

Abstracts
of
ASRCT Technical Reports
1971-74

With Cumulative Indexes 1965-1974

Compiled by
THAI NATIONAL DOCUMENTATION CENTRE

REF
5/6(048.1):047.3
A2
C.2

**ABSTRACTS
OF ASRCT TECHNICAL REPORTS
1971-74**
*With Cumulative Indexes
1965-74*

Compiled by
THAI NATIONAL DOCUMENTATION CENTRE

**APPLIED SCIENTIFIC RESEARCH CORPORATION OF THAILAND
BANGKOK 1976**



087068

REF

5/6(048.1):047.3

A₂ C. 2

C O N T E N T S

PREFACE

I. I N D U S T R I A L T O P I C S	1
ECONOMIC EVALUATION	1
Commercial	1
Industry studies	2
Pre-investment studies	4
UTILIZATION OF AGRICULTURAL PRODUCTS	5
Bananas	5
Coconuts	6
Fish products	6
Guava	8
Kenaf	8
Mangoes	11
Peanuts	12
Roselle	12
Soybeans	13
Vegetable protein food	15
EXPLOITATION OF NATURAL PRODUCTS	17
Perfume and flavouring materials	17
Pharmaceuticals	18
Pulp materials other than kenaf	20
CHEMICAL INDUSTRY	22
MINERALS AND METALS INDUSTRY	24
Foundry	24
Minerals	24
Tinplate	24
BUILDING INDUSTRY	25
PHYSICS AND ENGINEERING	29
Computerized structural engineering	29
Solar and terrestrial physics	30
II. O T H E R T O P I C S	32
AGRICULTURE	32
SCIENCE POLICY STUDIES	33
ENVIRONMENTAL AND ECOLOGICAL STUDIES	34
Bird studies	34
Exposure testing	34
Fish studies	40
Forest ecosystem studies	40
Water pollution and sewage treatment	43

AUTHOR INDEX	44
SUBJECT INDEX	48
RESEARCH PROGRAMME/PROJECT INDEX	53
MISCELLANEOUS INVESTIGATION/STUDY INDEX	55
APPRAISAL REPORT INDEX	56
CLASSIFIED INVESTIGATION INDEX	57

I. I N D U S T R I A L T O P I C S

Economic evaluation

Commercial

71-74/243

AGARWAL, M.C. Cooperative marketing of kenaf in Thailand - a case for vertical integration. Rep. no. 3 on Res. Proj. 1/10, 1971, 72 p.

Key Words: Kenaf, Commerce, Thailand, Finance.

(1) To assess past performance of the Cooperative Society in the last five years;

(2) To assess the economic and financial feasibility of a vertically integrated cooperative organization which will process graded fibre into standard export bales;

(3) If the above is found feasible, to estimate additional physical, financial and manpower requirements should the Cooperative decide to integrate marketing activity vertically by adding full-fledged baling facilities.-*Author.*

71-74/244

TONGDEE, Sing Ching, SRIVARDHANA, Aim-on, and LIMVATANAKUL, Unchalee. Handling of fresh mature ginger in the tropics for export. Rep. no. 1 on Class. Invest. no. 25, 1974. *CONFIDENTIAL.*

Key Words: Ginger, International trade.

71-74/245

WAKE, Norman L., and KAMOLRATANAGUL, Nipon. Commercial feasibility of developing apiculture in Thailand. Appraisal Rep. no. 25, 1972, 12 p.

Key Words: Apiculture, Commerce, Thailand, Beeswax.

(1) Imports of beeswax into Thailand have averaged 17-30 tonnes annually valued at some 600,000-800,000 baht in recent years. This supplements a highly variable local production. The wax is used largely in candle manufacture. Import of honey is only about 5 tonnes annually.

(2) Any serious attempt to expand local beeswax production would need to be based on the Italian bee, rather than the indigenous bees, and a market would have to be found for from 300 to 600 tonnes annually of honey which would arise along with the production of 20 tonnes of beeswax. Such an industry would gross between 2 million and 4 million baht per year.

(3) Evidence is presented that this may be a not-too-formidable task and that the venture could be commercially viable. A pilot apiary would permit a firmer commercial assessment and

indicate whether an ecologic survey of the Thai environment is worth-while.

(4) Recent, as-yet-unconfirmed, reports indicate that the accidental introduction of an African species of honey bee into South America, is upsetting apiculture there and that the unwanted bee is spreading to North America. In the longer term, this could change the pattern of world trade in honey and beeswax and could be to Thailand's advantage. -*Authors.*

Industry studies

71-74/246

KIRKENDALE, George A. Feasibility study for structural clay products industries in Thailand. Rep. no. 2 on Class. Invest. no. 16, 1973. *CONFIDENTIAL.*

Key Words: Clays, Industries.

71-74/247

PIYAPONGSE, Sachee. An economic review of the starch and starch products industries. Rep. no. 1 on Res. Proj. 48/1, 1972, 35 p.

Key Words: Starches, Industries, Economic analysis.

(1) The production of starch-bearing materials in Thailand indicates that raw materials for starch and starch products are quite ample. In 1968 production of cassava was 2,611 thousand tonnes; maize, 1,331 thousand tonnes; sorghum 57 thousand tonnes; sweet potato 237 thousand tonnes; mung bean 184 thousand tonnes; and broken rice, 2,688 thousand tonnes (estimated). The production trend and the target production plan shows that there should be a considerable increase in the production of these starch-bearing materials in the near future.

(2) The 1970 average wholesale prices of starch-bearing materials were as follows: tapioca, 0.33 baht/kg; maize, 1.23 baht/kg; sorghum, 1.14 baht/kg; sweet potato, 1.83 baht/kg; mung bean, 2.35 baht/kg; broken rice, 1.13 baht/kg; and glutinous rice, 1.14 baht/kg. The study suggests that sorghum and broken rice are the cheapest raw materials for starch and starch derivative manufacture.

(3) The following is the current position of starch and flour production in Thailand:

Tapioca flour (starch). Some 250,000 tonnes are produced annually, of which 80% goes to export, leaving a rather stable local consumption of about 50,000 tonnes per year. Of this, 90% is used in food manufacture and the remaining 10% is used in the textile, paper making and pharmaceuticals industries.

Rice starch and glutinous rice starch. Combined production is around 60,000 tonnes per year, most of which is used locally for making noodles and desserts. In 1969, 3,200 tonnes of rice starch and flour and 4,000 tonnes of glutinous rice flour were exported.

Mung bean starch. Only some 500 tonnes per year are produced and this goes to local food preparation.

Corn starch, dextrin, pharmaceutical grade dextrose are not produced in Thailand, and supplies come wholly from import. In 1969 import of corn starch was 160 tonnes; glucose (commercial grade), 700 tonnes dextrin and starchy substance, 240 tonnes; and dextrose, only 20 tonnes. There is recent evidence of an expanding local market for glucose and dextrin.

(4) An examination of overseas markets shows that corn starch has an attractive market in many countries especially the United Kingdom and Denmark, which import some 60,000 tonnes and 20,000 tonnes per year respectively. Rice starch finds markets in Canada, Austria, Belgium, which import a total of some 600 tonnes per year. The most important market for glucose is the United Kingdom, which imports about 20,000 tonnes per year. The Netherlands and Denmark are next in importance. The available statistics also show that imports of dextrin was 28,000 tonnes per year by the United Kingdom and 11,000 tonnes per year by U.S.A. in 1967.

This suggests that significant export markets exist for local starches and starch derivatives provided they are competitive in both price and quality.

(5) Starch can be used as a substrate for alcohol production, but under prevailing conditions in Thailand, molasses appears to be preferred on a commercial basis. -*Author*.

71-74/248

SANGSAN-ANAN, Sorot, TUNGKHASARANI, Metz, and PIYAPONGSE, Satchee. A brief survey of the vegetable oils industry in Thailand. Rep. no. 1 on Study no. 30, 1973, 69 p.

Key Words: Vegetable oils, Industries, Thailand.

Thailand retains from 75 to 100% of each oil-bearing material produced, a highly variable proportion of which is used for oil production. Nevertheless, despite this high domestic retention, 90,000-100,000 tonnes of oilseeds have been exported annually in recent years.

Export of oils is small compared with export of oilseeds. Export of oils in 1970 was 1,958 tonnes and was increasing. Imported oils are chiefly those not produced here, e.g. olive and linseed oils, together with oxidized and hydrogenated oils. Total import of oils in 1970 was 1,679 tonnes.

Export of oil cakes in 1970 was over 43,000 tonnes.

There is no unified overall policy aimed at developing the Thai vegetable oil industry. Certain firms have, however, received promotional privileges; targets have been set for increasing selected oilseed production during the Third National Economic and Social Development Plan, with particular emphasis on soybean production for export.

Government research programmes, often with international support, have been and are being carried out on oil-bearing seeds production and utilization.

Domestic demand for vegetable oils and hence for oilseeds will doubtless increase with population growth and income (combined, at about 4.4% p.a.), but supply and price of lard is a controlling factor.

Achievement of increased oilseed export, especially of soybean, looks brighter than formerly (Japan is buying virtually no Thai soybean currently) as higher-oil-yielding, more-pest-resistant strains are grown by farmers utilizing improved cultivation methods.

Outlook for much increased oil export appears dubious, although world demand for oil cakes will, reportedly, be sustained.
-Authors.

Pre-investment studies

71-74/249

CHEOSAKUL, Ubolsri, and VIBHATAKARASA, Suvanna. Pre-investment study for stabilized coconut cream manufacture. Rep. no. 2 on Class. Invest. no. 5, 1974. *CONFIDENTIAL*.

Key Words: Coconuts, Manufactures, Coconut cream.

71-74/250

KAMPEMPPOOL, Smith, and UDCMSAKDHI, Bancha. Reassessment of the economic feasibility of the manufacture of lightweight clay aggregate. Rep. no. 2 on Res. Proj. 21/8, 1973, 7 p.

Key Words: Clays, Lightweight aggregates, Manufactures, Economic analysis.

By employing realistic assumption to determine the probable production cost of lightweight clay aggregate, the possibility of manufacturing such material as a business venture is shown to be highly favourable. A scale-up study on the manufacture of bloated clay aggregate is strongly recommended to provide necessary data for pre-investment evaluation. -Authors.

71-74/251

SUPHAPHIPHAT, Phiphit. Long-term projections of demand and supply of pulp and paper in Thailand. Appraisal Rep. no. 27, 1974, 24 p.

Key Words: Pulps, Papers, Thailand, Supply (economics), Demand (economics)

It is evident from the study that the domestic supply of paper from the existing mills will not be able to catch up with the increasing demand for all categories of paper in the future. Without the materialization of all the new mills, the import of paper will continue to play important role as a supplement to the local supply of paper to meet the increasing domestic demand. There is,

therefore, a great need to stimulate establishment of the new mills otherwise the consumption of paper will continue to be source of a considerable drain on the country's foreign exchange. Since the acute shortage appears to be in industrial paper and newsprint, most of the new projects, therefore, have been geared toward the production of these two categories of paper. But the shortage of newsprint, tissue paper, writing and printing paper will remain implying that production of these papers should be expanded. As for domestic pulp manufacture, there is no large-scale pulp production in the country at this moment. Even the two large pulp projects are realized, the domestic supply of pulp will still be far below its requirements. Thus, great emphasis should be placed upon the pulp production in the country to make the Thai paper industry less dependent on the import. -*Author*.

71-74/252

UATHAVIKUL, Phaichayon. Flow of raw material supply to proposed UPPC mill site. Rep. no. 1 on Class. Invest. no. 15, 1973. *CONFIDENTIAL*.

Key Words: Pulp, Papers.

Utilization of agricultural products

Bananas

71-74/253

TONGDEE, Sing Ching. Polyethylene bags and ethylene absorbent for delaying banana ripening. Rep. no. 5 on Res. Proj. 32/7, 1972, 7 p.

Key Words: Bananas, Bananas storage.

Polyethylene bags and vermiculite concrete blocks impregnated with potassium permanganate as ethylene gas absorbent were used to delay ripening of kluai hom thong bananas of three - quarters full or about 75% ripeness at room temperature, 25-29°C. Fruits packed in polyethylene bags were still in good, green condition after 3 weeks, while the control had almost completely rotted. Vermiculite block, as ethylene absorbent and enclosed in the polyethylene bags, further helped retard ripening of the bananas. No sign of ripening was noticed after 35 days in storage. Fruits appeared to ripen normally on removal from the polyethylene bag. -*Author*.

71-74/254

TONGDEE, Sing Ching, and BOON-LONG, Siribongse. Proliferation of banana fruit tissues grown *in vitro*. Rep. no. 1 on Res. Proj. 32/8, 1972, 6 p.

Key Words: Bananas, Bananas cultivation.

Banana fruit tissues were induced to form the callus within 7 days on White's medium (solidified with 0.6% agar) supplemented

with 2, 4-D. Bananas of different varieties respond differently to the treatment. Callus induction was more rapid in 'kluai nam_wa' than it was in 'kluai hom-thong'. The main site of growth response was in the pulp. However, the presence of some vascular tissues along with the pulp may be necessary. Attempts to induce callus differentiation or organ formation were, at present, unsuccessful.-*Authors*.

Coconuts

71-74/255

CHEOSAKUL, Ubolsri. Canning of concentrated coconut milk. Rep. no. 1 on Class. Invest. no. 5, 1972. *CONFIDENTIAL*.

Key Words: Coconuts, Coconuts milk, Cannings.

71-74/256

CHEOSAKUL, Ubolsri, and INTHORN, Duangduen. Canning of a stabilized coconut milk. Rep. no. 2 on Class. Invest. no. 7, 1971. *CONFIDENTIAL*.

Key Words: Coconuts, Coconuts milk, Canning.

71-74/257

CHEOSAKUL, Ubolsri, INTHORN, Duangduen, and DOWNDAK, Churn. Production of a stabilized coconut milk in plastic bags. Rep. no. 1 on Class. Invest. no. 7, 1971. *CONFIDENTIAL*.

Key Words: Coconuts, Coconuts milk.

Fish products

71-74/258

SRIKUMLAITHONG, Sumalai, UDOMSAKDHI, Bancha, and VARDHANABHUTI, Sman. Accelerated nampla fermentation on a semi-pilot scale. Rep. no. 1 on Res. Proj. 31/6, 1974, 16 p.

Key Words: Fish sauce, Fermentation.

Accelerated nampla fermentation on a pilot scale has been found to produce an acceptable quality of the product, which is rather high in total nitrogen content and fair in aroma. The fermenting tank has the following internal dimensions, length 68.5 cm, width 67.5 cm, and depth 95 cm. Fishes were processed with an unrefined solar salt in two proportions, i.e. 25 parts of salt to 100 parts of fish and 30 parts of salt to 100 parts of fish by weight. The mixture was maintained at 49°C for 4 to 5 days and subsequently at 37°C for two to three months.

