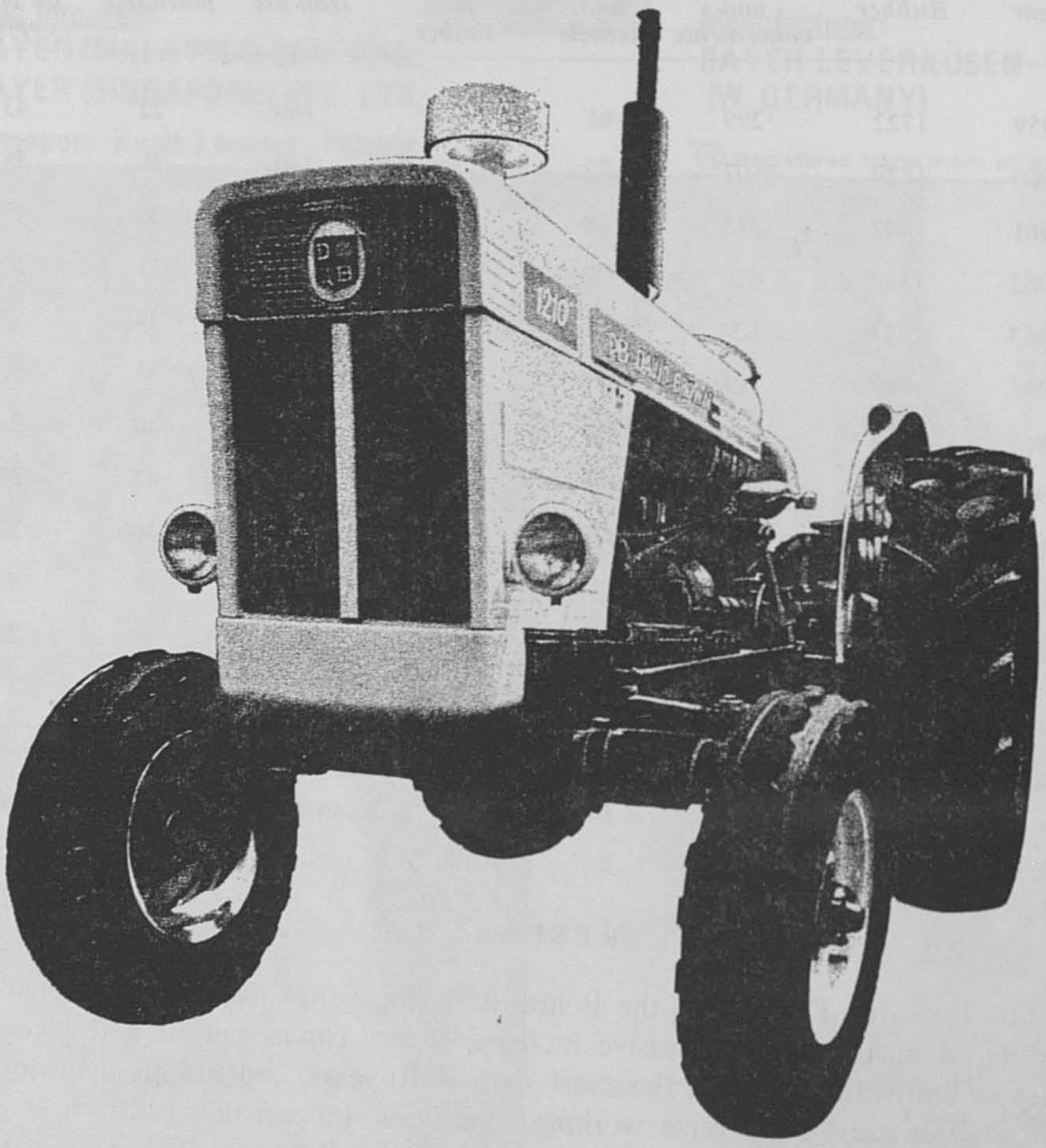
**Source for canned pineapple from 1966 onwards:* Malayan Pineapple Industry Board.

RESEARCH

The Research Division of the Board at Pekan Nanas has been entrusted with the duty of ensuring a progressive increase of *per capita* output and income in pineapple cultivation. Within the short span of 10 years, and the rapid turnover of senior staff because of adverse working conditions, the existing research staff has done well in developing new cultural methods and techniques. This is seen in the progressive increase in yield of ratoon crops since 1960, culminating in the doubling in yield by 1970 (*Table 5*). The increased yield is brought about by improvement in the cultivar through a vigorous programme of plant selection, and improved methods of fertiliser uses, weed control, pest and disease control and other cultural practices.

This year will go down in the annals of the pineapple industry as one in which our research staff succeeded in the selection of an improved cultivar named *Masmerah.* Preliminary observations show that this cultivar will yield 50 tonnes/ha

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with the plant crop and approximately 30 tonnes with the ratoons. The planting materials are currently being propagated and it is hoped to start distribution to growers in the near future.

Table 5. Pineapple yield 1960–1970

Year	Yield (tonnes/ha)		
	Smallholders	Estates	Overall
1960	7.90	14.89	11.70
1961	9.99	15.44	13.05
1962	11.47	18.68	15.54
1963	19.71	11.20	13.33
1966	16.99	26.06	20.44
1968	20.11	20.61	20.28
1969	22.52	21.74	22.24
1970	23.45	21.49	22.74

Intensification of research on this cultivar, which is currently being purified, confirms our view that future opportunities for exploitation of this crop will arise in time. In conjunction with this our research staff is actively pursuing the other broad objectives set out in the Pineapple Research Five-Year Plan (1971–1975). These objectives can be briefly listed as:

i. the lowering of the cost of production in the field,

ii. the increase in fruit yield per acre through superior fertiliser and cultural practices, and

iii. the control of pest and diseases.

Besides the above research programme, the Research Division also provides technical and advisory services through the Extension Unit. We have a team of 14 who go out to the field with the object of stimulating the adoption by farmers of improved practices and methods of production. In this we have been successful, as indicated by the increases in production, especially in the smallholder sector.

Expansion of the industry

With the establishment of the Malayan Pineapple Industry Board in 1957 the industry has steadily expanded (*Table 6*). Further expansion is envisaged, as seen by the establishment of the second government-owned cannery at Pulai Sabatang near Pontian in Johore and the announcement by the Selangor State Government that they are going to develop 2000 ha in Kuala Langat for pineapple. These measures will not only expand physical production but also provide employment opportunities for the rapidly-increasing rural population.

Table 6. Production of fresh and canned pineapple 1957–1969

Year	*Fresh fruit (000 tonnes)*	*Canned pineapple (000 tonnes)*
1957	117.86	38.61
1958	154.43	42.67
1959	145.29	39.62
1960	155.45	38.61
1961	167.64	44.70
1962	199.14	47.75
1963	192.02	51.82
1964	221.49	53.85
1965	258.06	66.04
1966	258.06	70.10
1967	279.40	65.02
1968	282.45	72.14
1969	305.82	70.10
1970	312.93	70.10
Increase in 1970 over 1957	166%	82%

CONCLUSIONS

Systematic regulation of the industry by the Board has been responsible for the industry's stability and rapid expansion during the last few years. Some of the salient points to note are:

i. The Board's Research Division has been successful in developing methods for maintaining the pineapple crop in permanent cultivation on peat soils. The Division has also succeeded in improving fruit quality and increasing fruit size. It has also been intensifying its efforts to produce an ideal pineapple for canning.

ii. The Research Division, in collaboration with the Board's Extension Unit and the Department of Agriculture, Johore, has contributed much to increased yield by smallholders through improved agronomic practices.

iii. The industry's canning capacity has been expanded to cater for the increased production of pineapple by smallholders. This was made possible through improved processing methods developed by private canners and the establishment of the Pineapple Cannery of Malaya in 1964.

iv. The Board guarantees a minimum price of 6.4 cents/kg for the fruits sold to the canneries. By this, the income of smallholders is stabilised despite fluctuations of fruit production.

v. The Board, through its regulations and the Pineapple Industry Marketing Corporation, has regulated and co-ordinated the marketing of Malaysian canned pineapple overseas.

vi. The Board, with its limited funds, has also carried out promotion for the sales of Malaysian canned pineapple overseas through advertisements, participation in international trade fairs and other mass media.

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Book review:

Plus ça change

RUBBER IN MALAYA 1876–1922 The Genesis of the Industry J.H. Drabble *Oxford University Press* pp xx + 256, 9 plates, 36 + xvi tables, map, bibliography and index. M$35.00.

Dr Drabble, a lecturer in history at the University of Malaya, sent his manuscript to the publisher in 1971 and the book has come from the press in 1973. Thus it is about a century since Collins presented his *Report on the Caoutchouc of Commerce* and recommended the shipment of *Hevea* from Brazil to southeast Asia, which was effected through Kew in 1876/7. Interest in the cultivation of the introduced rubber-bearing plants fluctuated and generally dwindled in Ceylon and Malaya over the next two decades. Even its most ardent advocate Ridley, who came to Singapore in 1888, could not sustain intensive investigation and enthusiastic propaganda through all those years. Swettenham was then a senior official in Malaya and inconsistent about the new crop, although his opinions hardened later in the London boardrooms.

The first—as yet incomplete—century of rubber in Malaya falls into four unequal periods. First came the lag phase which continued until the new crop was accepted about 1897. Next a quarter-century during which cultivated rubber overtook its wild-collected rival so successfully by the outbreak of the Great War in 1914, that the plantations could produce more than the depressed economies of America and Europe could utilise, culminating in the Stevenson Restriction Scheme of 1922. This and the subsequent International Restriction Scheme continued until the outbreak of the World War in 1939, when mechanised warfare demanded more rubber than the conflict twenty-five years earlier. The loss of shipping and, later, of the main producing areas, stimulated the production of alternative synthetic elastomers, especially in the U.S.A. So rubber entered its fourth period, when the plantations sought protection by vigorous competition and rejuvenation instead of through restriction. Policies of reconstruction rather than reparation have enabled both natural and synthetic rubbers to share the growing markets. Perhaps a new phase has already begun, in which partnership will replace competition, as hopefully is so of global political confrontations. John Drabble deals with the first two periods. Apart from setting straight the record of this curious and often confused history, his analysis is a valuable introduction to the current scene.