The production cost on a semi-pilot unit with a capacity of 720 litres of primary extract per year was calculated. The plant required an investment of 9,500 baht. The processing costs involved were 3.92 baht per litre of primary extract.-*Authors*.

71-74/259

VARDHANABHUTI, Sman, SOMCHAI, Praphaisri, and SUKHUMAVASI, Jiraporn. The use of papain in the biological quick process for fish sauce production. Rep. no. 5 on Res. Proj. 31/4, 1974, 19 p.

Key Words: Fish sauce, Papain.

The biological quick process for fish sauce production was modified through laboratory experiments by the incorporation of crude papain during the initial incubation at 49°C. This was found to be of much advantage. The yield of the primary extract increased by upwards of 20% with about that much increase in organic nitrogen content of the liquid. The quality of the extract was also improved. The recommended dose of the enzyme in the quick process is between 0.125 to 0.5 gramme per kilogramme of fish. There was only slight increase in the filtration rate of the primary extract and the filtration problem was not solved by this treatment. -Authors.

71-74/260

VARDHANABHUTI, Sman, SUKHUMAVASI, Jiraporn, KLINSUKONT, Chaiyuth, and LAUHASIRI, Pravat. Mixed trash fish for nampla fermentation by the biological quick process. Rep. no. 3 on Res. Proj. 31/4, 1972, 11 p.

Key Words: Fish sauce, Fermentation.

Iced mixed trash fish gives good quality primary extract and fair leachings by the new biological quick process for nampla production. It requires slightly more salt than the conventional fish species, however.

Because of its low cost when compared with that of the conventionally preferred fish species and its year-round availability, this type of fish appears to be economically suitable for the new process. -Authors.

71-74/261

VARDHANABHUTI, Sman, SUKHUMAVASI, Jiraporn, and LAUHASIRI, Pravat. Modifications of the biological quick process for nampla fermentation. Rep. no. 4 on Res. Proj. 31/4, 1973, 9 p.

Key Words: Fish sauce, Fermentation.

A modification of the original biological quick process for fish sauce production was carried out in an attempt to cut down the heating cost during the fermentation and to facilitate filtration. The fermenting mash was heated and stirred only during the primary stage of fermentation at 49°C, while the secondary stage was carried out at room temperature instead of at 37°C. stirring was also discontinued during the secondary stage.

Primary extract obtained from the modified method was slightly inferior to that obtained from the original method with regard to aroma, richness, and yields. These differences were slight and appeared to be justifiable.

Stirring during the secondary stage of fermentation was found

to be unnecessary. It did not affect the yield or the chemical composition of the primary extract by either method.

Omission of stirring did not facilitate the separation of the fermented mash by either method to an appreciable extent nor did it facilitate the filtration. -*Authors*.

Guava

71-74/262

CHEOSAKUL, Ubolsri. Guava jelly. Rep. no. 1 on Res. Proj. 40/1, 1972, 9 p.

Key Words: Guava, Guava jelly.

Three formulae of guava jelly have been developed in the Food Technology Unit. The ingredient cost of each formula is rather high. It can be reduced, however, by replacing citric acid and ground sucrose with lime juice and brown sugar respectively. The vitamin C content, viscosity, and colour depend on the time and temperature of cooking.

There is no significant difference in acceptability between the three formulae of guava jelly, since the difference between formulae is less than 0.134. Organoleptic tests show that the products are most satisfactory (treatment means of 3.957-4.057).

It is recommended that the guava jelly of FTU be further investigated to obtain a high-quality and low-cost product. -*Author*.

Kenaf

71-74/263

BOONKLINKAJORN, Prapandh. Effect of growing conditions on fibre quality of five Thai kenaf varieties. Rep. no. 8 on Res. Proj. 1/4, 1971, 9 p.

Key Words: Kenaf, Northeast Thailand, Kenaf cultivation, Kenaf fibers.

Five Thai kenaf varieties (*Hibiscus sabdariffa* var. *altissima*) were grown initially in a series of variety trial at three locations in northeast Thailand in 1970. Fibre samples were taken and measured for their diameter and ballistic strength from which their spinning qualities (k) were calculated. Statistical analysis shows that growing conditions prevailed in that part of the country had no influences on the fibre quality of these varieties (NS 001, NS 002, NS 003, THS 30, and THS 44). Average k values were above 3 which are very acceptable commercially and are comparable to Pakistan jute. Climatic conditions during the growth period are also discussed. -*Author*.

71-74/264

CHU, Chien, KASHEMSANTA, M.L. Sathit, and NIYOMWAN, Naiyana. Woolenization of kenaf retted fibre. Rep. no. 1 on Res. Proj. 1/18, 1974, 5 p.

Key Words: Kenaf, Kenaf fibre, Kenaf retting.

Modified kenaf fibres were prepared from retted kenaf cuttings by partial degumming the fibres at 150°C for 2 hours with alkaline solution containing 7% caustic soda and 3% sodium sulfide on fibre weight. The degummed fibres were washed and brightened with 2% hydrogen peroxide for 2 hours at 60°C. The brightened fibres with a cream colour were dried and soaked in cold 28% caustic soda solution for one minute. The modified fibres thus produced had curled and soft texture. The fibres were washed and dried. A non-woven fabric was made from the matted modified fibres with 25% resin emulsion as binder. The resin impregnated fibres were cured for one minute at 150°C. The non-woven produced was washable.

Hessian cloth made from retted fibres was woolenized in the same way as above described for retted kenaf fibre. The woolenized hessian was dyed with methylene blue. The dyed cloth has good brightness and soft texture which lends its possible use for furniture covering and window draping. -*Authors.*

71-74/265

CHU, Chien, NIYOMWAN, Naiyana, and PUANGVICHIT, Anchalee. Bleached magnetite pulp from kenaf. Rep. no. 1 on Class. Invest. no. 2, 1971. *CONFIDENTIAL.*

Key Words: Kenaf, Pulps.

71-74/266

CHU, Chien, NIYOMWAN, Naiyana, and PUANGVICHIT, Anchalee. Bleached chemical pulp from kenaf by sodium bisulphite process. Rep. no. 2 on Class. Invest. no. 2, 1971. *CONFIDENTIAL.*

Key Words: Kenaf, Pulps.

71-74/267

CHU, Chien, NIYOMWAN, Naiyana, and PUANGVICHIT, Anchalee. Bleached chemical pulp from kenaf by ammonium bisulphite process. Rep. no. 3 on Class. Invest. no. 2, 1971. *CONFIDENTIAL.*

Key Words: Kenaf, Pulps.

71-74/268

CHU, Chien, NIYOMWAN, Naiyana, and PUANGVICHIT, Anchalee. Chemical pulp from kenaf by ammonium sulphite process. Rep. no. 4 on Class. Invest. no. 2, 1971. *CONFIDENTIAL.*

Key Words: Kenaf, Pulps.

71-74/269

CHU, Chien, NIYOMWAN, Naiyana, and PUANGVICHIT, Anchalee. Chemical pulp from kenaf by neutral sulphite process. Rep. no. 5 on Class. Invest. no. 2, 1971. *CONFIDENTIAL.*

Key Words: Kenaf, Pulps.

71-74/270

CHU, Chien, NIYOMWAN, Naiyana, and PUANGVICHIT, Anchalee. Chemical pulp from kenaf by soda process. Rep. no. 6 on Class. Invest. no. 2, 1971. *CONFIDENTIAL*.

Key Words: Kenaf, Pulps.

71-74/271

CHU, Chien, NIYOMWAN, Naiyana, and PUANGVICHIT, Anchalee. Chemical pulp from kenaf by kraft and polysulphide processes. Rep. no. 7 on Class. Invest. no. 2, 1972. *CONFIDENTIAL*.

Key Words: Kenaf, Pulps.

71-74/272

CHU, Chien, NIYOMWAN, Naiyana, and PUANGVICHIT, Anchalee. Chemical pulp from kenaf bast. Rep. no. 8 on Class. Invest. no. 2, 1972. *CONFIDENTIAL*.

Key Words: Kenaf, Pulps.

71-74/273

CHU, Chien, NIYOMWAN, Naiyana, and PUANGVICHIT, Anchalee. Mixed pulping of kenaf and wood by kraft process. Rep. no. 9 on Class. Invest. no. 2, 1972. *CONFIDENTIAL*.

Key Words: Kenaf, Pulps, Wood pulp.

71-74/274

CHU, Chien, NIYOMWAN, Naiyana, and PUANGVICHIT, Anchalee. Chemical pulp from kenaf woody core. Rep. no. 10 on Class. Invest. no. 2, 1973. *CONFIDENTIAL*.

Key Words: Kenaf, Pulps.

71-74/275

CHU, Chien, NIYOMWAN, Naiyana, and PUANGVICHIT, Anchalee. Mixed pulping of kenaf and bagasse. Rep. no. 11 on Class. Invest. no. 2, 1973. *CONFIDENTIAL*.

Key Words: Kenaf, Pulps, Bagasse.

71-74/276

CHU, Chien, NIYOMWAN, Naiyana, and PUANGVICHIT, Anchalee. Mixed pulping of kenaf and rubberwood. Rep. no. 12 on Class. Invest. no. 2, 1973. *CONFIDENTIAL*.

Key Words: Kenaf, Pulps, Rubberwood.

71-74/277

CHU, Chien, NIYOMWAN, Naiyana, and PUANGVICHIT, Anchalee. Mixed pulping of kenaf and rice straw. Rep. no. 13 on Class. Invest. no. 2, 1974. *CONFIDENTIAL*.

Key Words: Kenaf, Pulps, Rice straw.

71-74/278

CHU, Chien, NIYOMWAN, Naiyana, and PUANGVICHIT, Anchalee. Newsprint from kenaf and rice straw. Rep. no. 14 on Class. Invest. no. 2, 1974. *CONFIDENTIAL*.

Key Words: Kenaf, Rice straw, Newsprints.

71-74/279

CHU, Chien, NIYOMWAN, Naiyana. and PUANGVICHIT, Anchalee. Chemical pulp from kenaf by two-stage bisulphite process. Rep. no. 15 on Class. Invest. no. 2, 1974. *CONFIDENTIAL*.

Key Words: Kenaf, Pulps.

71-74/280

CHU, Chien, NIYOMWAN, Naiyana, and PUANGVICHIT, Anchalee. Mixed pulping of kenaf, bamboo and other fibrous materials. Rep. no. 16 on Class. Invest. no. 2, 1974. *CONFIDENTIAL*.

Key Words: Kenaf, Pulps, Bamboos, Fiber crops.

71-74/281

CHU, Chien, UDOMSAKDHI, Banacha, and RAMANVONGSE, Sunanta. Preliminary investigation of kenaf seed oil. Rep. no. 1 on Misc. Invest. no. 50, 1973, 14 p.

Key Words: Vegetable oils, Kenaf seed oils.

Thai kenaf seed (*Hibiscus sabdariffa* var. *altissima*) gave 18% crude oil by solvent extraction with n-hexane. The oil had very small amount of free fatty acid ranging from 0.8 to 1.4%. Miscella refining of the oil with equal part of hexane was carried out with caustic soda at 60°C for 20 minutes. The refining loss was 2.9% for 1.3% free fatty acid. The soap stock with firm texture was 2.2% of the oil.

The neutral oil was treated with 5% citric acid at 150°C for 30 minutes at 1 mm Hg. This treatment effected inactivation of malvalic acid in the oil from 1.51% in the crude oil to 0.59% in the refined oil.

The seed meal from the solvent extraction was sieved to remove hull particles. The yield of screened meal was 50% of the crude meal. The protein content of the screened meal was 44%.
Authors.

Mangoes

71-74/282

TONGDEE, Sing Ching, and SRIVARDHANA, Aim-on. Fruit rot of mango during storage and its control. Rep. no. 1 on Res. Proj. 36/5, 1973, 6 p.

Key Words: Mangoes, Mangoes storage.

Wounds on mango fruits are required for initial penetration of *Botryodiplodia theobromae* and its subsequent development. Of the five major mango varieties tested, sweet varieties - nang klangwan and nam dokmai are more susceptible to the pathogen than the sweet-starchy type - thong dam and ok-rong; while phimsen-man, the starchy type, is least subject to attack.

The efficacy of different fungicides was compared. Benlate is the only effective fungicide tested. -Authors.

Peanuts

71-74/283

LOPITAKWONG, Rommanee. Preparation of high-protein peanut cookies. Rep. no. 1 on Res. Proj. 38/4, 1973, 17 p.

Key Words: Peanuts, Peanuts production, High protein feed.

High protein cookies of about 20% protein have been prepared from peanuts and other ingredients. Two forms of peanut were used: partially defatted peanut flour prepared by hydraulic pressing of the roasted peanut and peanut paste prepared from deskinning whole peanut. The cookies were well accepted by the children in the Municipal Day Care Centre and by ASRCT staff. -Author.

71-74/284

VISUTTIPITAKUL, Songkiat, and BOONKLINAJORN, Prapandh. Effect of variety and plant population on the yield of peanut. Rep. no. 1 on Res. Proj. 44/2, 1972, 9 p.

Key Words: Peanuts, Peanuts cultivation.

Three peanut varieties (Argentine, P.I. 161312, and Texas 206) were planted at the density of 26,800, 18,000 and 13,400 plants/rai (20 X 30 cm, 30 X 30 cm, and 30 X 40 cm spacing) at Khon Kaen Seed Multiplication Station and Non Sung Agricultural Experiment Station. Results of the study indicated that Argentine gave higher seed yield than P.I. 161312 and Texas 206 at Khon Kaen SMS, but it produced lower yield than the latter two at Non Sung AES. Texas 206 gave higher plant yield than P.I. 161312 and Argentine at both locations.

Closer spacing or greater plant population gave higher seed yield and plant yield than wider spacing or smaller plant population at both locations. However, it was also found that shelling percentage was not statistically influenced by variety and plant population under study. -Authors.

Roselle

71-74/285

CHEOWSAKUL, Ubolsri. Roselle syrup. (น้ำหวานกระเจี๊ยบชนิดร้อน) Rep. no. 2 on Res. Proj. 40/1, 1974, 7 p. (in Thai)

Key Words: Roselle, Roselle production, Beverages.

An experiment has been made to produce syrup from a fresh roselle fruit and to analyse bacteria for yearly preservation. If a prepared bottle is clean enough, and the remaining quantity of syrup kept in a refrigerator after some of it is being used, will be kept for a long span of time without deteriorating its flavour and test.

The raw material cost for production of roselle syrup is about 4 baht. One litre of roselle syrup will produce about 4 litres of drinking roselle. From the result of the experimental method of production and the raw material cost for production, it appeared that roselle syrup is one of the interesting products that can stimulate investors to make industrial investment in the country.-K.N.