As the author and his publishers remark, many books have been written about particular aspects—agricultural, economic, political or technological—with special reference to critical periods in the development of the rubber industry (which name sticks to this plantation enterprise), so sacrificing unity and continuity. Dr Drabble makes good his claim to keep all aspects in perspective. The treatment of some

subjects may sometimes fail to satisfy specialists, but they can always follow up through the full bibliography and copious cross-references. The cross-references in the index are incomplete, for example under Restriction one reads *see also* Combination, which latter is lacking. Also there are odd breaks in alphabetical order, Gr before Go, Si before Sh.

The layout raises the vexed question of footnotes to the text (those to tables are another matter). Some authors bring the bibliographic references into the narrative, for example, commendably DRABBLE (1973) has referred to the original sources more meticulously than most other writers on this topic. If indeed explanations or cross-references to other parts of the text or to the glossary are necessary, I would prefer that they be brought into the text as far as possible without disrupting the flow of the narrative. I find numerous footnotes distracting. At least that is my opinion; every author and publisher is entitled to his own. I read the book twice, once reading the footnotes as encountered and again skipping them. Perhaps so many footnotes are justified if they make the reviewer do his duty by the author and publisher by reading the book twice. Footnotes aside, I found the style (and the typeface) clear and easy. I noticed only one obvious misprint—Prfitso on page 158 and one wrong spelling *crotolaria* on page 86 n. Malaya's oldest railway line (to Port Weld) is missing from the map. The printers Charles Grenier Sdn Bhd Kuala Lumpur deserve their share of the credit for the production. The colour photograph on the cover might have been cropped to eliminate completely the pair of hands, amputated from the rest of the body, at the right-hand side.

Planters will be interested to learn the origins of a number of well-known estates and companies. Some companies purchased the properties of proprietary planters, a few of whom stayed on to manage the estates so formed. Coffee and sugar were among the crops displaced. Other companies were floated to acquire new land. Dr Drabble detailed the increase in capital per acre for various categories of rubber plantation. Although while Ridley was in Malaya his advice on practical agricultural operations was always in demand and earned the respect of the planters, he never seems to have been popular with the companies. For example he was not rewarded with seats on numerous boards on his retirement to England as were some other officials. Ridley underestimated capital requirements. He thought *Hevea* could be grown with little expenditure on upkeep, perhaps because the trees in his experiments never had much spent on them for lack of funds. They were the survivors of neglect rather than the product of husbandry. This and his enthusiasm, when at last his protégé was adopted, may have led him to underestimate the costs of planting and bringing trees into bearing within an economic period. Many adopted (against Ridley's advice) clean weeding to obtain rapid growth of the trees until the slump of the restriction period eliminated this costly practice and the need for conservation of the soil was recognised, even so preferred cover plant or weeding policies needed some expenditure.

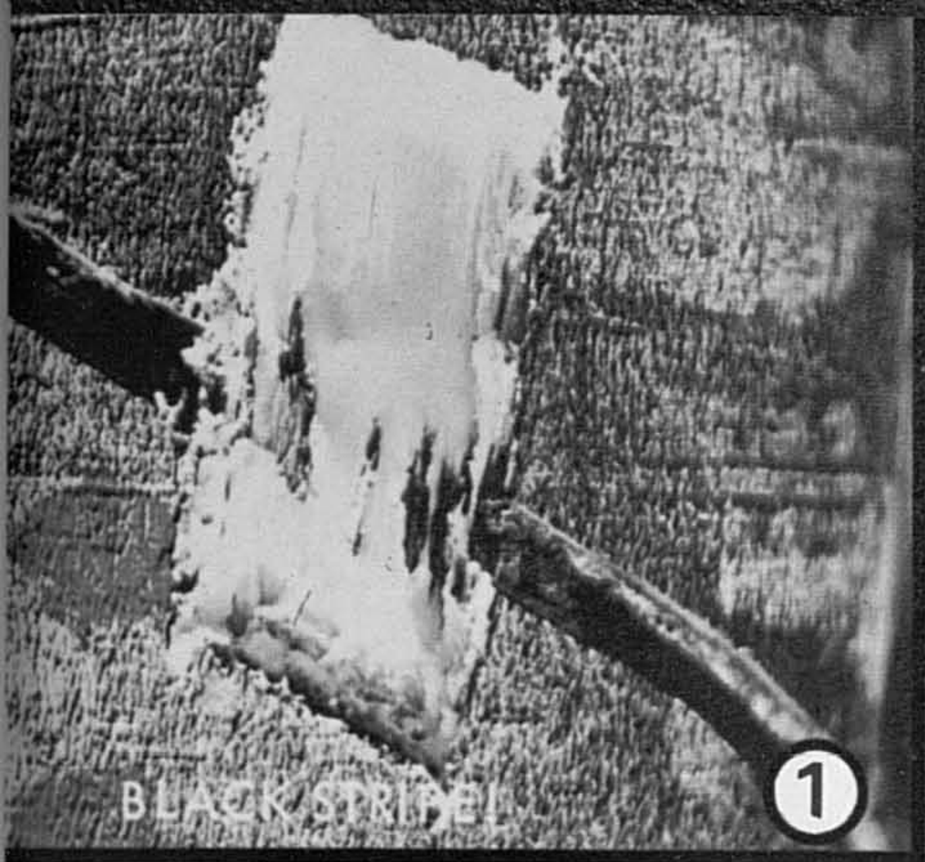
The cost of processing was also underestimated by Ridley. He did not project the need for factories equipped with machinery from his small-scale preparation of

samples of rubber by simple means and he probably took no account of the labour contributed by his colleagues in these trials. Dr Drabble's account of the economic history of the companies' early days has prompted my conjecture that Ridley may have been unpopular with the companies if they had found him a poor guide in business matters. Alternatively when Ridley returned to England in 1912, the boards may have already included those officials who did not find him acceptable as Director of Agriculture FMS in 1903. Or Ridley may not have wanted such rewards. He was appointed to the Technical Sub-committee of the London Advisory Committee for Rubber Research in 1932, when he was 77 and had outlasted his colonial contemporaries on the main committee.

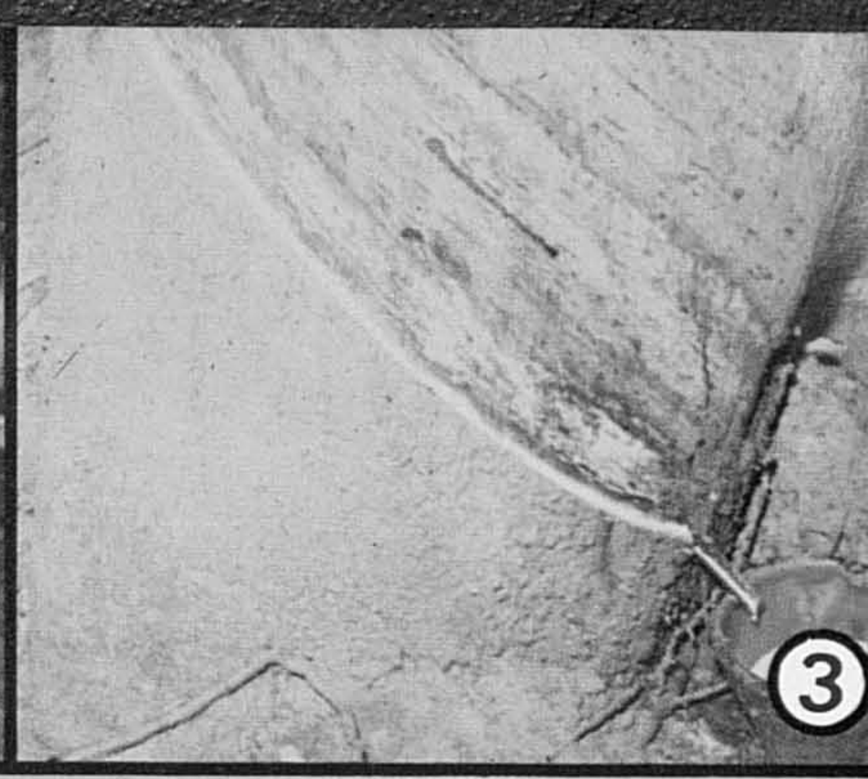
Capital was not the only problem in the establishment of the plantations. Land, including conditions of tenure, premium, rental, levies on produce and compulsory phased development against forfeiture, and labour (provided mainly by Indian migrants on European-owned estates) were also critical. It was particularly in order to negotiate with the Governments of the FMS, other Malay states and SS on these matters (concerning other crops as well as rubber) that the Selangor Planters Association (1892), the United Planters Association FMS (1897) later the Planters Association of Malaya (1907) and kindred bodies were formed. The Rubber Growers Association was formed in London (1907) with wide terms of reference and was destined to become a powerful lobby for British registered companies with the government in Whitehall. The formation of the Rubber Producers Association of Malaya (1919) was involved with the development of restriction. The origins and influences of these organisations are described in 'The Genesis of the Industry' and the shift in the balance of power from the Planting Associations to the R.G.A. is traced. The foundation in 1919 of the Incorporated Society of Planters, to improve the professional status of estate managerial staff receives favourable mention.

The origins and activities of Messrs Fivepercent (initially up to 2½%), as some planters refer irreverently to the agency houses, are recorded and analysed too. While admitting that there were some instances of profit-taking from more than one party to a deal by agencies, or of individuals using the organisation to acquire multiple directorships, Drabble in the main defends his erstwhile employers against some authors' accusations of wholesale excess and abuse. He agrees that further investigation is needed, but raises the valid point that so much capital was invested during the boom flotations, which speculators were so willing to subscribe, that agencies would have been hard put to find enough fluid cash to ensure controlling interests in every company.

The events which led to Sir James Stevenson's Rubber Restriction Scheme, the British or Imperial version, which was the forerunner of International Restriction, comprise a most complex history. This book unfolds the events in Malaya and London, also in Ceylon, the Hague and the Netherlands East Indies, starting from the first hints of combination selling and/or restriction of production during the slump in 1913. Most commentaries have been coloured by retrospective interpretations of the motives of those involved. McFadyean and Miller had positions to













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defend. Bauer, Knorr and Laurence have attacked according to their economic or political doctrines. By reference to original sources, Dr Drabble tries to disentangle known events from supposed motives, although these are inevitably interdependent. A timetable of actions by the different parties in the countries mentioned previously, and in the USA, would be a useful aid in sorting out this history.