Soybeans

71-74/286

CHOMCHALOW, Srivan. The effect of cobalt and peat inoculum on symbiotic nitrogen fixation of "S.J.2" soybean under aseptic condition. Rep. no. 5 on Res. Proj. 44/3, 1974, 6 p.

Key Words: Soybeans, Nitrogen fixation, Inoculation.

An experiment was conducted to study the effects of cobalt and peat inoculation on symbiotic nitrogen fixation of "S.J.2" soybean under the aseptic condition. Soybean was planted in Leonard's jars in a laboratory at ASRCT using CoCl_2 solution at the rate of 20, 200, and 400 mg of Co per kg of seeds, either applied directly to the seeds or mixed with the inoculum. The result indicated that the use of Co at 20 mg per kg of seeds prior to inoculation produced the highest yield of dry matter and nitrogen contents. The yield was reduced at the higher rate of Co. At 400 mg, without inoculum, Co was toxic to the plant. An easier practice was to mix Co with the inoculum prior to the application onto the seed, the optimum rate of Co was 200 mg per kg of seeds.-Author.

71-74/287

CHOMCHALOW, Srivan. Rhizobium - soybean symbiotic relationships. Rep. no. 6 on Res. Proj. 44/3, 1974, 10 p.

Key Words: Soybeans, Rhizobiaceae.

In order to study the relationships between the *Rhizobium* strains and soybean varieties, an experiment was conducted at ASRCT during January-March 1973 employing 3 varieties of soybean, namely SJ2, Acadian, and Taichung 12, inoculated with 6 strains of *Rhizobium* bacteria, CB1795, CB1809, US38, CN1, SPT and 15-7 strains. Three varieties of soybean were grown in pots filled with Yasothorn soil which has never been used to grow soybean before. They were then kept in the greenhouse until the end of the experiment. It was found that for SJ2 variety the most effective strain of *Rhizobium* was CB1795, the second and third ranks were US38 and SPT. For both Acadian and Taichung varieties the most effective was SPT and the runners up were CB1795 and US38. Regarding to soybean variety,

Taichung 12 gave the highest response in terms of dry weight but it is not significantly different from SJ2. As for *Rhizobium* strains, SPT was the most effective strain whereas CB1795 and US38 were the runners up. This study has the prime importance in selecting proper strains of *Rhizobium* for each variety of soybean.-Author.

71-74/288

CHOMCHALOW, Srivan, and NORMAN, Barry. A comparative study on the effectiveness of local and introduced *Rhizobium* strains on "S.J.2" soybean. Rep. no. 3 on Res. Proj. 44/3, 1971, 10 p.

Key Words: *Rhizobium japonicum*, Soybeans, Nitrogen fixation.

By modified "Leonard's jar" assembly, seven strains of introduced *Rhizobium japonicum* received from the United States (US 38, US 62, US 94, US 110, and US 112), and from Australia (CB 1795 and CB 1809) were inoculated onto "S.J. 2" soybean seeds in an attempt to compare the effectiveness of these introduced strains which have been known to be effective in inducing nodulation on foreign soybean varieties. A locally isolated strain from Chai Nat (CN 1) was also tested. It was found that strain CB 1795 was the best and strains US 38, US 110, and CB 1809 were equally effective on the bases of nodulation, dry weight per plant, and nitrogen uptake per plant. Strain CN 1 was effective in nodulation but its ability to fix atmospheric nitrogen was inferior to that of some of the introduced strains.-Authors.

71-74/289

PIRAMARN, Pradit. Effect of molybdenum levels and inoculants on soybean yield. Rep. no. 4 on Res. Proj. 44/3, 1972, 7 p.

Key Words: Soybeans, Inoculation.

The investigations were conducted in 1971 at Non Sung Agricultural Experiment Station and Khon Kaen Seed Multiplication Station. Four levels of Mo (0, 25, 50, and 100 g per rai) and three strains of inoculant (CB 1795, Chai Nat, and San Pa Tong) were used.

The studies showed that grain yield was increased at highly significant level by the inoculants at both locations. Chai Nat strain produced the most vigorous nodulation and gave the highest grain yield. No significant response in Mo application was shown at Khon Kaen Seed Multiplication Station, even though the 100 g per rai treatment gave the highest yield. Such a phenomenon was not seen at Non Sung Agricultural Experiment Station. No interaction between Mo and the inoculants was shown at both locations.-Author.

71-74/290

PIRAMARN, Pradit, and BOONKLINAJORN, Prapandh. A study on the effect of plant population on soybean grain yield. Rep. no. 2 on Res. Proj. 44/2, 1973, 8 p.

Key Words: Soybeans, Soybean cultivation.

The investigations were conducted both in rainy and dry seasons at Northeast Agricultural Center, Khon Kaen, and Non Sung Agricultural Experiment Station, Nakhon Ratchasima. Spacings of 15, 20, and 25 cm between hills, 50 cm between rows were used with 1, 2, and 3 plants per hill.

The results showed that soybean grain yield was increased when spacing between hills was closer. More plants per hill gave more grain weight per unit area. The experiments also showed that 50 X 15 cm spacing with 3 plants per hill gave more grain per hill than 50 X 20 cm spacing with 2 plants per hill as previously recommended. The difference, however, was not significant.-*Authors*.

Vegetable protein food

71-74/291

CHEOSAKUL, Ubolsri. Formulation of soya cookies. Rep. no. 1 on Class. Invest. no. 3, 1971. *CONFIDENTIAL*.

Key Words: Soybean production, High protein feed.

71-74/292

McGARRY, Michael G. Unicellular protein production using domestic wastewater. Rep. no. 1 on Res. Prog. 47, 1971, 13 p.

Key Words: Algae, Waste water, High protein feed, Animal nutrition.

Unicellular algae has been grown at the pilot plant scale in open ponds using nutrients derived from human wastes. After harvesting, the algae may be used as a dietary source of protein for chickens, swine, and cattle. This paper describes the overall process in terms of algal growth, concentration, dewatering, and drying.

Besides the availability of an inexpensive source of protein, several benefits may be accrued by the community using the algal production on wastes process. These are also described.-*Author*.

71-74/293

MEKSONGSEE, Lolita A., and SWATDITAT, Amornrat. Preparation of dehulled, defatted sesame flour. Rep. no. 1 on Res. Proj. 38/1, 1973, 12 p.

Key Words: Flours (food), Sesame.

Whole black sesame seeds were dehulled by alkali treatment. After grinding, oil was solvent-extracted with petroleum ether for 16 hours in the Soxhlet apparatus. The defatted meal was ground and either used directly or sifted to give the dehulled, defatted flour. Sifted or unsifted flour was also prepared from ground, polished white sesame seeds from which oil had been extracted.

The unsifted flour has about 50% protein at a moisture level of 6%. The hull accounts for 20% of whole sesame seed and about equal amounts (48%) of defatted meal and crude oil could be recovered from the dried, dehulled seed.-*Authors*.

71-74/294

MOLEERATANOND, Wiboonkiet. Development of protein-porridge from soybean. Rep. no. 1 on Class. Invest. no. 34, 1974. *CONFIDENTIAL*.

Key Words: Soybeans, High protein feed.

71-74/295

SUNDHAGUL, Malee, DAENGSUBHA, Wanchern, and SUYANANDANA, Puangpen. Thua-nao: a fermented soybean food of northern Thailand. II. Improved method of processing. Rep. no. 2 on Res. Proj. 38/3, 1973, 10 p.

Key Words: Soybeans, Soybean production, North Thailand, High protein feed.

Studies were made to find a suitable and more efficient method of producing a fermented soybean product called thua-nao. Whole soybeans were soaked in water prior to cooking, which was preferably accomplished by steaming under pressure. A bacterial culture of *Bacillus subtilis* N-8, isolated from native thua-nao, was used to ferment cooked soybeans. Fermented beans were then dried and ground into powder form which was palatable. The production yield of thua-nao powder was almost 90% based on the whole soybeans used. The product has more than 40% protein, one-third of which is in soluble form, and 20% of fat on the dry weight basis.-*Authors*.

71-74/296

SUNDHAGUL, Malee, DAENGSUBHA, Wanchern, and SUYANANDANA, Puangpen. Thua-nao: a fermented soybean food of northern Thailand. III. Development of a low-cost high protein food. Rep. no. 3 on Res. Proj. 38/3, 1973, 11 p.

Key Words: Soybeans, Soybean production, North Thailand, High protein feed.

A practical concept and approach to help solve the problem of supplying the nutritional requirements of the people with low income is proposed and demonstrated. It is to develop a cheap protein-rich food, which compares favourably in flavour and taste with locally existing food products in common use, from locally available basic commodities by technologically simple processes. The food developed is called "ferm-soy mix" and is in powder form. It contains thua-nao powder, which is a fermented soybean meal, as the major protein base constituent with added flavouring agents. The manufacture was limited to simple cooking, fermentation, drying, grinding, and mixing. The product is a basic high-protein food to which vitamins and minerals, if required, may be added. It is pre-cooked, ready to eat, with long shelf life under normal conditions, and intended mainly for that level of consumers who can seldom afford to buy the more sophisticated forms of high-protein food.-*Authors*.

71-74/297

SWATDITAT, Amornrat. Methods of manufacture of wheat noodles. Rep. no. 2 on Class. Invest. no. 8, 1973. *CONFIDENTIAL*.

Key Words: Wheat, Manufactures.

71-74/298

VARANGOON, Pivan. Development of soybean beverages. Rep. no. 1 on Class. Invest. no. 1, 1971. *CONFIDENTIAL*.

Key Words: Soybeans, Beverages.

71-74/299

VARANGOON, Pivan, and CHAVAKORN, Suwanna. Development of instant high-protein noodle. Rep. no. 1 on Class. Invest. no. 8, 1971. *CONFIDENTIAL*.

Key Words: High protein feed.

71-74/300

VARANGOON, Pivan, and LOPITAKWONG, Rommanee. Preparation of noodles from dehulled whole mung bean. Rep. no. 3 on Class. Invest. no. 8, 1974. *CONFIDENTIAL*.

Key Words: Mung beans, High protein feed.

71-74/301

VARDHANABHUTI, Sman, SUKHUMAVASI, Jiraporn, and LAUHASIRI, Pravat. A preliminary study of alcohol yields from glutinous rice and other carbohydrate sources. Rep. no. 1 on Res. Proj. 57/15, 1972, 17 p.

Key Words: Glutinous rice, Alcohols, Carbohydrates.

Preliminary study on the yield of alcohol was made with ordinary white rice, white glutinous rice, black glutinous rice, raw cassava, sorghum, corn, and molasses. The starchy materials were converted into fermentable sugars by commercial enzymes prior to the yeast fermentation. For the production of industrial alcohol by local distilleries under their existing conditions, molasses were found to be still the substrate of choice, but dry cassava would be another choice when molasses was in short supply. For beverage alcohol, sorghum and broken rice (both ordinary and glutinous) could be used with advantage. Corn and undermilled rice (both kinds) were found to be far too expensive for industrial alcohol production. Alcohol made from black glutinous rice has a special aroma peculiar to itself and may be useful for the production of a unique type of rice wine (spirit). Starch conversion by commercial enzymes is not practiced by the local industry and needs further study. -*Authors*.

Exploitation of natural products

Perfume and flavouring materials

71-74/302

LAWRENCE, Brian M., HOGG, James W., TERHUNE, Stuart J., and PICHEITAKUL, Nitasna. The essential oil of *Kaempferia pandurata* Roxb. Rep. no. 2 on Res. Proj. 11/1, 1971, 6 p.

Key Words: Essential oils, *Kaempferia pandurata*.

The constituents of oil of *Kaempferia pandurata* Roxb. have been identified and quantitatively estimated by gas-liquid chromatography.-*Authors*.

71-74/303

LAWRENCE, Brian M., HOGG, James W., TERHUNE, Stuart J., and PICHITAKUL, Nitasna. The essential oil of *Amomum globosum* Lour. Rep. no. 3 on Res. Proj. 11/1, 1971, 6 p.

Key Words: Essential oils, *Amomum globosum*.

The constituents of oil of *Amomum globosum* Lour. have been identified and quantitatively estimated by gas-liquid chromatography.-*Authors*.

71-74/304

MATTHEWS, W.S., and MUNSAKUL, Supatra. Preliminary appraisal of the essential oil from lemongrass (*Cymbopogon citratus*) commonly grown in Thailand. Rep. no. 1 on Res. Proj. 11/10, 1971, 7 p.

Key Words: Essential oils, Lemongrass, *Cymbopogon citratus*.

Lemongrass oil from takhrai, the local variety of *Cymbopogon citratus* growing in Thailand, may be of interest as a commercial product provided the citral content is above 75 per cent and production costs are competitive.-*Authors*.

Pharmaceuticals

71-74/305

JOHANSSON, Lars, KASHEMSANTA, M.L. Sathit, MOKKHAMMIT, Mongkol, NGARMWATANA, Watana, SAWASDIMONGKOL, Kamol, and SATRAWAHA, Prayuth. Pharmacological studies on the hypoglycemic activity of "Inthanin" (*Lagerstroemia speciosa* Pers.) leaves. Rep. no. 2 on Res. Proj. 17/7, 1972, 21 p.

Key Words: *Lagerstroemia speciosa*, Inthanin, Pharmacology, Medicinal plants.

Aqueous extracts of *Lagerstroemia speciosa* Pers. leaves were prepared by boiling the ground dry leaves with water. Tannin was then removed from the solutions. Both crude and tannin-free extracts were concentrated by vacuum evaporation. These were then given to rabbits orally and their blood sugar contents were determined at intervals. The results showed conclusively that neither the crude nor the tannin-free extracts thus prepared contained a useful level of hypoglycemic activity.-*Authors*.

71-74/306

JOHANSSON, Lars, NANDHASRI, Pranee, and LIMPINANTANA, Chalao. Preliminary study of a heart-active principle from *Salix tetrasperma* Roxb. (sanun). Rep. no. 1 (revised) on Res. Proj. 17/11, 1972, 16 p.

Key Words: *Salix tetrasperma*, Pharmacology, Sanun, Medicinal plants.

The leaves from *Salix tetrasperma* Roxb. have been extracted and the extracts fractionated by column and thin-layer chromatography. The fractions have been tested for heart activity on frog and turtle hearts. The crude extract shows increased cardiac tonus and rate, while some fractions show either increased tonus or rate. The chemical and physical properties of fractions resemble those of the well known heart glycosides. No acute toxic manifestations were observed when the crude extract and some fractions were tested on mice.-Authors.

71-74/307

MUNSAKUL, Supatra, and SAWASDIMONGKOL, Kamol. Extraction and fractionation of the active principle(s) of *Loranthus pentandrus* L. (Kafak-mamuang). Rep. no. 3 on Res. Proj. 17/4, 1972, 6 p.