When one understands the history, one can try to judge motives, although perhaps not correctly. The idea of restricting supply against a less flexible demand was to maintain prices, but for whose benefit? The labourers?, the planters?, the shareholders?, the directors?, the government?, the nation?, which nation? Stevenson and his chief, the Secretary of State for the Colonies, Mr Winston Churchill, had virtually no previous experience of the rubber industry, they conceived their duty in Imperial terms. Churchill, who was First Lord of the Admiralty six years previously, held that Britain owed much to the FMS for the gift of *HMS Malaya* to the Royal Navy during the war. Emotion and prejudice entered into their motivation and our assessment of it. Were the Dutch waiting to profit by unlimited sales at the higher prices won by British initiative in restricting production in Malaya, or did they believe that only efficient producers were fit to survive the purge of low prices and win even greater markets free from threat of competition? Were the British companies in the Netherlands East Indies fifth columnists or martyrs? Were the American consumers forcing unfair prices on producers so that they could snap them up as bargains, or were they too the victims of uncontrolled economic forces?

The conclusions we may draw from the present volume may be tested by the subsequent history, which Dr Drabble hopes to write. For example the Dutch participated in the International Restriction Scheme in 1934, when production by smallholders in the Netherlands East Indies had already done much to undermine the Stevenson Scheme. The answer of some of the American consumers, Firestone, Ford and Goodyear, was not to buy bankrupt estates but to start new plantations in Africa and tropical America as well as in Asia, outside the British sphere of influence.

It would be difficult and unfair to try to sum up how and why restriction began, when this book has already achieved much by objective condensation and comment. However it is worth emphasising that the germ of restriction first began some years before Stevenson became Commercial Adviser to the Secretary of State for the Colonies. He advised against it less than 18 months before his committee's rather abrupt decision to implement compulsory restriction in Ceylon and Malaya.

My own special interest concerns the origins of research, on which Dr Drabble records several episodes reminiscent of more recent events. Ridley's invention of excision tapping was the essential basis of rubber exploitation and it was soon obvious that many more problems needed attention. There has long been both private and official research, and debate whether the latter should be handled by a general organisation such as the Department of Agriculture or by a specialist

institution such as the Rubber Research Institute of Malaya. Drabble argues that the planters (or their employers) wanted the emphasis on immediately applied investigations, whereas the official advisers leaned towards more fundamental research. Although I agree with this in part, I doubt if I go so far he does. The subsequent record shows private research to be generally applied in character but official research is not overwhelmingly pure or fundamental. Yield stimulation was discovered simultaneously at commercial and official institutions by serendipity. Rubber research has not produced any spin-offs of great general value such as pH and Student's 't' from the brewers. I think the attitude of the rubber growers was quite simple. They considered that rubber was the most important crop, actually or potentially providing a large proportion of the government revenue and supporting the welfare of a large section of the community. Therefore it deserved undivided attention and a lot of it. They distrusted official research organisations of a general nature, which might dissipate resources over a wide range of crops including unproven novelties.

Although Ridley in Singapore was joined in 1904 by other workers, some of whom were more systematic than he was, it was obvious that the Botanic Gardens with so many and diverse responsibilities could not provide official research on an adequate scale. Yet progress was slow and went through such well-established procedures as reports by overseas experts and the formation of examining committees and advisory boards. Dr J.C. Willis, Director of the Botanic Gardens in Ceylon, visited and wrote a *Report on Agriculture in the FMS* in 1904. (Willis is better known to present-day botanists for his valuable *Dictionary of Flowering Plants and Ferns* and his theories about plant evolution and geography). Professors Engeldow and Blackman can regard Willis as a worthy predecessor. Acting on the report Carruthers (of the Ceylon Botanic Garden) was appointed Director of Agriculture FMS in 1905, however he had to share the chemist and entomologist engaged in 1906 with the Institute of Medical Research, to which they were more closely attached. The Department of Agriculture had no buildings or a mycologist until 1907.

Meanwhile Lanadron Estate for example employed a mycologist privately and the RGA engaged a chemist to investigate processing for a consortium of commercial companies under the guidance of consultants in London. This was the state of affairs when Lewton-Brain became Director of Agriculture in 1910. Until his death twelve years later he was increasingly concerned to keep official rubber research exclusively within the D. of A., but in this he failed. In 1921 (one overseas expert E.J. Butler and several committees of the PAM, RGA and Governments in London and Kuala Lumpur later) it was decided to set up, independent of the D. of A., what became the Rubber Research Institute in 1926. Such a long period of gestation may make the birth of MARDI seem quite rapid.

The late C.E.T. Mann told me that Dr H.A. Tempany (later Sir Harold), who was Secretary for Agriculture SS and FMS and the President of the RRIM Board during its early years, did not give up his hopes of bringing the Institute back into the fold of the D. of A. During the war, when as the Agricultural Adviser to the Secretary of State for the Colonies he was a member of the London Advisory

Committee for Rubber Research, Tempany allegedly recommended that the British Military Administration effect such a reorganisation, but he was thwarted in this by Dr H.J. Page, Director RRIM, who immediately on release from POW camp in 1945 convened a meeting of the Board and appointed C.C.T. Sharp as Acting Director, so re-establishing the Institute on its original basis, before he (Page) went on much needed rehabilitation leave or the BMA got round to the Tempany plan. But that is hearsay and going far into matters which must be left for Dr Drabble's next volume, which he and I hope he will write.

There was considerable official and private research going on in the period between the respective formations of the Department of Agriculture and the Rubber Research Institute. Both the RGA and D. of A. chemists worked on processing, testing and standardisation of plantation rubber and proving it equal to or better than Fine Hard Para. (The publican at the Railway Signal, Hitchin, who had been a rubber dealer in Belem and Liverpool, told me in 1956 that Morgan and Eaton had never convinced him). Present day research staff are familiar with joint committees for co-operation between official and private investigators to study such problems as Brown Bast like the one set up in 1918, and berated soon after for not producing satisfactory answers quick enough. The need for better selection of planting material had been recognised by Burkill at the Singapore Botanic Gardens in 1912 and in the pioneer studies of variability by Whitby the following year. The founding of Prang Besar Estate, when Gough persuaded several other demobilised soldiers to pool their 100 acre war service land grants, was an important milestone in commercial research (although not mentioned explicitly in the present volume).

One of the objects of the International Restriction Scheme was to encourage replanting with improved, higher-yielding planting material to rejuvenate the plantations. One advantage of this for research was that planting of new land was allowed only for experiments. Replanting was not carried out in Malaya as extensively as intended during the years immediately prior to the World War. This was due in many cases to a lack of funds to finance the operation, but it may have reflected also a relaxation of effort when feather-bedded by restriction. Whether that was so or not, it was significant that the decision to undertake centralised official research, including breeding and selection, was made about the same time as events led to the Stevenson Restriction Scheme. The RRIM was established while the Scheme was in operation. The formation of the RRIM and continued Restriction did not bring private research to an end, but rather stimulated it.

Those who criticised Malayan rubber producers for their dependence on controlled output during the restriction period should note that other solutions to problems were sought by research into improved production, products and new uses. For those of us who get our livelihood from research, there can never be too much research and the retrenchments of 1932 were a betrayal. Nevertheless the need for research was recognised once the plantations were established, and the need for central, official but independent research was recognised as producers became organised. Research has not failed rubber producers. Research, especially breeding

and selection by official and private organisations, has kept the Malayan rubber industry in business.

When rubber in Malaya celebrates its centenary in 1976, the Rubber Research Institute of Malaya will celebrate its golden jubilee. I hope Dr Drabble's next volume will be out by then, but that may be a tall order if he devotes to it as much careful research as he has to this one, which I commend to all interested in the Genesis of the Industry.

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The monthly crop

The Ministry of Education has appointed a special advisory committee on technical and vocational education, and of the three *ad hoc* committees it comprises, one will deal with agriculture. The idea is to promote a better dialogue between the Ministry and the private sector in the field of vocational education, especially at craft level.

The terms of reference of the Committee on Agriculture are: 'To study the syllabus and curriculum in Agriculture as taught in the Secondary Vocational Schools and to suggest amendments, where necessary, in the light of job requirements, particularly in the private sector'.

The Society has been honoured with the request to appoint a chairman of this committee and we are pleased that the Minister of Education has now signed a letter of appointment confirming Encik Tan See Yeok, the ISP's Chairman, in this role.

Dunlop's Denovo tyre, mentioned in our editorial last month, is to be fitted as an option to production models of the Rover 3500, one of Britain's fastest saloon cars. According to *Rubber Journal,* who don't normally carry out consumer tests on tyres, but couldn't resist having a go at something so radically different as the Denovo: "when flat they run like an inflated tyre, and when inflated they also run like an inflated tyre". *RJ* used a Rover 3500 on a 70-mile run through the byways of Southern England, most of it in a torrential downpour. They found that the tyres behaved like any other first-line low profile radial, "coping excellently with fast cornering on sodden roads, emergency braking and rapid acceleration". For the last 12 miles they ran with a purposely deflated off-side front tyre, and apart from a low rumbling, the only noticeable effect was a tendency for the bonnet to tuck in on left-hand bends. There were no problems with line ahead stability and no waywardness on emerging fast from 'S' bends.

You won't find the Denovo in the shops though. It can only be used in conjunction with a special two-part road wheel.

The man standing in a bus queue with a crocodile under his arm was bound to attract attention. "You should take that animal to the zoo" commented a woman. "I took him there yesterday" the man replied, "today I'm taking him to the cinema".

The Thirty-fifth Annual Report of the Natural Rubber Producers' Research Association is a finely produced publication and the NRPRA have kindly air-mailed a number of copies to us. One can learn a lot about the state of the art from this report and we will be pleased, while stocks last, to send a copy to any interested member.

The ceremony marking Heroes' Day at the National Monument on 31 July was an impressive and moving affair. The Chairman of the Society being away in Kelantan, the ISP was represented by the Executive Secretary.

Sadder still in retrospect is the fact that this occasion saw one of the very last public appearances of the late Tun Dr Ismail, who died only two days later.

Keeping up to date with members' changes of address has its problems, but there is no reason to suppose that the member who wrote us the following letter wasn't trying to be helpful:

'Dear Sir,

Kindly note that I am not at the above address.

Yours faithfully:'

Even the most cautious of 'hunt-and-peck' typists will wonder how *that* happened.

Consider what a thief has to do before he can steal the cassette player from your car. Getting in to the car is as easy as it ever was, but then he must bring into play an assortment of small spanners and screwdrivers to remove the player from its mounting. No problem there. But wait! the newspapers have begun carrying advertisements for a new "thief-proof" cassette player, and a famous manufacturer states: The model 'comes with a special mounting. When you retire to your house at night, just slide out the cassette-player and bring it into your house. No worry, no theft'.

NOW consider what a thief has to do.....

Probe on
disease
passed
by cats

(*Malay Mail* headline)

Were the moggies unanimous we wonder?

Crop protection and the balance of nature

The terms 'balance of nature' and 'biological equilibrium' are only rarely used by biologists themselves and then with reluctance, the reason being that the concept can only be defined with difficulty so that the terms often lead to misinterpretation. According to the physical definition an equilibrium is a "situation in which two or more opposed actions (forces) counteract one another". A clear illustration of this, known to everyone, is provided by the pharmacist's scales.

Such resting equilibria are unknown in nature. Here it is far more a question of reactions within each specific environment to the multitude of external and internal factors, so that a resting balance never occurs. If it is possible to speak of an equilibrium at all then it is of a dynamic equilibrium or, as it has also been termed, "an oscillation about an average"[1].

It may be useful to clarify these relationships with two comparisons: in meteorology it is, of course, possible to define every point on earth meteorologically. Stockholm, for example, has an average January temperature of –2·5°C, an average July temperature of + 16·9°C, an average temperature for the year of +5·9°C and an average annual rainfall of 569 mm. But these are all average figures and the weather in each individual year can vary from extreme heat and drought to wet and cold conditions.

The same applies to the equilibrium or balance between the species in a specific environment. Thus, it was established in a forest region in sourthern Germany that the average relationship of the numbers of overwintering pupae of four important species of forest insect over a number of years was 100 pine sawflies (*Diprion* spp) to 35 pine loopers (*Bupalus piniarius*), to 11 caterpillars of the species *Dendrolimus pini* to seven pine noctuids (*Panolis flammea*). But these average figures, "the average situation", never actually occurred in any one year; rather there were years when *Bupalus* predominated over *Diprion*, or often when *Panolis* was more frequent than *Dendrolimus*[2].

This continual fluctuation in the population density of species belonging to a specific environment is an inevitable consequence of the multiplicity of factors active in nature. This can be clearly demonstrated by means of a second comparison, a model—the mobile—which hangs as an ornament in many homes nowadays. If one were to hang paper discs of different sizes instead of swans or other shapes on a mobile constructed of string or wire, one could imitate the situation found in an ecosystem. The discs would carry inscriptions such as temperature, humidity, precipitation, sunshine, nature of the soil, grass population, weed flora, mice, grain-eating birds, insect-eating birds, carab beetles, aphids, ichneumonids, *etc.* It is quite clear that the oscillating balance will never reach a steady state in these circumstances since all the factors interact and all are subject to continual change. If the temperature increases the relevant disc in the mobile has to be enlarged. This immediately alters the position of all the other discs in the system.

An example of this in nature could be as follows: a thin forest stand allows sufficient light to penetrate to the forest floor to permit the growth of grasses. Larvae of a sawfly species live on these grasses and may carry parasites, namely ichneumonids. The parasites have a second host, namely other sawflies living in the forest trees. As the forest stand grows the canopy closes over, casting a shadow on the forest floor; grasses decline and with them the sawflies and their reservoir of parasites. There is a rapid increase in the sawflies which damage the trees since one of their natural enemies has lost part of its means of existence. An equilibrium is not re-established until the increasing numbers of sawfly cocoons, lying on the soil, attract an accumulation of mice and shrews which feed on them.

Mankind and biological balance

The above examples show that in the natural environment a balance between the population densities of different species is usually achieved with wide oscillations. One must consider the influence of man's cultivation of the soil against this background. As man began to clear forests and plough the soil for the cultivation of crops which were being developed, he interfered with the existing dynamic balance partly by artificially encouraging the overpopulation of a species—namely, the crop. In doing so he largely excluded other plant species from the area so that only those animals which could adapt to the new conditions could survive. Some, which fed on the crop itself, found ideal conditions since their food was far more abundant than it would ever have been in natural conditions, and in addition, a large proportion of their natural enemies could not adapt to the change in conditions. It therefore became necessary for man the farmer to take over the role of natural enemy, to regulate the situation, just as in cultivated forests the hunter with his gun has now taken the place of extinct predatory animals.

Crop protection and balance

The sequence in disturbing and restoring the balance of nature is that, first, man plants crops; secondly, pests thrive; and thirdly, man controls them, artificially restoring the balance which nature had achieved earlier, but on a higher plane of production. Thus, it has become clear that man, by protecting crops from attack by pests and diseases, tends to produce an imbalance rather than a balance in agriculture, although the resources available to him were inadequate for thousands of years: attacks on the growing crop leading to devastating famine were all too frequently the case. It has been only since the middle of the last century, and particularly in the last few decades of this century, that it has been possible to prevent such catastrophies, and then only with the help of chemical crop protection.

How do these measures act when the term biological equilibrium is seen from the point of view presented here? It is certain that the devastation of a crop by insect and other animal pests or fatal disease disturbs the unstable equilibrium in a growing crop far more than a successful chemical treatment. It is also clear that all control measures against fungal or bacterial plant diseases encourage rather than disturb this equilibrium. The control of insect and animal pests remains to be considered. Here, it is true that most pesticides are not so specific in their action

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that they control damaging species and protect beneficial species. But this is not possible anyway since the terms "damaging" and "beneficial" are used by man in an economic context. The influence which this has varies from crop to crop.

In annual crops, *e.g.*, cereals and root crops, the natural enemies of the pest cannot keep pace with the rapid increase in pests fast enough to decimate the pests before significant damage occurs, so that here chemical crop protection establishes an equilibrium more effectively than parasites or predators. In perennial cultures, such as orchards and vineyards, in which an equilibrium can develop over years, more pronounced influences can be recognized. The regular control of major pests in areas of intense cultivation has led to the situation that some of them are no longer of any importance—for example, in many places, the codling moth (*Carpocapsa pomonella*). To compensate, other species, such as summer fruit tortrix moths (*Capua* spp.), have increased.

Some species with a rapid sequence of generations have developed resistance to certain insecticides. This leads to interesting trends; one learns increasingly by the correct choice of pesticides and timing of treatment to develop methods of pest control which protect beneficial insects, that is, to utilize the forces which tend to establish an equilibrium (this is what is meant by integrated pest control). Research work over the next few years will be focused on this aspect.

In summing up, one can say that crop protection results from changes in equilibria which man has brought about, and must bring about, to ensure his food supply. This can be clarified by an example from medicine. Great epidemics such as plague, cholera, spotted fever and typhoid decimated mankind well into the last century. From the scientific point of view, forces were active which led to a biological equilibrium, since resistant patients survived to pass on their inherited characteristics of resistance while susceptible patients died. The "equilibrium" between man and the agent of disease was shifted in favour of man by means of hygiene, sulphonamides and antibiotics, and maintained at this new level by medical knowledge and increased food production. Coming full circle, the high survival rate of man brought about by the shift in equilibrium between himself and his natural enemies makes it necessary to increase food production. For this he must again change existing equilibria and maintain the newly created conditions by the same principles of hygiene and treatment which have given him his biological predominance.

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What is Ecology?

WILLIAM BOWEN

An unfamiliar word, standing for an obscure science, has suddenly thrust itself into the flood of current discussion of environmental problems. The following article offers a concise introduction to the meanings of the word and the implications of the science.

William Bowen is an editor of *Fortune* magazine and a student of the biological sciences. This article appeared in *The Environment: a National Mission for the Seventies,* published by Harper & Row, Inc.

As recently as 1962 the naturalist Marston Bates wrote:

> Ecology may well be the most important of the sciences from the viewpoint of long-term human survival, but it is among those least understood by the general public. . .

Even a year or two ago, anyone not a biologist or a biology student could easily go for months on end without encountering any mention of ecology.

But now we meet ecology—the word, at least, if not the science—at dinner parties, in newspaper editorials, on the covers of magazines, in speeches by public officials, at gatherings of scholar in fields remote from biology, and in the names of recently born or reborn corporations (Ecological Science Corp., Ecologic Resources Corp., Ecology Inc.). There is an element of fad, of course, in this swift transformation of a mossy scientific term into a conspicuous "In" word. But there appears to be something much more important, too: awakened perception by a great many people of an urgent practical need for the kinds of information, insights, and concepts embraced in ecology.

The term ecology was coined a hundred years ago by the German biologist Ernst Haeckel. The eco-, from the Greek *oikos* (house), is the same eco- as in economics, and according to an old definition what ecologists study is "the economy of animals and plants." In the now-standard definition, ecology is the science of the relations between organisms and their environment.

That will do as a working definition if we bear in mind that neither in nature nor in the thinking of ecologists are there two distinct compartments, organisms and environment. For any organism, other organisms constitute part of the environment. And the physical environment itself is largely created and maintained by organisms. Atmospheric oxygen, necessary to the survival of life on earth, is itself a product of life, accumulated from the transpiration of aquatic organisms and terrestrial plants. A hardwood forest can maintain its stability for many centuries on end because it creates its own peculiar environment, in which seedlings of only certain plant species can grow to maturity. Recognizing that organisms and their physical environment are interacting parts of a system, an ecologist uses the term "ecosystem" to mean the community of living things and the physical environment, both together, in the segment of nature he is studying.

Courtesy of Fortune Magazine, February 1970. © 1970 Time Inc.