Key Words: *Loranthus pentandrus*, Kafak-mamuang.

Crude extracts of *Loranthus pentandrus* L. leaves from Chon Buri were prepared and also dialyzed. The fractionation of dialyzate with silica gel (kieselgel 0.2-0.5 mm, E. Merck AG., Darmstadt, Germany) was attempted. Five different fractions were prepared and were tested for hypotensive activity on dogs. Two fractions showed significant effect on blood pressure.-Authors.

71-74/308

WASUWAT, Sasithorn, DISYABOOT, Pornsawan, CHANTARASCOMBOON, Prangkongsiri, NANDHASRI, Pranee, THARAVANIJ, Savanat, and NGAMWATANA, Wantana. Study on antiamebiasis property, *in vitro*, of the extracts of *Brucea amarissima* (Lour.) Merr. (Ratchadat). Rep. no. 2 on Res. Proj. 17/10, 1973, 14 p.

Key Words: *Brucea amarissima*, Ratchadat, Antiamebiasis.

Laboratory investigation showed that extracts of the fruits of *Brucea amarissima* possess antiamebic property, *in vitro*, against *Entamoeba histolytica*. One active fraction at 1.3 mg/ml concentration gave an amoebicidal effect equivalent to that of 0.7-0.8 mg/ml 2-dehydroemetine dihydrochloride injection (Roche). Preliminary study on acute toxicity of the active fraction, on albino mice, was made; it was found that the LD₅₀ was 184.4 mg/kg body weight (mouse) compared with 59.82 mg/kg (mouse) for 2-dehydroemetine dihydrochloride. Another isolated fraction possesses high toxic property; its LD₅₀ was 7.1 mg/kg body weight (albino mouse) and its amoebicidal effect at 0.25 mg/ml concentration was equivalent to that of 2-dehydroemetine dihydrochloride at 0.8 mg/ml. The yield of active fraction was 0.075%, based on dried raw fruits.-Authors.

71-74/309

WASUWAT, Sasithorn, DISYABOOT, Pornsawan, CHANTARASCOMBOON, Prangkongsiri, PAN-URAI, Ratanasuda, MOKKHAMMIT, Mongkol, and SATTAVANA,

Prayuth. Study on antidysentery and antidiarrhea properties of extracts of *Brucea amarissima*. Rep. no. 1 on Res. Proj. 17/10, 1971, 13 p.

Key Words: *Brucea amarissima*, Ratchadat, Antidiarrheals, Anti-dysentery.

Laboratory investigation showed that extracts from the kernel of *Brucea amarissima* possess antibacterial action, *in vitro*, against *Shigella shiga*, *Shigella flexneri*, *Shigella boydii*, *Salmonella lexington*, *Salmonella derby*, *Salmonella typhi* Type II *Vibrio cholera inaba* and *Vibrio cholera ogawa*. Extracts from the pericarp do not possess antibacterial action against these test bacteria. The methylene chloride soluble fraction, derived from the methanol extract of *Brucea amarissima* kernel, has the highest antibacterial activity against *Shigella shiga*, *in vitro*, and the smallest LD₅₀ in albino mice. By TLC of the methylene chloride soluble fraction, several substances could be separated. Further study of the extracts is continuing.-Authors.

71-74/310

WASUWAT, Sasithorn, and DISYABOOT, Pornsawan. Improved technique for producing uniform colour on certain drug and vitamin coating tablets. Rep. no. 1 on Class. Invest. no. 18, 1974. CONFIDENTIAL.

Key Words: Drugs, Vitamin.

Pulp materials other than kenaf

71-74/311

CHU, Chien, NIYOMWAN, Naiyana, and PUANGVICHIT, Anchalee. Pulp and paper from *Casuarina equisetifolia* wood. Rep. no. 1 on Misc. Invest. no. 64, 1972, 8 p.

Key Words: Pulps, Papers, *Casuarina equisetifolia*, Pulpwood.

Pulping hardwood, *Casuarina equisetifolia*, was investigated with three processes. The magnesite process with 18% SO₂ at 150°C for 4 hours gave 52% yield. The pulp was bleached to 94% brightness with 9% chlorine in DC/E/D-H sequence. The bleached pulp has good quality featuring tearing factor of 105. Kraft pulping with active alkali 16.85% total Na₂O and 27% sulphidity at 160°C for 2 hours gave 47% yield. The pulp was bleached to 88% brightness with 8% chlorine in DC/E/D sequence. The pulp has better strength. Polysulphide pulping at 175°C for ½ hour with active alkali 20.2% total Na₂O, 39% sulphidity, and 1.5% sulphur, with subsequent MnO₂ oxidation gave 46% yield. Bleaching with 9% chlorine gave 88% brightness with the best strength featuring tearing factor 151, burst factor 58, breaking length 7,282 m, and folding endurance 384.-Authors.

71-74/312

CHU, Chien, NIYOMWAN, Naiyana, and PUANGVICHIT, Anchalee. Pulp and paper from sorghum (*Sorghum vulgare*). Rep. no. 2 on Misc. Invest. no. 64, 1972, 9 p.

Key Words: Pulps, Papers, Sorghum, *Sorghum vulgare*.

Stalks of sorghum (*Sorghum vulgare*) were shredded and converted into pulp by neutral sulphite process. The cooking yield was 55% and bleached yield 46% on raw material. Pulping was done with 16.0% sodium sulphite and 2.5% sodium bicarbonate on raw material for 2-hour cooking at 170°C with liquor ratio at 3:1. The crude pulp was refined and bleached to 86% brightness with 7% chlorine in C/E/H bleaching sequence. The bleached yield attained 87% on unbleached pulp. The bleached pulp tested at 430 ml S-R freeness has good quality with tear factor 85, breaking length 7,334 m, and burst factor 39. -Authors.

71-74/313

CHU, Chien, NIYOMWAN, Naiyana, and PUANGVICHIT, Anchalee. Pulp and paper from bamboo grass (*Arundinaria pusilla*). Rep. no. 3 on Misc. Invest. no. 64, 1972, 4 p.

Key Words: Pulps, Papers, Bamboo grass, *Arundinaria pusilla*.

Sodium bisulphite pulping of bamboo grass (*Arundinaria pusilla*) with 23% sodium bisulphite at 150°C for 4½ hours gave 55% pulp. Bleaching the pulp to 80% brightness with 8% chlorine in C/E/H sequence produced bleached yield of 83% on the unbleached pulp. Physical test of handsheets from the bleached pulp at 450 ml S-R freeness gave breaking length 4,975 m, burst factor 28, folds 85 and tear factor 102. -Authors.

71-74/314

CHU, Chien, NIYOMWAN, Naiyana, and PUANGVICHIT, Anchalee. Pulping of castor (*Ricinus communis*) stalks. Rep. no. 4 on Misc. Invest. no. 64, 1973, 8 p.

Key Words: Pulps, Castor beans stalks, *Ricinus communis*.

Castor stalks (*Ricinus communis*) as a by-product in castor bean production could be a good raw material for pulp and paper. Three processes for pulping the stalks were explored. Soda pulping with 20% caustic soda at 170°C for 2 hours gave 48% yield. Bleaching to 86% brightness was attained by 9% available chlorine in C/E/H bleaching sequence. The bleached pulp with a yield of 37% on chips has soft quality and good opacity. Kraft pulping with 16% caustic soda and 5% sodium sulphide at 150°C for 3 hours gave 44% yield. Bleaching to 80% brightness with 8% available chlorine in C/E/H sequence gave 88% bleached pulp or 39% on chips. The bleached kraft pulp has better strength than the soda pulp. Castor stalk chips gave high yield of pulp at 66% on chips by neutral sulphite pulping with 16% sodium sulphite and 3% sodium bicarbonate at 170°C for 2½ hours. The pulp with 41% brightness has good strength and can be used for liner board. -Authors.

71-74/315

CHU, Chien, UDOMSAKDI, Bancha, NIYOMWAN, Naiyana, and PUANGVICHIT, Anchalee. Pulping of Columbus grass (*Sorghum almum*), Napier grass (*Pennisetum purpureum*), and reed (*Phragmites karka*). Rep. no. 5 on Misc. Invest. no. 64, 1973, 6 p.

Key Words: Pulps, Columbus grass, *Sorghum almum*, Napier grass, *Pennisetum purpureum*, Reed, *Phragmites karka*.

Pulping Columbus grass (*Sorghum almum*) by kraft process and neutral sulphite process was compared. The neutral sulphite process appeared to give a better pulp. A cooking yield of 50% was obtained by pulping the grass at 170°C for 2 hours with 16% sodium sulphite and 3% sodium bicarbonate based on the grass. Bleaching the pulp with 6% available chlorine gave a bleached yield of 87.8% on the pulp or 44% on the grass. The bleached pulp has good opacity, excellent formation and high brightness of 83%

The pulp with high initial freeness of S-R 820 ml was beaten to S-R 430 ml in 4 minutes and showed good strength in handsheets evaluation, featuring breaking length 5,629 m, tear factor 66, folding endurance 85, and burst factor 33.

Pulping *Phragmites karka* reed in the same way as Columbus grass gave similar results except lower strength.

Napier grass (*Pennisetum purpureum*) was tried in pulping. The result was inferior to those obtained with the above two raw materials. -Authors.

71-74/316

KASHEMSANTA, M.L. Sathit. A pre-feasibility study for the established of a rubberized coir fibre plant. Rep. no. 1 on Class. Invest. no. 24, 1973. CONFIDENTIAL.

Key Words: Coir fibers, Fiber crops.

Chemical industry

71-74/317

LAWRENCE, Brian M., HOGG, James W., TERHUNE, Stuart J., and PICHITAKUL, Nitasna. The chemical composition of *Ocimum basilicum* and *Ocimum sanctum*. Rep. no. 1 on Res. Proj. 11/4, 1971, 20 p.

Key Words: Chemical composition, Horapha, *Ocimum basilicum*, Kaphrao, *Ocimum sanctum*.

The constituents of horapha (*Ocimum basilicum* L.) and kaphrao (*Ocimum sanctum* L.) have been identified and quantitatively estimated by gas-liquid chromatography. Furthermore a comparison of the chromatograms obtained from four phenotypic varieties of *O. basilicum* and one variety of *O. sanctum* were made. -Authors.

71-74/318

MUNSAKUL, Supatra. Preparation of Thai licorice. Rep. no. 1 on Misc. Invest. no. 60, 1973, 4 p.

Key Words: Licorice, *Albizzia myriophylla*, *Glycyrrhiza glabra*.

Thai licorice powder was prepared by crushing and grinding the woody part of a local species, *Albizzia myriophylla* Benth.,

while the imported licorice is derived from another species, *Glycyrrhiza glabra*. The ground wood was wetted with hot water and percolated with boiling water. The extracted liquor was concentrated by evaporation on a steam bath to produce a very viscous liquid. It was concentrated further in vacuum oven, and the powder of licorice was finally obtained. The yield of crude extract was about 18-20%. Determination of the properties of the powder, essential in tobacco blending, was made, and they were compared with those of the imported licorice. The Thai licorice properties were found to be very similar to those of the imported licorice.-
Author.

71-74/319

MUNSAKUL, Supatra, and UDOMSAKDI, Banacha. Extraction of wax from Thai lignite. Rep. no. 1 on Misc. Invest. no. 53, 1973, 7 p.

Key Words: Waxes, Lignite.

The contents of wax from three known lignite deposits (Li, Mae Mo, and Krabi) were studied. Laboratory Soxhlet extraction at the boiling point of various solvents were carried out. Of the solvents tried, a mixture of benzene and ethanol (50:50) was found to be the best. All crude extracts were black in colour. The effect of particle size was also investigated. The yields of crude extract were 0.9 - 4.8% (Li lignite), 0.64 - 3.00% (Mae Mo lignite), and 0.88 - 3.50% (Krabi lignite). The yields of crude wax were very low, and therefore only the crude was from Li Lignite was refined and bleached.-*Authors.*

71-74/320

STHAPITANONDA, Kannika, BUSAYASAKUL, Naronchai, and UDOMSAKDI, Banacha. Preparation of dicyclopentadiene modified rubber-seed oil. Rep. no. 1 on Class. Invest. no. 26, 1973. *CONFIDENTIAL.*

Key Words: Rubber seed oils.

71-74/321

UDOMSAKDI, Banacha, MUNSAKUL, Supatra, and STHAPITANONDA, Kannika. Potential value of rubber seed. Appraisal Rep. no. 26, 1973, 12 p.

Key Words: Rubber seeds, Rubber cultivation.

Rubber cultivation is one of the major activities of Thailand. Calculation, based on the total area of cultivation, indicates a large yearly tonnage of rubber seed. Only a small fraction of the seeds has been commercially exploited for oil and meal, while its bulk has been wasted. Thailand is importing finished or semi-finished products to meet her demand, at a substantial cost to the country. Many imported products, derived from or related to oil-seed, can be easily manufactured locally using indigeneous rubber seeds as raw material. Various potential fields of application of rubber seed have been carefully studied and the economic importance of rubber seed is clearly shown.-*Authors.*

71-74/322

MUNSAKUL, Supatra, and UDOMSAKDI, Banacha. A study of the flavour stability of bovine tallow. Rep. no. 1 on Class. Invest. no. 33, 1974. *CONFIDENTIAL*.

Key Words: Tallow.

Minerals and metals industry

Foundry

71-74/323

KNUDSEN, L.S. A technique for the manufacture of cast gem lapping discs. Rep. no. 1 on Class. Invest. no. 10, 1971. *CONFIDENTIAL*.

Key Words: Gems, Manufactures, Polishing.

Minerals

71-74/324

OVERGAARD, Jens, and POTHISRI, Ladawal. Grain size and chemical analysis of Thai laterites. Rep. no. 1 on Misc. Invest. no. 57, 1972, 11 p.

Key Words: Laterites, Chemical analysis, Saraburi, Chon Buri.

Samples of lateritic soils are taken from Saraburi and Chon Buri; and distribution of grain size and chemical composition in respect of SiO_2 , Al_2O_3 , and Fe_2O_3 are compared.-*Authors*.

71-74/325

POTHISRI, Ladawal. Evaluation of certain properties of clay for paper manufacture. Rep. no. 1 on Class. Invest. no. 13, 1973. *CONFIDENTIAL*.

Key Words: Clays, Paper industry.

71-74/326

POTHISRI, Ladawal. Quality assessment of shanks sanitary wares. Rep. no. 1 on Class. Invest. no. 20, 1973. *CONFIDENTIAL*.

Key Words: Sanitary engineering.

Tinplate

71-74/327

KNUDSEN, L.S. Study of lacquer adhesion on locally lacquered tinplate. Rep. no. 1 on Misc. Invest. no. 42, 1971, 5 p.

Key Words: Tin coating, Lacquers, Adhesion.