Ecologists study all kinds of segments, great and small. One ecologist may investigate how various species of mites coexist in the pine-needle litter on a forest floor by occupying separate "niches", or ways of making a living. (It is a well-established principle of ecology that only one species can occupy a particular niche in any habitat.) Another ecologist may work out the intermeshed food chains of various species in a pond or a forest. Still another, a worker in the sprawling, almost unbounded field called "human ecology," may trace the paths by which radioactive substances and persistent pesticides, created by our interventions in nature, accumulate in the tissues of our bodies.

The great web

In the diverse studies of ecologists, certain basic themes keep recurring. Together they may be regarded as the compressed wisdom of ecology.

Interdependence. "The first law of ecology," biologist Barry Commoner remarked not long ago, "is that everything is related to everything else." The continued functioning of any organism depends upon interlinked functionings of many other organisms. Seemingly autonomous man ultimately depends upon photosynthesis for his food. The seemingly autonomous oak in the forest depends upon microscopic organisms to break down fallen leaves, releasing nutrients that can be absorbed by its roots. Interrelations between organisms are often intricate, and some obscure species provide vital linkages not at all apparent to the casual observer. The seeds of the bitterbush, an important food plant for browsing animals in arid sections of Africa, fail to germinate unless several seeds are buried close together below the surface of the soil; that happens in nature only through the intervention of a species of ground squirrel, which buries hoards of seeds and often forgets them. It is unwise for men ever to decide without very close study that any species is entirely dispensable.

Limitation. The saying that trees do not grow to the sky expresses another basic theme of ecology. Nothing ever grows indefinitely—no organism, no species. Much more commonly than non-ecologists might suppose, animal species limit their own growth: rates of reproduction respond to crowding or other signals so that total numbers remain commensurate with the resources of the ecosystem. In the over-all ecosystem of the earth, total animal energy is limited by the amount of solar energy plants embodied in organic compounds. Since combustion consumes oxygen, the amount of combustion the earth can sustain is limited—other limiting factors aside—by the ecosystem's net production of free oxygen.

Complexity. When he looks closely at any ecosystem, the ecologist invariably comes upon complexity, an intricate web of interrelations. A diagram showing the movement of a single chemical element through an ecosystem can get exceedingly complicated. In the ecosystem of man, which includes institutions and artifacts that themselves impinge upon and alter the environment, the interrelations are unimaginably complex. This great web, an ecologist said, "is not only more complex than we think. It is more complex than we *can* think."

Unexpected consequences

In ecosystems as in social systems, causes and effects are often widely separated in both time and space. Accordingly, our interventions often yield unexpected consequences.

After years of spraying persistent pesticides to kill insects, we find that we have come close to wiping out a national symbol, the bald eagle: concentrated through food chains, pesticides accumulate in the tissues of eagles and certain other birds to the point of impairing reproduction. We drain Florida swamplands and learn later on that by reducing the outflow of fresh water into estuaries we have increased their salinity and thereby damaged valuable breeding environments for fish and shrimp. Egypt's Aswan Dam impounds silt that would otherwise be carried downstream, so the Nile no longer performs as richly as before its ancient function of renewing fields along its banks. The fertility of the Nile Valley is therefore declining. That is only one variety of ecological backlash from this triumph of engineering. With the flow of the river reduced, salt water is backing into the Nile delta, harming farmlands there. And in time, some authorities predict, the flow of Nile water to new farmlands through irrigation canals will bring on a calamitous spread of schistosomiasis, a liver disease produced by parasites that spend part of their life cycle in the bodies of snails.

Garrett Hardin of the University of California pithily expressed the principal lesson of all this in pointing out that "we can never do merely one thing." When we intervene in a complex system so as to produce a certain desired effect, we always get in addition some other effect or effects, usually not desired. As Professor Hardin also said: "Systems analysis points out in the clearest way the virtual irrelevance of good intentions in determining the consequence of altering a system."

The dangers of simplification

Ecologists are accustomed to looking at nature as a system, and if we had paid more attention to them we might have been spared a lot of backlash. In trying to reduce insect damage to crops, for example, we might have made more use of specific biological or biochemical means of control and less use of persistent broad-spectrum insecticides. We might now, accordingly, have more birds in our countryside and less DDT in our streams—and in some places, fewer harmful insects in our fields.

The recurrent themes of ecology run counter to some old ways of perceiving and thinking that are deeply ingrained in the prevalent world view of Western man. We believe in limitless growth (or did until recently); ecology tells us all growth is limited. We speak (or spoke until recently) of man's "conquest" of nature; ecology tells us we are dependent for our well-being and even survival upon systems in which nature obeys not our rules but its own. Our scientists and engineers, and our social scientists, too, proceed by isolating and simplifying; ecology tells us to heed existent complexity and patiently try to trace out its strands. In a sense, then, ecology is subversive. The ecologist Paul B. Sears, a few years ago, called it "a

subversive subject," and the editors of a recent compilation of essays on the ecology of man entitled their book *The Subversive Science.*

In the recent popularity of the word "ecology," therefore, we may be witnessing the sign of a momentous historical change. Alterations in the ways men perceive and think about reality lead to alterations in the goals and modes of action. It is too early to tell whether an enduring shift to ecological ways of perceiving and thinking is now in progress, but if it is, the effects will surely be beneficial, on balance. Ecology can help us cope with the environmental ills that beset us, if only by enabling us to avoid bringing on new unintended consequences in trying to remedy old unintended consequences.

Less obviously, ecological thinking can help us cope with the social ills that also insistently press upon us. The social sciences are proving to be inadequate as guides to policy, and the inadequacy is inherent in the prevalent methods and mind sets of social scientists. In general, they have aped the successful methodology of the physical sciences, but in the study of complex social systems, simplification too readily slides into oversimplification. The social sciences would benefit greatly—and so would we all—by borrowing from the ecologists their willingness to accept and try to puzzle out complexity and their habit of sustained, open-eyed observation of what actually goes on.

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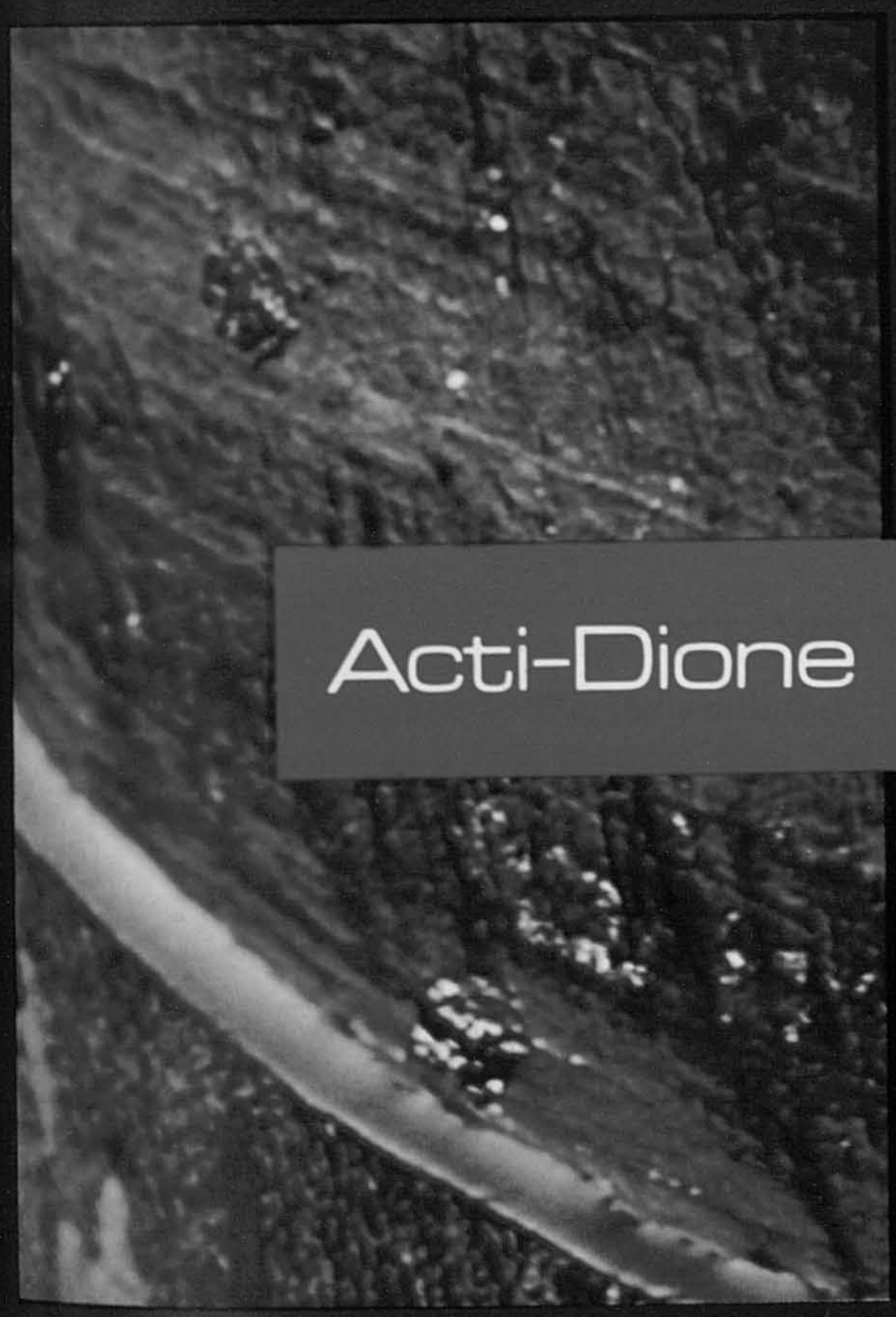
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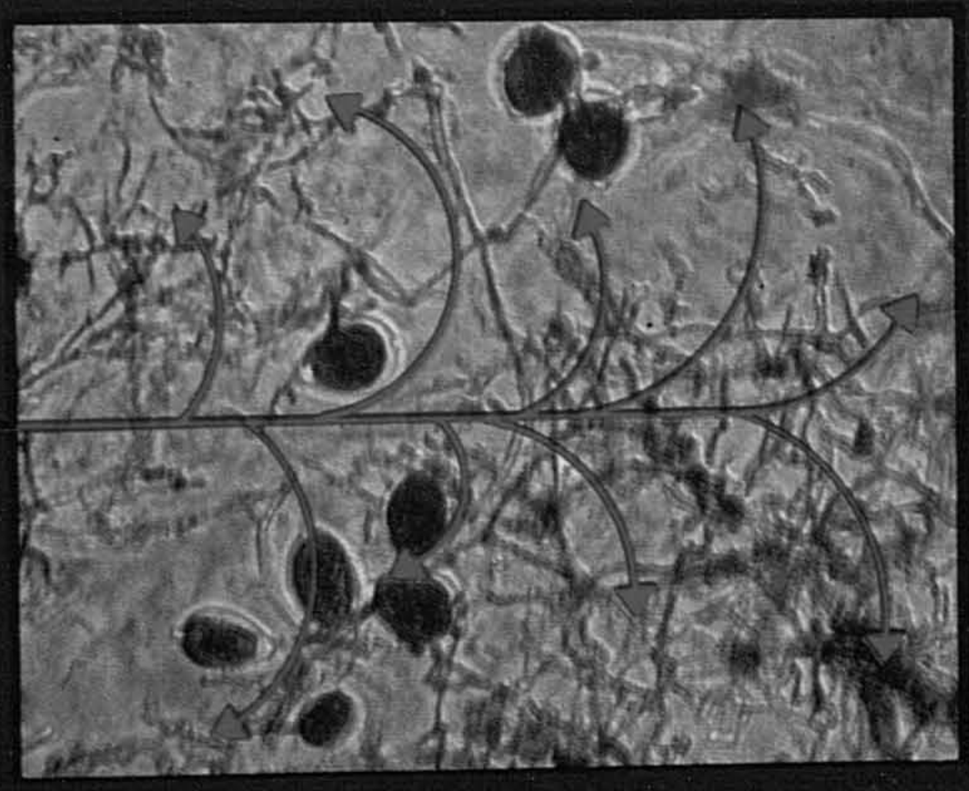
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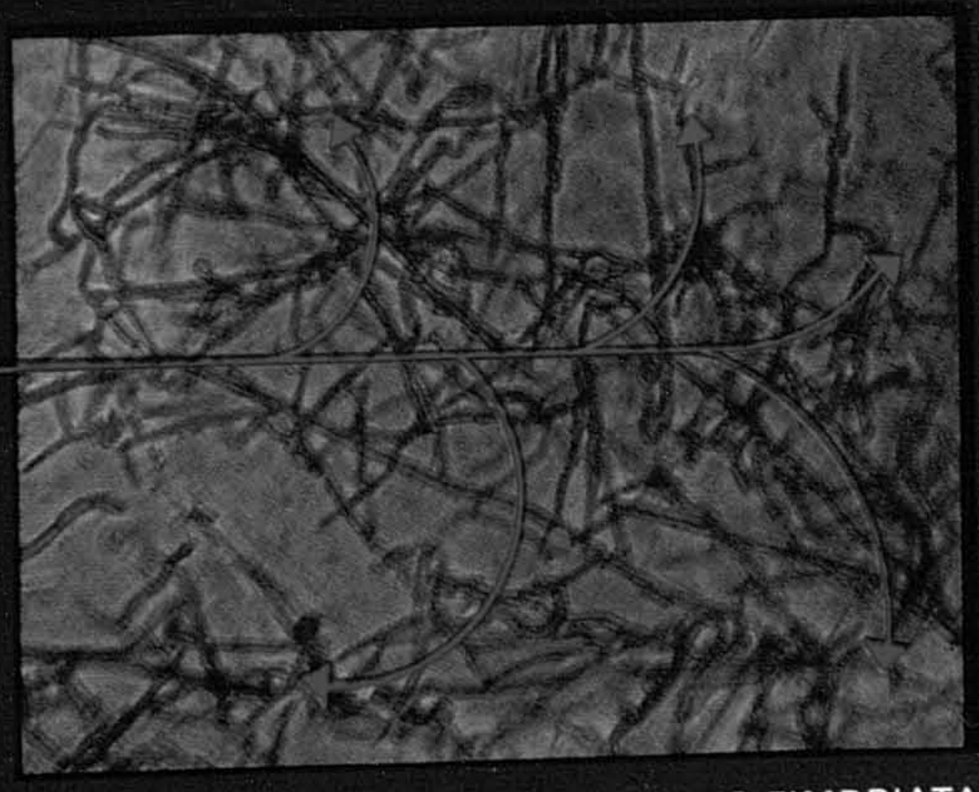
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The changing face of food scarcity

LESTER R. BROWN*

This year's sharp increases in food prices have alerted consumers throughout the world to some surprising changes that are taking place in world food demand and supply. Many factors including the poor rice harvest in Asia, the shortfall in the Soviet wheat crop and the disappearance of the anchovies off the coast of Peru, have combined to dramatize the world food situation this year. But today's shortages and rising prices also reflect long-term trends and should not be viewed as merely temporary phenomena.

Although many developing nations in Asia, the great food importers of the past are now producing a much greater share of their own food needs, economically advanced nations such as the Soviet Union and Japan are now the leading food importers. These two countries alone imported 28-million and 17-million tons in grains respectively this past year compared to India's imports of just under 10-million tons during the food crisis years of 1966 and 1967. In addition to global population growth, rising affluence has emerged as a major factor in the burgeoning world demand for food.

These changing trends are building a strong case for stepping up international efforts to aid the agricultural development of the poor countries. Over the next decade, there is far greater unrealized potential for achieving large, relatively low-cost increases in agricultural production in many developing countries than there is in the more agriculturally advanced nations. With appropriate organization, economic incentives, and agricultural inputs, food production in such key countries as Brazil, India, Indonesia and Nigeria could be greatly expanded to help meet the increased demand.

POPULATION AND AFFLUENCE

During the 1960's, the world food problem was perceived as a food/population problem—as a race between food and people. At the global level, it remains the dominant cause of increasing demand for food; merely maintaining current *per capita* consumption levels will require a doubling of food production over the next generation. But beyond this pressure of population on supply, rising affluence is also emerging as a major new claimant on world food resources.

This impact of rising affluence on demand for food can best be illustrated by its effect on consumption of cereals, which dominate the world food economy. In the poor countries, annual consumption of grain averages about 400 lb per person. Virtually all of this small amount must be consumed directly to meet minimum energy needs. In the United States and Canada, by contrast, *per capita* grain use is

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approaching one ton per year. All but 150 lb of this *per capita* total is consumed indirectly in the form of meat, milk and eggs. In the case of beef alone, annual *per capita* consumption in the United States has grown from 55 lb in 1940 to 117 lb in 1972. During the same period, the American population has expanded by 57 percent. Altogether, national beef consumption has tripled, making the United States a leading beef importer.

In the northern tier of industrial countries, stretching from Western Europe through the Soviet Union to Japan, dietary habits now more or less approximate those of the United States in 1940. As incomes continue to rise in this group of countries a sizeable share of the additional income is being converted into demand for livestock products, particularly beef. Many of these countries lack the capacity to satisfy the growth in demand for livestock products entirely from indigenous resources. As a result, they are importing increasing amounts of livestock products, or of feed grains and soybeans with which to expand their livestock production.

CONSTRAINTS ON EXPANDING THE WORLD FOOD SUPPLY

As world demand climbs, due to both population growth and rising affluence, several important constraints on further expansion of efforts to expand global food production become increasingly apparent. The traditional approach to increasing production—expanding the area under cultivation—has only limited scope for the future. Some more densely populated countries, such as Japan and several western European countries, have been experiencing a reduction in the land used for crop production, while other parts of the world have been losing disturbingly large acreages of cropland each year because of severe erosion.

An even more important constraint in the future may be the shortage of water for agricultural purposes. In many regions of the world, fertile agricultural land is available if water can be found to make it productive. Yet most of the rivers that lend themselves to damming and to irrigation have already been developed. Future efforts to expand fresh water supplies for agricultural purposes will increasingly focus on such techniques as the diversion of rivers (as in the Soviet Union), desalting sea water and the manipulation of rainfall patterns.

One of the key questions concerning future gains in agricultural production is: Can the more advanced countries sustain the trend of rising per acre yields of cereals? In some countries, increases in per acre yields are beginning to slow down, and the capital investments required for each additional increase may now start to climb sharply. In agriculturally advanced countries such as Japan, the Netherlands and the United States, the cost per increment of yield per acre is rising for some crops. What impact the energy crisis will have on food production costs and trends also remains to be seen. Rising energy costs may cause farmers engaged in high-energy agriculture, as in the United States, to hold down future production increases.

CONSTRAINTS ON PROTEIN PRODUCTION

In looking ahead, there is reason for particular concern about the difficulties of expanding the world protein supply to meet the projected rapid growth in demand.

Two major constraints are operative in the case of beef. Agricultural scientists have not been able to devise any commercially viable means of getting more than one calf per cow per year. For every animal that goes into the beef production process, one adult must be fed and otherwise maintained for a full year. The other constraint on beef production is that the grazing capacity of much of the world's pasture land is now almost fully utilized. This is true, for example, in most of the U.S. great plains area, in East Africa and in parts of Australia.

A further potentially serious constraint on efforts to expand supplies of high quality protein is the inability of scientists to achieve a breakthrough in per acre yields of soybeans. Soybeans are a major source of high-quality protein for livestock and poultry throughout much of the world and are consumed directly as food by more than 1000-million people throughout densely populated east Asia.

In the United States, which now produces two-thirds of the world's soybean crop and supplies about 90% of all soybeans entering the world market, soybean yields per acre have increased by about 1% per year since 1950; corn yields, on the other hand, have increased by nearly 4% per year. One reason why soybean yields have not climbed very rapidly is that the soybean, being a legume with a built-in nitrogen supply, is not very responsive to nitrogen fertilizer. Close to 85% of the dramatic fourfold increase in the U.S. soybean crop since 1950 has come from expanding the area devoted to it—a process which cannot continue indefinitely.

The oceans are our third major source of protein. In 1969, 20 years of sustained growth in the world fish catch was interrupted by a sudden decline. The catch has since been fluctuating rather unpredictably, while the amounts of time and money expended to bring it in continue to rise every year. Many marine biologists now feel that the global catch of table grade fish is at or near the maximum sustainable level. If, as currently seems probable, the global fish catch does not continue rising in the next decades as it did during the last two, the pressures on land-based protein sources can be expected to increase substantially.