Tests show, that lacquer adhesion on electrolytic tinplate lacquered by two companies in Thailand is comparable to that of imported lacquered electrolytic tinplate from Japan, whereas the lacquer adhesion on hot-dipped tinplate lacquered by two other companies appears to be unacceptable. However, more tests on samples using different lacquer condition on preferably the same type of tinplate should be made for more conclusive findings. -*Author*.

71-74/328

KNUDSEN, L.S., and RIEBROICHAROEN, Suwat. Study of lacquer coating on hot-dipped tinplate. Rep. no. 1 on Class. Invest. no. 9, 1971. *CONFIDENTIAL*.

Kwy Words: Tin coating, Lacquers.

Building industry

71-74/329

BALAJIVA, Kasem, and KNUDSEN, L.S. Premature fracture in ribbed reinforcement bars. Rep. no. 1 on Misc. Invest. no. 46, 1971, 6 p.

Key Words: Reinforcement bars, Steels, Fractures (materials), Construction materials.

A local steel manufacturer producing ribbed reinforcement bars found a substantial amount rejected by customers due to cracks and fracture of the bars upon restraightening before use. Investigation showed that the failure was caused by interaction between a too high tin content, which increased the notch sensitivity, and the undercut at the base of each rib. The effect is probably accentuated by a relatively high carbon content. If these unfavourable conditions are avoided, no failure are believed to occur. -*Authors*.

71-74/330

HANSEN, Finn, and SAMREJPRASONG, Suddhisakdi. Investigation of the construction techniques of ferro-cement vessels. Rep. no. 1 on Res. 21/15, 1971, 11 p.

Key Words: Ferro-cement, Ships, Construction materials.

The construction techniques from available literature were examined with a view to industrial application in Thailand.

Recommendations are offered for improvement of the technique employed in the construction of ferro-cement barges. -*Authors*.

71-74/331

HANSEN, Finn, and SAMREJPRASONG, Suddhisakdi. Investigation of the effect of distribution and amount of reinforcement on the physical properties of ferro-cement. Rep. no. 2 on Res. Proj. 21/14, 1971, 25 p.

Key Words: Ferro-cement, Construction materials.

The working strength of ferro-cement in relation to distribution and amount of reinforcement is established in order to facilitate design. The working strength is defined as the strength corresponding to the load of first deviation from a linear load-deflection diagram. The investigation reveals that this strength increases sharply as the average wire spacing decreases below 4-5 mm, indicating that below this critical wire spacing all potential cracks are contained between adjacent wires.

Promising results were obtained from tests on panels reinforced with shorth lengths of wires mixed into the mortar, suggesting wide structural application of this material where crack controlling characteristic is of importance such as in flexible pavements, marine structures, hulls and liquid containers.-*Authors.*

71-74/332

HANSEN, Finn, and SAMREJPRASONG, Suddhisakdi. The strength of joints in P.S. block wall. Rep. no. 1 on Misc. Invest. no. 44, 1971, 7 p.

Key Words: Construction materials, Concrete blocks, Joints (junctions)

The use of specially shaped concrete blocks for the building of domestic dwellings can greatly reduce cost and time of construction. The compressive strength of the mortar joint which is a critical factor for the strength and stability of the final structure was investigated. The results indicate that although the compressive strength of the individual P.S. block is lower than the value specified by ASTM, the strength of the joint is substantially higher than the ASTM standard value. The reason for this behaviour is attributed to the tongue-and-groove design of the block.-*Authors.*

71-74/333

KAMPEMPOOL, Smith, and DISATHIEN, Preecha. Ferrocement reinforced with short wires. Rep. no. 1 on Res. Proj. 21/18, 1974, 14 p.

Key Words: Ferro-cement, Construction materials.

The investigation was performed in two stages. The first stage is to determine the optimum wire length based on the strength of the slab. The second stage is to establish the wire size to yield the maximum strength of the test piece.

A set of impact test and bending test have been applied to the slabs. A conclusion can be drawn that No. 19 gauge wire of 5 cm in length gives the highest impact resistance and bending strength.-*Authors.*

71-74/334

KIRKENDALE, G.A., and POTHISRI, Ladawal. Preliminary investigation of clay properties for building brick and sewer pipe. Rep. no. 1 on Res. Proj. 61/1, 1973, 63 p. *CONFIDENTIAL.*

Key Words: Clays, Bricks, Construction materials, Sewer pipes.

71-74/335

KNUDSEN, L.S., and RIEBROICHAROEN, Suwat. Die and roller steels for pelletizing tapioca. Rep. no. 1 on Misc. Invest. no. 49, 1971, 6 p.

Key Words: Pelleting, Machine tools, Cassava starch.

By examination of original imported spare parts for pelletizing machines, the types of steel used and the heat treatment applied in the manufacture of the die and roller have been determined. Based on the findings appropriate recommendations on the manufacture have been given. -*Authors.*

71-74/336

KNUDSEN, L.S., and RIEBROICHAROEN, Suwat. Study of the mechanical properties of steel plate for liquefied petroleum gas containers. Rep. no. 1 on Misc. Invest. no. 47, 1971, 4 p.

Key Words: Steels, Gas containers.

The investigation shows that the low ultimate tensile strength of the steel found by quality control testing at the factory, is not caused by the manufacturing process but is due to an initial too low strength of the raw material. It is recommended, that only steel sheets which qualify the specification should be used for the gas container manufacture. -*Authors.*

71-74/337

OVERGAARD, Jens, and SUKAPADDHANADHI, Narong. Elementary mix design technique. Rep. no. 1 on Res. Proj. 21/6, 1973, 15 p.

Key Words: Concretes.

A relatively simple method of designing concrete mix to obtain a concrete that matches given requirements, both in the soft and the hardened state, is described. It emphasises on showing contractors and manufactures of concrete and concrete products how to control the various properties of concrete. The report is not intended to give recipes for different set mixes. This, on the other hand, should enable users to design and, where necessary, to adjust concrete mixes to meet specific requirements

As some of the diagrams reflects results from a limited number of laboratory experiments, users are encouraged to plot results obtained from their practical work in the diagrams and, where necessary, adjust the diagrams to match their own experience. -*Authors.*

71-74/338

OVERGAARD, Jens, and SUKAPADDHANADHI, Narong. Ferrocement roofing element. Rep. no. 1 on Res. Proj. 21/17, 1973, 14 p.

Key Words: Ferrocement, Construction materials.

An investigation of ferrocement application for self-supporting roofing elements of long spans, and its suitability for prefabrication in mould.

A prototype element was made in a wooden mould. The design was a folded plate type with a W-shape section. It's span was 7.00 m and it's width was 1.20 m. Thickness was 20-25 mm with 6 layers of gauge 25 galvanized "chicken mesh" and 6 mm bars centre reinforcement.

The reinforcement was bent and tied primary to being placed for plastering in the mould. Plastering proved very difficult, although a pneumatic vibrating trowel was used. Ultimate bending strength was very high equivalent to a load of 600 kg/m² roofing area. The deflection at the critical load was about 1/130 of the span. -Authors.

71-74/339

OVERGAARD, Jens, and SUKAPADDHANADHI, Narong. Ferrocement roofing element II. Rep. no. 2 on Res. Proj. 21/17, 1973, 12 p.

Key Words: Ferrocement, Construction materials.

In extension of the previous test on ferrocement roofing, another element was made in the same mould but only 18 mm thick and without transverse reinforcement bars. The wire mesh reinforcement which is the most costly item of the material components was reduced to 3 layers only. This was done to reduce the cost of materials as well as labour inputs.

Due to the simplicity of the reinforcement it was not necessary to tie it together before placing in the mould. Mesh and longitudinal bars could be placed directly in the mould and they were only tied where the mesh was not flat enough to fit to the sides of the mould. Bars were held in place by stretching and fastening them at each end of the mould. In comparison with previous experience this technique proved considerably easier. Also the plastering was greatly facilitated by the more open reinforcement in this element. It took only one fifth of the time that was spent on plastering the previous element which was more heavily reinforced. This meant that the whole 7.30 X 1.20 m element could be plastered in one operation, thus avoiding cold joints. As in the previous test a vibrating trowel was used. This seems essential for a good compaction.

The element was exposed to a load test after 21 days curing under wet gunny bags, and it collapsed due to lacking stability of the sides at midspan. The load at the critical load was equivalent to an evenly distributed pay-load of 360 kg/m² on a 7.00 m span. Related to the requirements of the building practice in Thailand of 50 kg/m² this means the factor of safety was 7. -Authors.

71-74/340

POTHISRI, Ladawal. Cause of cracking of Sleeve Brick L-6. Rep. no. 1 on Class. Invest. no. 19, 1973. CONFIDENTIAL.

Key Words: Bricks, Construction materials, Cracking (fracturing).

71-74/341

SAMREJPRASONG, Suddhisakdi. Investigation of the effect of aggregate on the physical properties of ferrocement. Rep. no. 1 on Res. Proj. 21/16, 1973, 10 p.

Key Words: Ferrocement, Construction materials, Sand.

Sand from Rayong, as an aggregate in mortar, is hitherto most promising and suitable to be used in future ferrocement application since it has given the highest density, compressive strength and modulus of rupture to the ferrocement test specimens. In addition, the grain size of such sand in natural state appears to be fairly well graded which, consequently, minimizes the cost of sand preparation.

On the other hand, Ratchaburi sand has proved to possess a little lower quality than that from Rayong. However, Ratchaburi sand is readily available in Bangkok market at a lower price. Therefore, for common ferrocement work like boat construction, economical advantages could be gained by using the sand from Ratchaburi.-*Author.*

71-74/342

VIETMEYER, Noel D., KAMPEMPOOL, Smith, NUTALAYA, Siengtong, DISATHIEN, Preecha, and PATARAGETVIT, Sampao. "Thailo" ferrocement rice bin. Rep. no. 1 on Res. Proj. 21/19, 1973, 10 p.

Key Words: Rice bin, Ferrocement, Thailo, Construction materials.

A review has been made of the status of research and development work conducted in Thailand on the construction and use of ferrocement for grain storage. Four-year storage test has proved successful application of "Thailo" for rice with practically no damage due to insects, birds, and fungi. Further study should be made to transfer this technology to actual application at the farmers' level. The result so far obtained indicated potential application not only in Thailand but also in other countries facing similar storage problems.-*Authors.*

Physics and engineering

Computerized structural engineering

71-74/343

SUNTORNPALIN, Jitjaroen. A computer subroutine subprogramme for forming stiffness matrix for triangular elements with linear varying strain. Rep. no. 1 on Res. Proj. 46/3, 1972, 21 p.

Key Words: Computer programmes, Structural analysis.

The technical report covers important details concerning the generation of the subroutine subprogramme TRIANG for forming the stiffness matrix for a triangular membrane shell element. The subprogramme is coded in Fortran IV. The condition of material homogeneity is only to be fulfilled within each elements, but it is permitted to vary from element to element. It can be treated like an ordinary subroutine packet which can be combined with any Fortran IV calling programme in the normal way. TRIANG is especially recommended for use in analysing ferro-cement constructions as well as other plate structures made of anisotropic and inhomogeneous materials where the out-of-plane bending does not exist.-*Author.*

71-74/344

SUNTORNPALIN, Jitjaroen, and DISATHIEN, Preecha. A computer sub-system programme for analysing large complex structures. Rep. no. 2 on Res. Proj. 46/2, 1971, 35 p.

Key Words: Computer programmes, Structural analysis.

A computer subsystem programme based on the so called "condensed stiffness matrix displacement method" is described. By making use of the method, a large complex structural system may be analysed on a relatively small computer. Internal data transfer in binary form may occur between the CPU-main storage and auxiliary storage units at certain points during the execution. Owing to this necessity, the programme is therefore not suitable for analysing small structures, since longer computation time will be required than using the original mainline or even the mainline version I.

Data preparation is described in detail so that an unskilled analyst can do it by himself without any difficulty even for the analysis of a complicatedly built-up structural system.

The subsystem is composed of two parts: the mainline and the subprogramme. The subprogramme part is composed of a number of system subroutines combined together. When different categories of structural system are to be analysed, only the subprogramme part is required to be changed accordingly whilst the mainline remains the same. In this manner the system programme will be expanded as required by adding to it more subroutines. These subroutines are developed from finite element of suitable geometrical forms. Thus, when suitable subroutines are developed for sophisticated structural systems, such as thick and thin shells of arbitrary form, the system will be capable of analysing highly complex structures, e.g., aircraft, boat, ship, hyperbolic paraboloid shells, dam, colling tower, silo, steel converter vessel, bio-mechanics problems, etc.-*Authors.*

Solar and terrestrial physics .

71-74/345

BHAVILAI, Preda, and PATANAVANICH, Sacran. Photospheric observations during April-June 1970. Rep. no. 15 on Res. Proj. 4/1, 1971, 8 p.

Key Words: Photosphere.

The solar activity in the southern hemisphere decreased rapidly in June 1970. Active latitudes in the northern hemisphere were 16-18°. Sunspots in the southern hemisphere were in lower latitude than those in the northern hemisphere. The condition of seeing was rather poor.-*Authors.*

71-74/346

BEAVILAI, Preda, and PATANAVANICH, Sacran. Photospheric obser-

vations during July-September 1970. Rep. no. 16 on Res. Proj. 4/1, 1971, 8 p.

Key Words: Photosphere.

(1) Most sunspot groups of class E appeared in the northern hemisphere, only one group was in the southern hemisphere in early July. The northern hemisphere was therefore more active than the southern hemisphere. The whole activity was still as it was in the former period.

(2) Sunspots in the northern hemisphere occurred in higher latitudes than those in the southern hemisphere. Five large sunspot groups of this period occurred in latitudes 17-22° and two groups occurred below latitudes 10° in the northern hemisphere while one large group in the southern hemisphere was at latitude 10°.

(3) Mean seeing was poor.-*Authors.*

71-74/347

BHAVILAI Freda, and PATANAVANICH, Sacran. Photospheric observations during October-December 1970. Rep. no. 17 on Res. Proj. 4/1, 1971, 8 p.

Key Words: Photosphere.

(1) There was no large sunspot group in the southern hemisphere during this period. So far it is shown that there is an unsymmetry in the activity in the two hemispheres. The northern hemisphere is always more active than in the southern hemisphere except during the period of January to May 1970 which is the period of the maximum phase of the activity in the southern hemisphere. The whole activity was still the same as in the previous period.

(2) The active latitudes in the northern hemisphere in this period were lower than during the last period. There was one large group at latitude 19° in late October, the others were at latitudes 12-14° and 4°. The large group of class F at latitude 14° N and longitude 34° in the middle of November disappeared at the west limb by the solar rotation on 22 November and reappeared on 5 December at the east limb. It lasted on the solar disk for more than 1½ rotations.

(3) Mean seeing was poor, especially in December there were six cloudy days when observations were impossible.-*Authors.*

I I. O T H E R T O P I C S

Agriculture

71-74/348

BOONKLINKAJORN, Prapandh, and DURIYAPRAPAN, Soonthorn. An observation on the adaptability of forage species under dipterocarp forest conditions. Rep. no. 2 on Misc. Invest. no. 36, 1973, 7 p.

Key Words: Forestry, Forage crop, *Digitaria longiflora*.

Thirty species of forage crops were subjected to a preliminary trial to study their adaptability under dipterocarp forest conditions. The trial was carried out at ASRCT Sakaerat Experiment Station in Pak Thong Chai, Nakhon Ratchasima from June 1971 to October 1972. The study revealed that *Digitaria longiflora* (Retz.) Pers., green panic, guinea, hamil guinea, Napier, ruzi, two varieties of signal, zacate of the grass species stylo (var. Q 8558) of the legume species showed satisfactory adaptability to such conditions. -Authors.

71-74/349

BOONKLINKAJORN, Prapandh, and DURIYAPRAPAN, Soonthorn. Studies on Townsville stylo. Rep. no. 2 on Res. Proj. 41/1, 1972, 5 p.

Key Words: Townsville stylo.

A yield trail of five varieties of Townsville stylo (*Stylosanthes humilis*) was repeated at the Non Sung Agricultural Experiment Station in 1971. The trial revealed exactly the same result as that obtained from the first trial in 1970, i.e. Gordon, producing 1865 kg/rai of dry matter, outyielded the other four varieties, Pak Chong, Unknown, and Lawson, producing 1180, 1053, and 940 kg/rai respectively, were runners up, while Greenvale gave the lowest yield of 658 kg/rai. A separate study also showed that two cutting produced much higher yield than one cutting. The increased ranged from 29% as seen in Gordon to 170% in Pak Chong. -Authors.

71-74/350

BOONKLINKAJORN, Prapandh, DURIYAPRAPAN, Soonthorn, and PRAYOONWONG, Chuchawan. Low-profile vegetation for base perimeters. Rep. no. 1 on Class. Invest. no. 12, 1972. CONFIDENTIAL.

Key Words: Vegetation.

71-74/351

DURIYAPRAPAN, Soonthorn, and BOONKLINKAJORN, Prapandh. Chemical control of ya-phet. Rep. no. 1 on Misc. Invest. no. 36, 1972, 7 p.

Key Words: Ya-phet, *Arundinaria pusilla*, Herbicides.

Chemical control of ya-phet (*Arundinaria pusilla*) was investigated at Sakaerat Experiment Station from June to December 1971.

The herbicides used were Lalapon, Gramevin, Dowpon, aminotriazole, Gesaprim, Gesapax, Cyconate, 2, 4, 5-T, Karmex and Hyvar-X. The study revealed that Lalapon at 1 kg/rai, Gramevin at 1 kg/rai, Dowpon at 2 kg/rai, 2, 4, 5-T at 1.25 l/rai, and Cyconate at 1 l/rai were conclusively effective.-*Authors.*

71-74/352

KRITTAYANAWACH, Prawit, CHANJANAKIJSKUL, Jiraporn, and NORMAN, Barry. Effects of nitrogen application, spacing, and planting method on two varieties of sunflower. Rep. no. 1 on Res. Proj. 52/2, 1974, 42 p.

Key Words: Sunflowers, Fertilizer applications, Sunflower cultivation.

Two varieties of sunflower, Saratovskij and Sunfola have been studied on the effects of nitrogen fertilizer application, spacing, and planting method at Central Region Agricultural Centre at Chai Nat from February to June 1972. It was found that Saratovskij out-yielded Sunfola in grain yield, good seed weight, 100 good seed weight, size of head and plant height. Single row/ridge planting produced good seed weight, 100 good seed weight, size of head and plant height better than double rows/ridge, but the latter gave more grain yield than the former. Spacing between plants at 6.25 cm apart produced better grain yield, good seed weight, 100 good seed weight, and size of head than those at 12.5 and 25 cm apart. Both varieties demonstrated significant gave responses to N fertilizer at 100 and 50 kg/ha.-*Authors.*

71-74/353

WICHAPAN, Kwanyeun, and CHOMCHALOW, Narong. Preliminary study on the pre-emergence selectivity of seven herbicides in jute. Rep. no. 9 on Res. Proj. 1/4, 1972, 3 p.

Key Words: Jute, Herbicides.

Two doses of seven pre-emergence herbicides tested no jute showed no selectivity against weed species. Nitratin, the compound that ranked first, caused the germination of jute seeds to be significantly lower than the control.-*Authors.*

Science policy studies

71-74/354

GLYDE, Henry R. Institutional links in science and technology - the case of the United Kingdom and Thailand. Rep. no. 1 on Res. Proj. 55/5, 1973, 63 p.

Key Words: Institutional links, Sciences, Technology, United Kingdom, Thailand.

There are 16 bilateral links in science and technology between institutions in the United Kingdom and Thailand. Links initiated by direct contact between individuals in the respective institutions

tended to be more successful than those initiated by a third body. Links in which the objectives were set within the DC institution tended to be more successful. There was no apparent relation between the nature and field of link activity and link success. Links tended to be more successful if the AC personnel visited repeatedly (mainly for short visits) in small numbers rather than for a continuous long period in a group. Links were more successful when the overseas training was integrated with the AC technical assistance visits. Links involving core funded AC institutions tended to be more successful. The more successful links were associated with DC institutions having a strong and enthusiastic management. Small link programmes tended to be more successful than large ones. No one single factor predominantly differentiated the successful from the less successful links.-R.K.

Environmental and ecological studies

Bird studies

71-74/355

McCLURE, H. Elliott. Annual progress report 1970. Annual progress rep. 1970 on Res. Prog. 24, 1971, 18 p.

Key Words: Birds, Parasites.

Field work by all cooperating institutions but two was closed in 1970. With reduced funds and activity for only six to eight months the total birds ringed was about 107,500 (not listed) a brief summary of ringing in each country is given.

The major ectoparasite genera are listed and a discussion of the occurrence of Mallophaga on owls in Thailand is given.

More than 4,000 recovery records have now been received and these are totaled by family. Greatest recovery rate has been from the Philippines, 24% of all records.-*Author*.

71-74/356

McCLURE, H. Elliott. Annual progress report 1971. Annual progress rep. 1971 on Res. Prog. 24, 1972, 118.

Key Words: Birds.

During the period of active bird ringing by the MAPS groups, July 1963 to July 1971, a total of 1,165,288 birds of 1216 species were captured and marked. This report lists these species by family and by species and year giving the totals that were banded.-*Author*.

Exposure testing

71-74/357

ENVIRONMENTAL AND ECOLOGICAL RESEARCH INSTITUTE. Semi-annual report

for period 1 January to 31 May 1972. Semi-annual rep. on Res. Prog. 54, 1974, 6 p.

Key Words: Material deterioration.

Covers the progress of ASRCT Research Programme 54 -Exposure testing (study of material deterioration) - for the period of 1 January to 31 May 1972.-K.N.

71-74/358

NUALCHAWEE, Kaew. Concentrated animal food. Rep. no. 1 on Res. Prog. 54 (Preserved food series), 1974, 33 p.

Key Words: Animal nutrition.

The chemical compounds obtained from the result of chemical analysis were the figure calculated by the company. The percentage of decrease of the compounds analysed after being laid down, was too little compared to the previous quantity. Thus the quantity of the chemical compounds should be deteriorated in a 2-month testing. Moreover, the analytical result on rancid smell of the animal food which would reveal whether or not the animal could eat did not increase more than previously, e.g. the percentage increased or decreased. Based on these grounds, it was concluded that there should not be any bad smell that the animals could not eat this food.

The results from the examination through the naked eyes already carried out were that the animal nutrition was not decidedly put in a plastic bag, but with the reasons mentioned above, only many paper bags were used and the result of this method (naked eyes) disclosed some damage of the paper gnawed by insects such as mice, ants etc. It was found that mice and ants did not like to gnaw this kind of food because after gnawing and testing it, they did not gnaw it further, neither did they carry it for their next food. It was also discovered that insects and maggots were in the organic container which they might possibly develop in the animal nutrition when the hatchery cycle of insects, maggots and white moths etc. was due, but they were not found in all the bags. Thus it should not worry that it would be contaminated in this period.-
Author.

71-74/359

NUALCHAWEE, Kaew, and PREWETT, William G. Combat and survival rations. Rep. no. 5 on Res. Prog. 54 (Preserved food series), 1974, 48 p.

Key Words: Food preserving.

A number of different kinds of preserved foods was supplied to us for use as test specimens for the Exposure Testing Programme by the Preserved Food Organization. These preserved foods were put on shelves prepared to simulate actual storage, as supposed to be exercised by the Armed Forces, to determine the shelf life of each kind of food under the prevailing conditions.

Physical examinations of food containers, weighing, and microorganism tests were conducted before exposure in the same way as they were carried out after exposure.

Microbiological test, included total aerobic count, mold count, coliform test, and anaerobic test. Total aerobic count and mold count were mostly positive but coliform test and anaerobic test were negative or non-detectable before exposure. Others were only slight increased in mold count, and total anaerobic test detected in the tests carried out after exposure.

Physical examinations showed that most preserved foods in bags are likely to be attacked by insects, especially ants, and rodents, such as mice. In most cases weight increases were observed, only a few specimens showed decrease in weight.-*Authors.*

71-74/360

NUALCHAWEE, Kaew, and PREWETT, William G. Combat and survival rations. Rep. no. 6 on Res. Prog. 54 (Preserved food series), 1974, 27 p.

Key Words: Food preserving.

The following is a report on exposure tests made on samples of preserved foods at the second withdrawal (after a period of 6 months exposure). The report begins with a statement of purpose which is contained in the introduction. This is followed by a description of the nature of the samples, the conditions of exposure, and the tests applied to the exposed samples which description is, in turn, followed by tables of results and of meteorological records made at the exposure sites during the exposure period. The tables are followed by a discussion of the results presented in them.

It is stated in the conclusion, which follows the discussion of results, that the packaging of the samples has already been demonstrated to be far from perfect. Most samples appear to be acquiring moisture which will ultimately lead to their decay, some have been attacked by insects and some packets are visibly perforated. However, at the time of this withdrawal, microorganism counts were still low.-*Authors.*

71-74/361

NUALCHAWEE, Kaew, and PREWETT, William G. Combined combat ration. Rep. no. 7 on Res. Prog. 54 (Preserved food series), 1974, 62 p.

Key Words: Food preserving.

Samples of combined combat rations were supplied to ASRCT by the Preserved Food Organization for use as test specimens for the Exposure Testing Programme. They were put on shelves in shelters in a manner intended to simulate storage conditions employed by the Armed Forces, to determine the shelf life under prevailing conditions.

Visual examination of food containers, weighing, and microorganism tests were conducted before and after exposure.

Microbiological tests made were total aerobic count, mold count, anaerobic tests, and coliform test. Results of total aerobic count and mold count were mostly positive but those of anaerobic and coliform tests were negative. There were slight increases in mold count and total aerobic count compared with the tests made on unexposed samples.

Physical examinations of the food containers showed that most, if not all, of them were bitten through by ants, and may be, by other insects or rodents. In most cases weight increases were observed, only a few specimens showed decrease in weight. -*Authors:*

71-74/362

NUALCHAWEE, Kaew, and PREWETT, William G. Textiles. Rep. no. 1 on Res. Prog. 54 (Textiles series), 1974, 76 p.

Key Words: Textiles.

Samples of six varieties of military cloth were subjected to exposure, above the ground, on racks in evergreen forest and in a forest clearing in North-east Thailand with the purpose of assessing their deterioration under such conditions. Similar samples were also stored in buildings near the exposure sites to assess their shelf life.

Samples were withdrawn from exposure for testing at intervals of three months, the tests made being, measurement of tensile strength and elongation at break in the directions of warp and of filling, total mold count and assessment of colour change.

Results of the tests show that, samples either stored under cover or after nine months exposed in the forest have deteriorated little if at all, whereas, samples after nine months exposed in the clearing deteriorated seriously both in tensile strength and in colour. Mold was densely and rapidly populated on samples exposed at both sites. Colour fading and loss of strength are presumably due to the effect of actinic destruction caused by direct sunlight. -*Authors.*

71-74/363

NUALCHAWEE, Kaew, and PREWETT, William G. Textiles. Rep. no. 2 on Res. Prog. 54 (Textiles series), 1974, 39 p.

Key Words: Textiles.

A final report is presented of results obtained from a one year programme for exposure testing of textile samples. Six samples of Thai military cloth were tested. They were tested for perishability when exposed in the dry-evergreen forest and in a forest clearing and when stored in depots all at the same location in North-east Thailand.

Visual observations were made on the samples. Their tensile strength and elongation at break were measured. Their mold populations were counted, and a semi-quantitative assessment was made of their colours.

Little deterioration was observed in samples stored under cover. Samples exposed in the forest became disfigured by mold and dirt but lost only a moderate degree of physical strength.

Samples, exposed in the forest clearing, became unusable by the end of the year. In some cases, the colour of their upper surfaces faded until it matched that of a white test sample. Their physical strength was reduced to a small percentage of the original.-*Authors.*

71-74/364

NUALCHAWEE, Kaew, PREWETT, William G., and PAKARNSEREE, Pakorn. Concentrated animal food. Rep. no. 2 on Res. Prog. 54 (Preserved food series), 1974, 38 p.

Key Words: Animal nutrition.

A number of concentrated animal food samples were supplied, by Charoen Phokphan Feed Mill Co. Ltd., through the Military Research and Development Center (MRDC) of the Supreme Command Headquarters, to the Exposure Testing Project for use as test specimens. The liaison personnel for MRDC were Col. Adulsuckdi Mitrabhuckdi, Maj. Sripan Vichapan, and Maj. Howard S. De Witt. The purpose of the test is to study the shelf life of the concentrated animal food. The animal food in two different types of container and in five different formulae, were placed on the wooden floors of the wooden huts, built to simulate field depots. The two wooden huts are located in the clear site, and at the jungle site. There is one wooden building, fitted with an air-conditioner to serve as a control room, located near the two aforementioned huts. Therefore conditions for exposure are storage in the clear site, storage in the jungle site, and storage in the control room.

Tests were performed on the animal food for changes in weight, visible changes, microbiological changes, and changes in chemical composition occurring during exposure.

Changes in weight were positive in most cases except in some cases of samples stored in the control room which were negative. Visible changes of containers and the food itself varied widely with the kind of container and conditions of exposure. Most plastic containers suffered from ants and rodents as well as from breakage of seams (creases) due to inadequacy of sealing procedure. They also suffered breakage in the course of handling and transportation. In not very many cases did laminated paper/plastic containers show any defect.