Although there are substantial opportunities for expanding the world's protein supply, it now seems likely that the supply of animal protein will lag behind growth in demand for some time to come, resulting in significantly higher prices for livestock products during the 1970's than prevailed during the 1960's. We may be witnessing the transformation of the world protein market from a buyer's market to a seller's market, much as the world energy market has been transformed over the past few years.

DEPLETED GLOBAL RESERVES

Since World War II, the world has been fortunate to have, in effect, two major food reserves. One was in the form of grain reserves in the principal exporting

countries and the other in the form of reserve cropland idled under farm programs in the United States. As world consumption expands, so should the size of global grain reserves, but the trend over the past decade has been one of dwindling reserves and climbing consumption.

One-seventh of US cropland, or roughly 50-million acres out of 350-million acres, has been idled under farm programs for more than a decade. Though not as quickly available as the grain reserves, most of this acreage can be brought back into production within 12 to 18 months once the decision is made to do so.

In recent years, the need to draw down grain reserves and to utilize the reserve of idled cropland has occurred with increasing frequency. This first happened during the food crisis years of 1966 and 1967, and again in 1971 as a result of the corn blight in the United States. In 1973, in response to growing food scarcities, world grain reserves once more declined, and the United States again resorted to cultivating its idled cropland, but to a much greater degree than on either of the two previous occasions. Government decisions in early 1973 permitted at least two-thirds of the idled cropland to come back into production, and the government announced plans to eliminate all payments for idled cropland in the 1973/74 crop year. In the years ahead, world food reserves may become chronically low, and the idled crop acreage in the United States may decline sharply or even disappear entirely. Consequently there is the prospect of very volatile world prices for the important food commodities.

SOME POLICY IMPLICATIONS

The possibility of a chronic global scarcity of food resulting from growing pressures on available food resources underlines the need to stabilize and eventually halt population growth in as short a period of time as possible. Current demographic trends suggest that this conceivably may take place in the industrial countries. In the poor countries, however, it will be much more difficult to achieve. For one thing, the historical record indicates that birth rates do not usually decline in the absence of a certain improvement in well-being—a reasonable standard of living, an assured food supply, a reduced infant mortality rate, literacy and health services.

Population-induced pressures on the global food supply will continue to increase if substantial economic and social progress is not made. Populations that double every 24 years—as many are doing in poor nations—multiply 16-fold in scarcely three generations! It may well be in the self-interest of affluent societies, such as the United States, to launch an attack on global poverty not only to narrow the economic gap between rich and poor nations, but also to meet the basic social needs of people throughout the world in an effort to provide incentives for lowering birth rates.

These population trends, together with the emerging constraints on food production, also call for serious consideration of the creation of an internationally managed world food bank, as the FAO has proposed, to maintain some semblance of order and stability in the world food economy. Just as the US dollar can no longer serve as the foundation of the international monetary system, so US agricul-

ture may no longer have sufficient excess capacity to ensure reasonable stability in the world food economy.

A world reserve could be built up in times of relative abundance and drawn down in times of acute scarcity. In effect, the cushion that surplus American agricultural capacity has provided for a generation would be provided at least partially by a world food bank. A system of global food reserves would provide a measure of price stability in the world food economy that would be in the self-interest of all nations. The world community of course also has a basic humanitarian interest in ensuring that famine does not occur in the densely populated low-income countries following a poor crop year—an assurance the affluent nations may be less able to provide in the future if the current system of autonomous, nationally oriented planning is allowed to continue without modification.

A close examination of the extent of over-fishing and stock depletion in many of the world's fisheries also underlines the urgency of evolving a cooperative global approach to the management of oceanic fisheries. Failure to do this may result in soaring seafood prices that will make those of the early 1970's seem modest by comparison. It is in this context that all nations have a direct interest in the success of the upcoming UN Law-of-the-Sea Conference.

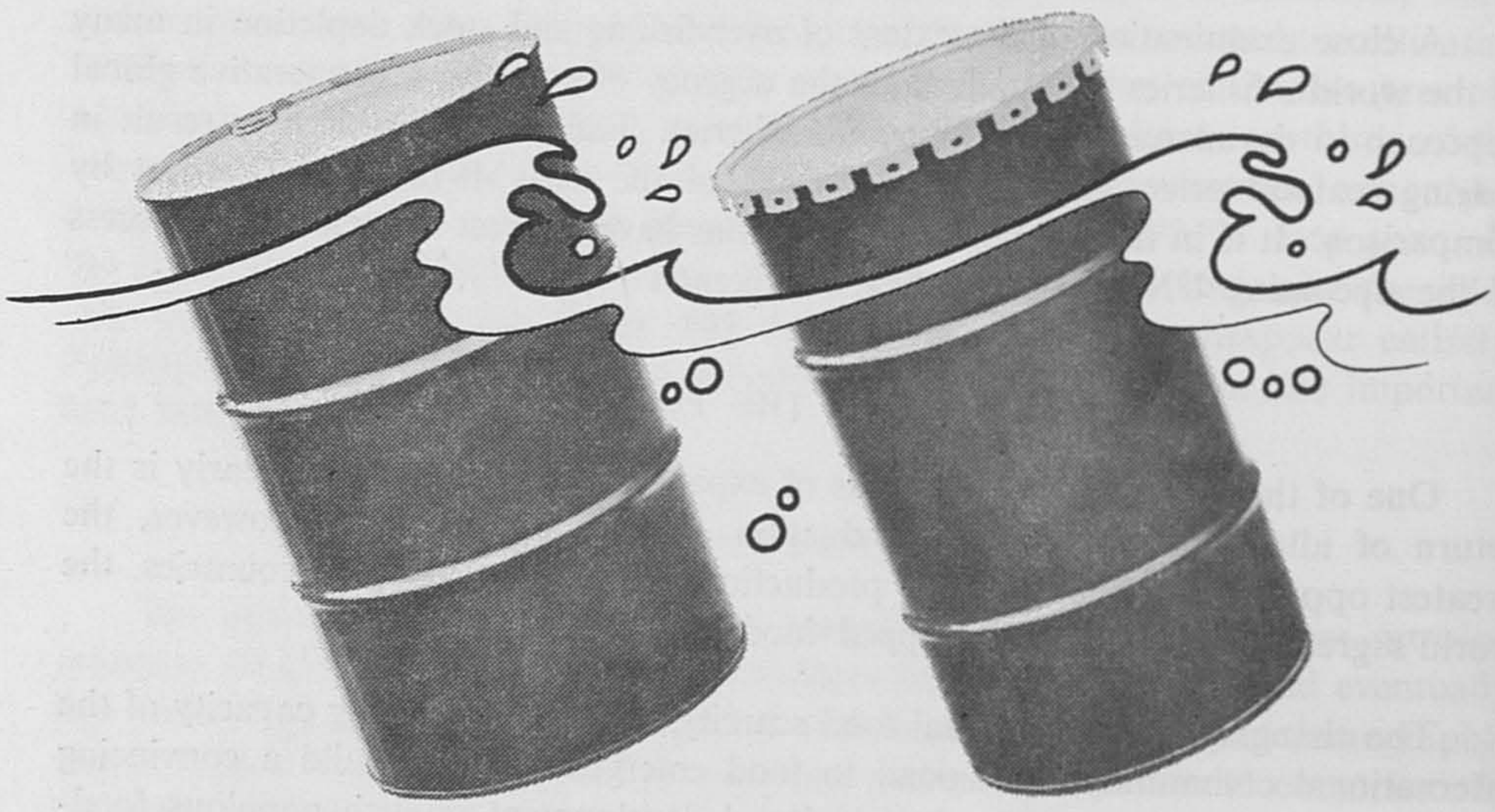
THE POTENTIAL OF THE POOR COUNTRIES

One of the most immediate means of expanding the food supply clearly is the return of idled US cropland to production. Over the longer run, however, the greatest opportunities for increased production are in the developing countries, the world's greatest reservoir of untapped food production potential.

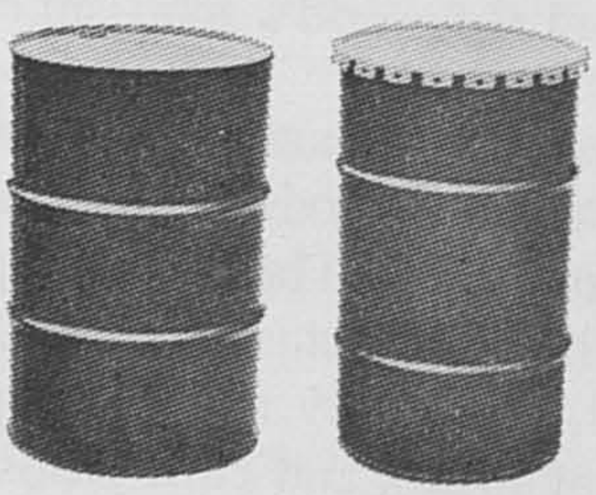
The changing nature of global food scarcity and the diminishing capacity of the international community to respond to food emergencies both build a convincing case for strengthened support of agricultural development in such populous food-short countries as Bangladesh, India, Indonesia and Nigeria. One important step in this direction is a bipartisan legislative proposal introduction to the US Congress in 1973 that would restructure the US Agency for International Development and increase by 50% the support it provides for agricultural and rural development in the years immediately ahead. This proposal seeks to capitalize on the unique capacity of the United States to lead an enlarged effort to expand the world's food supply.

In those countries having the appropriate organization, economic incentives, fertilizer, water and other necessary agricultural inputs, the introduction of new wheat and rice varieties has increased production substantially. The jump in per acre yields in developing countries appears dramatic largely because their yields traditionally have been so low relative to the potential. But today rice yields per acre in India and Nigeria still are only one-third those of Japan, and corn yields in Thailand and Brazil are less than one-third those of the United States. Large increases in food supply are possible in these countries at far less cost than in agriculturally advanced nations if farmers are given the necessary economic incentives and the requisite inputs.