Many cases, especially samples from the jungle site showed mold growth which could be seen through plastic containers. This could also be confirmed by the temperature of the containers which were warm to the touch. Results from microbiological study showed an increasing quantity of microorganisms in the animal food, especially on ones exposed in the jungle site depot. Results of chemical analysis indicates very small degrees of deviation from the results of the first withdrawal. The free fatty acid test showed very little change from the results of the first withdrawal.-*Authors.*

71-74/365

NUALCHAWEE, Kaew, PREWETT, William G., and PAKARNSEREE, Pakorn. Concentrated animal food. Rep. no. 3 on Res. Prog. 54 (Preserved food series), 1974, 23 p.

Key Words: Animal nutrition.

The concentrated animal food samples were supplied by the Military Research and Development Center (MRDC), to test for weight changes, visible changes, microbiological changes, and composition changes by means of chemical analysis.

It was found that the majority of animal food samples showed increase in weight, especially those exposed in the depots in the cleared site and in the jungle site. The majority of laminated paper/plastic containers remained in good condition until the time of the third withdrawal. Foodstuff inside the containers showed mold growth, and insect infestation to varying degrees. The least mold infestation was found in the control room. Results from microbiological study showed an increasing quantity of microorganisms in the animal food. Results from counting may not be very accurate, but the mold growth on the animal food pellets was enough to be an indication that the animal food had deteriorated beyond the acceptable standard. Results of chemical analysis indicated small degrees of variation from the results of the previous withdrawals. The free fatty acid test showed some change from the results of the previous withdrawals, especially in the case of replicate number X of formula 1 in the depot in the cleared site which increased about 47%. -Authors.

71-74/366

NUALCHAWEE, Kaew, PREWETT, William G., and PAKARNSEREE, Pakorn. Concentrated animal food. Rep. no. 4 on Res. Prog. 54 (Preserved food series), 1974, 26 p.

Key Words: Animal nutrition.

A number of concentrated animal food samples was supplied, by Charoen Phokphan Feed Mill Co. Ltd., through the Military Research and Development Center of the Supreme Command Headquarters, to the Exposure Testing Project for use as test specimens. The liaison personnel for MRDC were Col. Adulsuckdi Mitrabhuchkdi, Maj. Sripan Vichapan, and Maj. Howard S. De Witt. The purpose of the test was to study the shelf life of the concentrated animal food stored under the environmental conditions of Sakaerat Experiment Station. The animal food in two different types of container and five different formulae was placed on the wooden floors of the wooden huts, built to simulate field depots. The two wooden huts are located in the cleared site, and at the jungle site. There is one wooden building, fitted with an air-conditioner to serve as a control room, located near the two aforementioned huts. Therefore conditions for exposure storage are specified as storage in cleared, and jungle sites, and in a control room (air-conditioned room). -Authors.

Fish studies

71-74/367

KRUTANUT, Sunee. DDT residues in fresh water fishes in Bangkok. Rep. no. 1 on Misc. Invest. no. 74, 1974, 17 p.

Key Words: Fresh water fishes, Insecticides, DDT, Bangkok.

The amount of toxic residue of DDT in fresh water fish favourably consumed by the public collected from raw and perishable food-stuff markets in Bangkok areas has been experimentally investigated from March-August 1974; the amount of it in each fish species and the places where fishes were caught have been also comparatively studied.

The results of investigation indicated that among the samples of 81 fish species, 62 contained certain amount of toxic residues of DDT in fresh fish, the rest (19) did not. The quantity of toxic residues found varied widely, ranking from 0.0004 p.p.m. to 0.17 p.p.m. with 0.01 p.p.m. by average. Among the samples of the toxic residues of DDT, 45 samples contained toxicity of less than 0.01 p.p.m. onward. Pla Sawai (*Pangasius pangasius* Hamilton) collected from the Sapan Mai market, Don Muang, was found to hold toxic residue of DDT with 0.17 p.p.m. as maximum and Pla duk dan (*Clarias batracus* Linn.) from the Bang Sue market and Pla krai (*Notopterus chitala* Hamilton) from the Phra Khanong market contained 0.0004 p.p.m. as minimum.

From the experimental results, it can be concluded that 77 per cent of the sample of fish found in the Bangkok areas contained the toxic residues of DDT.-Author.

Forest ecosystem studies

71-74/368

ATTHASAMPUNKA, Poonsook. Microbiological data on the activity of takhian wood and tetrahydroxystilbene. Rep. no. 1 on Misc. Invest. no. 72, 1973, 7 p.

Key Words: Takhian, *Hopea odorata*, Mahat, *Artocarpus lakoocha*, Tetrahydroxystilbene.

Wood chips from a tree locally called 'takhian', scientifically known as *Hopea odorata*, and a crystalline preparation from the woods of another tree called 'mahat', *Artocarpus lakoocha*, were tested for their antimicrobial activity against several kinds of bacteria, yeasts, and fungi. Results indicated that they were effective, in varying degrees, in inhibiting growth of most microorganisms tested. In general, large amount of materials were required to completely inhibit the growth of the microorganisms.-Author.

71-74/369

NALAMPUN, Anand, SANTISUK, Thawatchai, and SMITINAND, Tem. The

preliminary study on forest fire in dry deciduous dipterocarp forest at ASRCT Sakaerat Experiment Station (Amphoe Pak Thong Chai, Changwat Nakhon Ratchasima). Rep. no. 3 on Res. Proj. 27/8, 1974, 29 p.

Key Words: Forestry, Forest fires.

The study in the condition of undergrowths and the forest fire in the dry deciduous dipterocarp forest can be summarized as follows:

(1) Ya-phek, the main undergrowth in the vicinity of the Station commences its vegetative growth in April after being burnt down by the annual ground fire in the hot dry season; the vegetative growth stops in November, when the moisture content of the soil is lowest.

(2) Towards the end of growing season the moisture content of ya-phek decreases from November onwards, resulting in the desiccation of leaves and stems. During December-January most of the arborescent species in the dry deciduous dipterocarp forests shed their leaves, exposing the undergrowth to the direct solar heat, which is quickening their desiccation.

(3) The daily moisture content of ya-phek is variable throughout 24 hr the lowest is recorded between 1400-1600 hr, when the temperature and the solar heat are also at their peaks.

(4) There occurred annual ground fire in the vicinity of the Station during January-February, deliberately caused by man, when the moisture content of the undergrowth is lower than 35%.

(5) The undergrowth is inflammable when its moisture content is at 40% or lower; the rate of conflagration is 69.65 m/hr at a moderate wind speed.

(6) After burning some parts of the undergrowth are left over, such as stems of seedlings of arborescent species and some ya-phek. The amount of left-overs is 2-4.4% (dry weight) of the total biomass before firing.-*Authors.*

71-74/370

SMITINAND, Tem, PHENGKHLAI, Chamlong, CHAIYANAND, Chumsri, PHUPHA-TANAPONG, Leena, SANTISUK, Thawatchai, and REYNOLDS, Sally. Flora of Sakaerat part one. Rep. no. 18 on Res. Proj. 27/1, 1974, 88 p.

Key Words: Plants (botany).

The first part of Flora of Sakaerat contains 22 families of vascular plants and is roughly 23.5% of the collection acquired during 1967-1970; there is no novelty.

A short description of the vegetation of Sakaerat is given together with ecological factors.-*Authors.*

71-74/371

SMITINAND, Tem, SANTISUK, Thawatchai, and NALAMPHUN, Anand. The

defoliation of yang-krat (*Dipterocarpus intricatus* Dyer) and daeng (*Xylia kerrii* Craib & Hutch.) at ASRCT Sakaerat Experiment Station (Amphoe Pak Thong Chai, Changwat Nakhon Ratchasima). Rep. no. 2 on Res. Proj. 27/8, 1974, 31 p.

Key Words: Yang-krat, *Dipterocarpus intricatus*, Daeng, *Xylia kerrii*, Forestry.

The defoliation of tropical trees is to reduce the loss of water through transpiration during the hot dry season and at the same time helps to conserve the moisture content in the soil. The moisture content in the soil plays an important role in the defoliation of tree species.

Yang-krat started to sparsely defoliate from the early part of November, The defoliation was highest during the latter half of December to the middle of January. When the defoliation was going on about 70 per cent, yang-krat started to bud new leaves to replace the defoliated one. At the beginning of March the trees were full-leaved again and started to flower.

The rate of defoliation of daeng is markedly different from yang-krat; the defoliation of daeng was highest, when that of yang-krat was at the lowest. The defoliation of daeng commenced at the same time of yang-krat, and the rate of defoliation was increasing in January. The defoliation of daeng was complete within a shorter period of time. Daeng commenced to bud new leaves together with flowers after a short resting period of one week since the completion of defoliation. -K.N.

71-74/372

SUNDHAGUL, Malee, and KLINSUKONT, Chaiyuth. Studies on cellulose decomposition in the soils at Sakaerat Experiment Station. Rep. no. 14 on Res. Proj. 27/1, 1971, 18 p.

Key Words: Sakaerat, Forest soils.

Cellulose decomposition in the soils of the two forest types, namely, the open dry dipterocarp forest and the dense dry-evergreen forest, was investigated using the buried-slide technique. Decomposition occurred slowly in the open dry dipterocarp forest and at a faster rate in the dense dry-evergreen forest. The rate of decomposition was influenced by the soil moisture content and was highest during the heavy rainfall period. *Penicillium* was found to be the primary colonizer and later joined by other fungi. Many of the fungi were common in both types of forest while some were confined to only one type and not the other. -Authors.

71-74/373

SUPORN RATANA, Somsak. Mesometeorological observations at ASRCT Sakaerat Experiment Station (Nakhon Ratchasima), July 1969 to September 1969. Rep. no. 15 on Res. Proj. 27/1, 1972, 35 p.

Key Words: Meteorology, Sakaerat.

Shows the data on the mesometeorological observations of the

eight stations at the ASRCT Sakaerat Experiment Station during July 1969 to September 1969.-R.K.

71-74/374

SUPORN RATANA, Somsak. Mesometeorological observations at ASRCT Sakaerat Experiment Station (Nakhon Ratchasima), October 1969 to December 1969. Rep. no. 16 on Res. Proj. 27/1, 1972, 34 p.

Key Words: Meteorology, Sakaerat.

Shows the data on the mesometeorological observations of the eight stations at the ASRCT Sakaerat Experiment Station during October 1969 to December 1969.-R.K.

71-74/375

SUPORN RATANA, Somsak. Mesometeorological observations at ASRCT Sakaerat Experiment Station (Nakhon Ratchasima), January 1970 to March 1970. Rep. no. 17 on Res. Proj. 27/1, 1972, 35 p.

Key Words: Meteorology, Sakaerat.

Shows the data on the mesometeorological observations of the eight stations at the ASRCT Sakaerat Experiment Station during January 1970 to March 1970.-R.K.

Water pollution and sewage treatment

71-74/376

RATASUK, Sermpol. Improvement of water and waste water treatment systems. Rep. no. 1 on Class. Invest. no. 23, 1973. *CONFIDENTIAL*.

Key Words: Waste water, Water treatment.

71-74/377

ENVIRONMENTAL ENGINEERING UNIT. Drainage and water pollution control system for Bangehan Industrial Estate. Rep. no. 1 on Class. Invest. no. 31, 1974. *CONFIDENTIAL*.

Key Words: Waste water, Water treatment, Water pollution, Drainage, Pollution control.

AUTHOR INDEX

(Figures refer to abstract numbers with the years omitted)

AGARWAL M C	1,243		257,262,285,
AKSORNKOAE S	214,216		291
AMIEL Y	123,124	CHIN Y P	149,150
ATTHASAMPUNNA P	201,368	CHINTAKANANDA A	224
AUVUCHANONDA M	161,162,163	CHOMCHALOW N	30,31,34,37, 38,80,81,89, 91,92,194, 353
		CHOMCHALOW S	65,286,287, 288
BALAJIVA K	20,131,132, 134,135,136, 137,138,329	CHOUVALIT C (J)	51,52,53,87, 88,129
BERKSON G	225,226,227, 228,229,230	CHU C	4,5,10,36, 39,40,41,42, 58,59,111, 112,113,114, 115,116,264, 265,266,267, 268,269,270, 271,272,273, 274,275,276, 277,278,279, 280,281,311, 312,313,314, 315
BHAVILAI P	164,165,345, 346,347		6
BHAVILAI R	162,163,166, 167,175	CHUCHART C	215
BHODACHAROEN W	72	CHUNKEO K	
BHUNTUMKOMOL K	62		
BOONKLINKACHORN P	30,31,32,33, 34,35,37,80, 81,82,89,90, 92,194,263, 284,290,348, 349,350,351	DAENGSUBHA W	295,296
		DARANANDA N	141,142
BOONLIANG L	211	DARRAGH P	7,44,133
BOON-LONG S	160,254	DEETESNA S	143,144
BOONMEEPRASERT E	123,124	DHAMA-UPAKORN P	110
BOONNITEE A	214	DISATHIEN P	141,142,150, 155,191,192, 333,342,344
BOS F	202	DISYABOOT P	308,309,310*
BUNNAG A	139	DONSAGUL S	110a
BUSAYASAKUL N	320	DOWNDAC C	40,41,57,58, 257
		DURIYAPRAPAN S	348,349,350, 351
CAVUSOGLU T	2,3,29,36	DURRANI S M A	242
CHAICUMPA V	225		
CHASILAPIN S	30,31	ECON EVAL-GRP	8,9
CHAIYANAND C	217,370		
CHAMSWASDI S	140,244		
CHANDHANAMUTTA P	30,31		
CHANDRANOI S	30,31		
CHANJANAKIJSKUL J	352		
CHAROENSOOK D	224		
CHANTARASOMBOON P	308,309		
CHAVAKORN S	299		
CHEOSAKUL U	54,55,56,57, 58,59,117, 249,255,256,		