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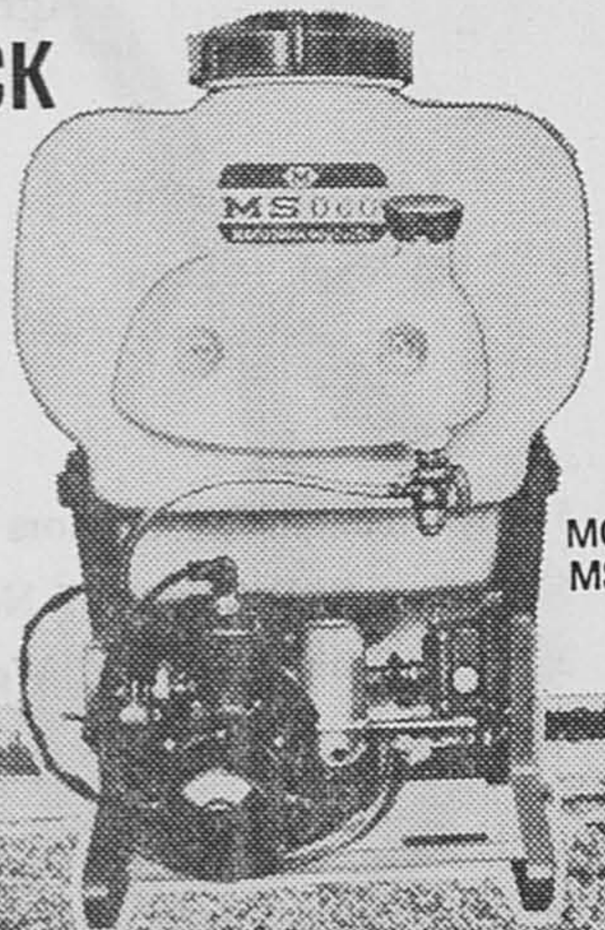
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Concentrating efforts on expanding food production in the poor countries could reduce upward pressure on world food prices, create additional employment in countries where continuously rising unemployment poses a serious threat to political stability, and raise income, and improve nutrition for the poorest portion of humanity—the people living in rural areas of the developing countries.

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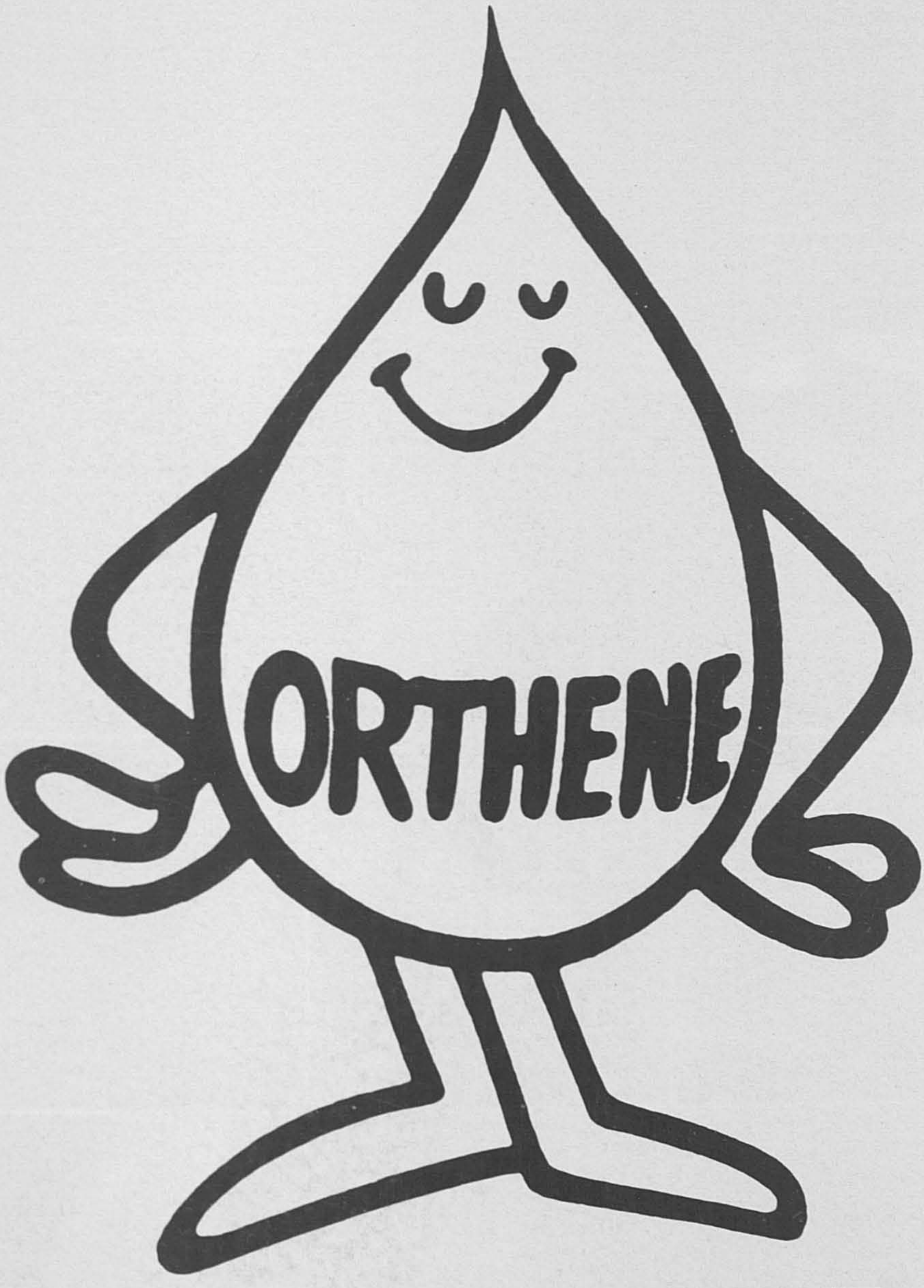
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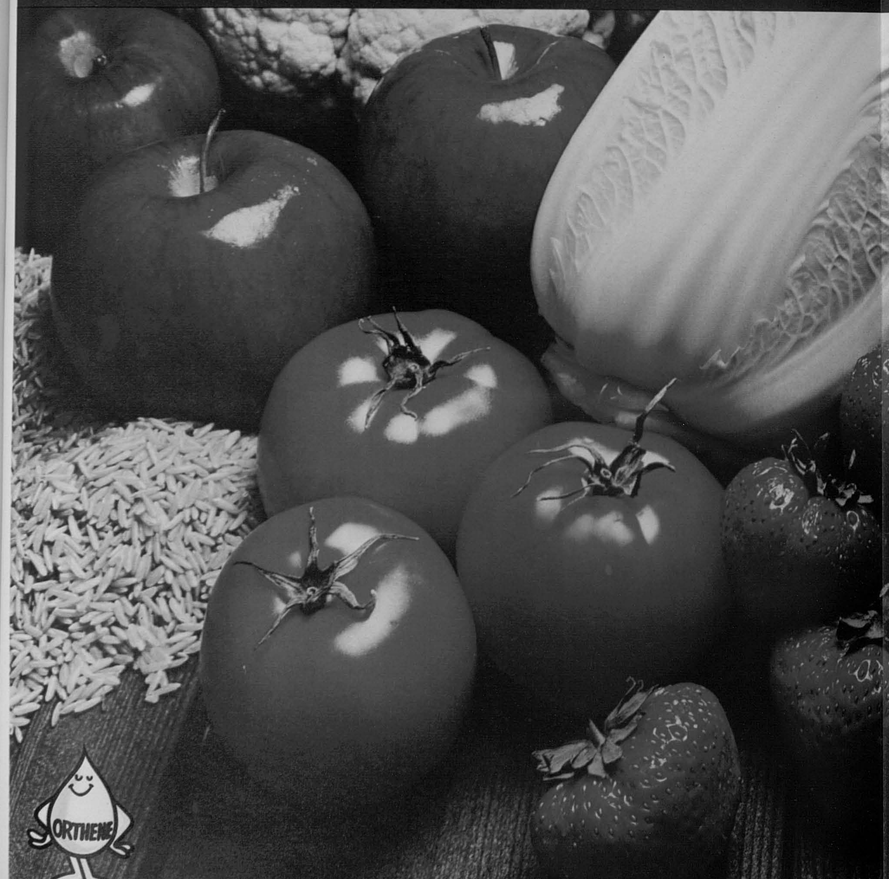
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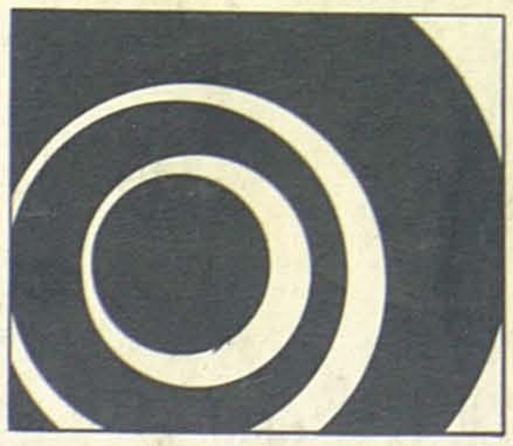
	PAGE
Bayer (Malaysia) Sdn. Bhd.—	
Dipterex SP/95/Matacil	Facing 325
Champion Motors (S) Pte. Ltd.—	
Land Rover	V
Chemara Agricultural Services—	
Oil Palm seedlings	IV
Cycle & Carriage (M) Sdn. Bhd.—	
Maruyama	352
Chevron Chemical Co.—	
Orthene	Facing 353
Dow Chemical International—	
Dowpon-S	Facing II
Dowpon	Facing 325
Harrisons & Crosfield (M) Sdn. Bhd.—	
Ansor 529	Facing 332
Difolatan 4F	Facing 332
Hoechst Malaysia Sdn. Bhd.—	
Thiodan/Morocide	VII
I.C.I. Agriculture (M) Sdn. Bhd.—	
Gramoxone	Facing 340
Fertiliser	Facing V
Malaysia Air Charter Co. Sdn. Bhd.—	
Agricultural aircraft	336
Malaysian Soil Investigation Sdn. Bhd.—	
Ground water drilling	329
Mercantile Bank Ltd.—	
Instant Service	342
Progress Motors Pte. Ltd.—	
Holden	I
Quantas Airways—	
Quantas is the airline	II
Rheem Hume (S) Pte. Ltd.—	
Steel drums	VI
Shell Malaysia Bhd.	Cover pages
Acti-Dione	Facing V
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