ENVIR ECOL RES INST	203,204,205, 206,207,208, 357	KING B	231
ESSELINK B P	17,21,124, 125,126,143, 144,145,146	KITTIYAKARA H R C	177
FIELDS A A K	211	KIRKENDALE G A	246,334
GLYDE H R	354	KLINSUKONT C	53,260,372
GREENHILL W L	43,44,45,46, 47,48	KNUDSEN L S	323,327,328, 329,335,336
GRIVAPHAN V	51,53	KOBAYASHI N	211
HAANTJENS H A	209	KRAIRIT A	5,40,41,113
HAPNER J	199	KRISHNAKAN B	44
HANSEN F	147,330,331, 332	KRITTAYANAWACH P	32,33,34,352
HERMANS W G J	10,22,28,60, 61,62,63,64	KRUTANUT S	211,367*
HEYER W R	210	LAUHASIRI P	87,88,260, 261,301
HEYLIGERS P L	209	LAWRENCE B M	95,302,303, 317
HILL J	67,68	LEKSKUL S	91,92
HOGG J W	95,302,303, 317	LIMPINANTANA C	104,306
HUGHES H	20	LIMSTWAWONGSE T	240
INTHORN D	56,57,58,69, 256,257	LIMVATANAKUL U	244
JAKSIRINONDS N	112	LOHAVANIJAYA P	211
JINAHYON S	80,81	LOO Y C	160
JINDAPRASARN S	93,94,101	LOPITAKWONG R	283,300
JOHANSSON L	93,94,101, 103,104,105, 106,118,119, 305,306	McCLURE H E	232,233,234, 235,355,356
JOHANSSON K	102,103	McGARRY M G	292
JUTASIRIWONGSE P	52	MAHAWAN B	151,152,153
KALISKY A	193	MARSHALL J T Jr	226
KAMOLRATANAKUL N	5,11,245	MATTHEWS W S	304
KAMPEMPOOL S	250,333,342	MAYNE J W Jr	168,178,179, 180,184,195, 186
KASEMSARN B	85	MEKHANTONG V	140
KASHEMSANTA M L S	119,264,305, 316	MEKSONGSEE L A	70,71,73,75, 293
KASHEMSANTA M R S	148	METHIKUL A	212
KASIPAR A	30,31,34,37	MOKKHASMIT M	305,309
KHEMNARK C	214,216	MOLEERATANOND W	294
		MUNSAKUL S	304,307,318, 319,321,322*
		NALAMPHUN A	213,217,369, 371
		NANDHASRI P	104,306,308
		NGAMPONGSAI C	215
		NGAMWATANA W	305,308
		NICHOLLS F G	59,224
		NIYOMMAN N	40,41,42,51, 53,111,112, 113,114,115,

NIYOMWAN N	116,264,265, 266,267,268, 269,270,271, 272,273,274, 275,276,277, 278,279,280, 311,312,313, 314,315	PRATEEPAVANICH O	24
NOPAKUN N	45,46,47,48	PRAYOONWONG C	350
NORMAN B	288,352	PRAYUTSENEE C	197
NUALCHAWEE K	358,359,360, 361,362,363, 364,365,366	PREWETT W G	359,360,361, 362,363,364, 365,366
NUTALAYA S	160,342	PUANGVICHIT A	42,114,115, 116,265,266 267,268,269, 270,271,272, 273,274,275, 276,277,278, 279,280,311, 312,313,314, 315
OVERGAARD J	324,337,338, 339	RAMANVONGSE S	281
PADUNGCHEWIT I	214	RASANAND S	11
PAJEVIC M M	12,13,14,15, 23,24,148, 149,150,151, 152,153,154, 155,156	RATANAPHUNVORAKUL V	63,64
PAKARNSEREE P	364,365,366	RATANAWORAPHAN N	195
PAN-URAI M L R	309	RATASUK S	241,376
PATANAVANICH S	164,165,169, 170,171,172, 173,174,175, 345,346,347	RATISOONTHORN P	216
PATARAGETVIT S	83,160,342	REYNOLDS S	370
PATTRAKULCHAI V	141	RIEBROICHAROEN S	137,138,328, 335,336
PENGSRITONG K	18,106	RIMMER P	200
PESCCD M E	240,241	ROSS B A	226,227,228, 229,230
PHENGKHLAI C	370	SABHASRI S	214,215,216
PHONGSATHA A	168	SALUJA N S	49,127,157, 158,159
PHOTIYARAT P	131,132	SAMREJPRASONG S	147,330,331, 332,341
PHUPHATANAPONG L	370	SANGSAN-ANAN S	248
PICHITAKUL N	62,101,103, 105,118,302, 303,317	SANTISUK T	213,217,369, 370,371
PIETIYA (R) P	96,100	SATRAWAHA P	305,309
PIRAMARN P	289,290	SAWASDIMONGKOL K	305,307
PIYAPONGSE S	11,20,196, 247,248	SCRIVENOR M	198
PODIMUANG V	95,96	SERENE R	239
PONGPANGAN S	197	SHOLTON E J	38,50
PONGSAPIPAT S	211	SILPALIT M	212
POTHSIRI L	133,156,324, 325,326,334, 340	SITTLERT S	211
		SMANMATHURAPOJ P	72,86
		SMITINAND T	213,217,369, 370,371
		SMITH R B L	160
		SOMBATPANIT Y-H	87,88
		SOMCHAI P	259
		SORNCHAI C	11

SORNSRIVICHAI P	86	UATHAVIKUL P	252,281
SRIKUMLAITHONG S	258	USOMPONGSANOND N	135,136
SRIPATR P	138	UDOMPONGSANOND P	53
SRISUTHEP R	76,77,78, 121,122	UDOMSAKDI B	25,79,250, 258,315,319, 320,321,322*
SRIVARDHANA, A	244,282		
STHAPITANONDA K	320,321		
SUKAPADDHANADHI N	141,142,154, 155,337,338, 339	VANANUVAT P	68
	211	VARANGOON P	74,75,76,77, 78,97,98,120, 121,122,298, 299,300
SUKAPANPOTHARAM V	259,260,261, 301	VARDHANABHUTI S	16,51,52,53, 87,88,128, 129,130,258, 259,260,261, 301
SUKHUMAVASI J	72,84,85,86, 130,201,295, 296,372		
SUNDHAGUL M	187,188,189, 190,191,192, 343,344	VIBHATAKARASA S	11,19,249
SUNTHORNPALIN J	251	VIBULSRESTH S	176
	373,374,375	VIETMEYER N D	342
SUPHAPHIPHAT P	6	VISUTTIPIITAKUL S	35,66,82,90, 284
SUPORNATANA S	295,296		
SUTHASATHIEN S	70,73,79, 293,297	WAKE N L	5,6,11,17,18, 19,26,27,28, 196,245
SUYANANDANA P			
SWATDITAT A		WANOTAYAROTE R	11,28,71
		WASUWAT S	106,107,108, 109,110,110a, 308,309,310*
TANGTRONGSAKDI P	156		
TANTAVICHETKIT S	131,132	WEILBACHER B F	218
TEÑAZA R	230	WICHAPAN K	353
TERHUNE S J	95,302,303, 317	WONGSRATA T	41
THARAVANIJ	308	WRENSHALL C L	18,79,99, 100
THONGLONGYA K	211,236,237, 238		
THUNDUAN V	202		
TONGDEE S C	83,244,253, 254,282	ZABRANSKY J	219,220,221, 222,223
TRUTASNAWINT W	181,182,183		
TUNGKHASARANI M	248		

* in Thai

SUBJECT INDEX

(Figures refer to abstract numbers with the years omitted)

<i>Acrodictiopsis</i>	218	Buddha images	134
Adhesives	124,143,144	Building materials	<i>see</i> Construction materials
	145	Burma grass	116
Agricultural wastes	148	Calcium oxides	14
Alcôhol		Cassava starch	
glutinous rice	301	pelleting	335
Algae	242	Castor stalks	314
<i>Amomum globosum</i>	303	<i>Casuarina equisetifolia</i>	311
Amphibia	210	Cements	14,150,154
Animal nutrition	292,358,364, 365,366	testing	155
Animals		Ceramic industry	7
Sakaerat	203,204,205, 206,207,208, 211	Ceramic shell mould	135
Apiculture	245	Chemical compounds	
<i>Artocarpus lakoocha</i>	103,368	directory	8
<i>Arundinaria pusilla</i> <i>see</i> Bamboo grass		Chromosphere	161,162,163, 167,175
<i>Bacillus subtilis</i>	51	Citric acid	129
Bagasse	275	<i>Citrus hystrix</i>	95
Bamboo	111,148,280	Clay aggregates	25
Bamboo grass	313,351	Clays	133,150,325, 334
Banana industry	19	industries	246
Bananas		lightweight aggregate	250
cultivation	254	Chlorinated rubber <i>see</i> Rubber chlorohydrocarbon	
ripening control	82	Coconut cream	249
storage	80,81,83,253	Coconut milk	54,55,56,57, 58,59,255, 256,257
Bean stalk	70	Coco-soya milk	75
Beef		Coir fibers	316
flavors	98	Columbus grass	315
Benzoic acid	26	Computer programs	177,178,180, 181,182,183, 184,185,186, 190,192
Beverages		structural analysis	34,187,191, 343
coco-soya milk	76	Concrete blocks	332
soybeans	297	Concretes	337
Birds	234,238,355, 356	compressive strength	149
skins	231	Construction materials	
Birds banded	232,233,235, 236,237	directory	9
Boiled fish industry	85,86	industry	12,13,14,15
Brachyura	239	research	15
Bricks	23,152,153, 334,340		
compressive strength	151		
<i>Brucea amarissima</i>	308,309		

- Cornstalks 115
 Cottonseed husk 114
 Critical path method 184
Cyamopsis tetragonoloba see Guar
 Daeng see *Xylia kerrii*
 DDT
 fishes 367*
 industry 27
 Depolarization 131
Dipterocarpus intricatus 371
 Discharge sources 193
 Drugs 310*
 Dry cells 131,132
 Essential oils
 Amomum globosum 303
 Citrus hystrix 95
 Kaempferia pandurata 302
 lemongrass 304
 Ocimum 91,92
 Euphorbia lagascae 194
 Fauna see Animals
 Feed (animals) 67
 Ferro-cement 142,160,330,
 331,332,338,
 339,341,342
 Fermentation 259,260,261
 Fertilizer applications
 sunflowers 352
 Fertilizers
 consumption 29
 Fiberboard 147
 Fiber crops 280
 Fiber storage 48
 Fishes
 DDT 367
 food dispensing 84,85
 industry 85
 Fish sauce 87,88,258,
 259,260,261
 Flavors 96,97
 beef 98
 garlic 100
 Food preserving 360,361
 Food processing 359
 Forest ecology
 Sakaerat 214,217
 Forest fires 369
 Forestry 348,369,371
 Forestry meteorology
 Sakaerat 219,220,221,
 222,223
 Forests
 Sakaerat 215,216
 Forest soils
 Sakaerat 372
 FORTRAN 180,185
 Foundries 136
 Garlic oil 100
 Gas containers 336
 Gems 323
 Geological surveys
 Sakaerat 212
 Gibbons 225,226,227,
 228,229
 Ginger 244
 Glutinous rice 301
 Glycerine see Glycerol
 Glycerol 22
 Ground water
 maps 198
 Guar 194
 Guava jelly 262
 Gypsum 14
 testing 156
 Herbicides 351,353
 High protein feed 67,77,299
 mung beans 70,73
 peanuts 283
 soybeans 69,74,291,294,
 295,296
Hopea odorata 368
Horapha see *Ocimum basilicum*
 Housing projects see Residential
 buildings
 Indian ironweed 194
 Industrial microbiology see
 Microbiology
 Industries 11
 clays 246
 coconut cream 249
 starches 247
 vegetable oils 248
 Institutional links
 science and technology 354
 International trade
 ginger 244

- Inthanin *see Lagerstroemia speciosa*
- Investment casting 134,135
- Ipomoea pescaprae* 109,110
- Iron and steel industry 20
- Iron production 20
- Isophotal contour map 162
- Jute 353
- Jute fibers 48
- Kaempferia pandurata* 302
- Kafak-mamuang *see Loranthus pentandrus*
- Kaphrao *see Ocimum sanctum*
- Kenaf 6,243,265, 266,267,268, 269,270,271, 272,273,274, 275,276,277, 278,279,280
- baling industry 1
- cultivation 30,31,32,33, 34,35,37,38
- decortication 50
- knot efficiency tests 49
- microbiology 52,53
- mill industry 4,5
- newsprint 40
- pulp 36,39
- Kenaf fiber 43,48,263, 264
- Kenaf retting 44,45,46,47, 51,52,53, 141,264
- Kenaf seed oils 281
- Kenaf stalks 45,46,47,53
- Lacquers 327,328
- Lagerstroemia speciosa* pharmacological studies 102,305
- Land surveys
- Sakaerat 209
- Laterites 324
- Lemongrass 304
- Lethocerus indicus* 94
- Licorice 318
- Lignite 319
- Lime *see* Calcium oxides
- Loranthus pentandrus* 101,105,307
- Lorises *see* Lorisidae
- Lorisidae 230
- Mahat *see Artocarpus lakoocha*
- Maengda-na *see Lethocerus indicus*
- Manganese ores 131
- Mangoes
- storage 282
- Material deterioration 357
- Matrices (mathematics) 188,189
- Matrix inversion *see* Matrices (mathematics)
- Matrix method 177,181,182, 192
- Medicinal plants 106,107,305, 306
- Meteorology
- Sakaerat 373,374,375
- Microbiology 128,130
- Moulding sands 136
- Mungbeans 66,300
- Mung beans flour 68,70,73,79
- Napier grass 315
- Newsprint 40,278
- Nitrogen fixation
- soybeans 286
- Ocimum* 89,91,92
- Ocimum basilicum* 317
- Ocimum sanctum* 317
- Odors 96
- Paint industry 17
- Papers 251,252
- bamboo grass 313
- Casuarina equisetifolia* 311
- pinewood 113
- rubber wood 112
- sorghum 312
- Patchouli oil 99
- Peanuts cultivation 65,66,284
- Peanuts production 283
- Pentacme suavis* 213
- Phakbungthale *see Ipomoea pescaprae*
- Pharmaceutical industry 18
- Photosphere 164,165,171, 172,173,174, 345,346,347
- Pinewood 113
- Plants (botany) 370

- Plant proteins 67
 Plywood 143,144,145
 Pollution control 377
 Polyethyleneglycol *see* Poly-
 oxyethylene
 Polyoxyethylene 146
 Power system 179,180,181,
 182,183,184
 Precision casting *see* Investment
 casting
Pseudocheilidon sirintarae 238
 Pulp and paper industry 2,3
 Pulp
 3,251,252
 bamboo 111
 bamboo grass 313
 burma grass 116
 castor stalks 314
Casuarina equisetifolia 311
 columbus grass 315
 cornstalks 115
 cottonseed husk 114
 kenaf 36,39,41,42,
 265,266,267,
 268,269,270,
 271,272,273,
 274,275,276,
 277,279
 napier grass 315
 pinewood 113
 reed 315
 rubberwood 112
 sorghum 312
 Pulpwood 311
 Radio-telescopes 176
 Rainfall
 North east Thailand 224
 Rang *see* *Pentacme suavis*
 Ratchadat *see* *Brucea amarissima*
Rawolfia serpentina 108,110a
 Reed 315
 Reinforcement bars 329
 Reptiles 210
 Reserpine 110a
 Residential buildings 140
 Rhizobiaceae 65,66,287,
 288
 Rhizobium *see* Rhizobiaceae
 Rice bin 342
 Rice bran 60
 stabilization 61,62,63,64
 Rice bran flour 71
 Rice bran oil 60
 industry 10
 Rice storage 160,342
 Rice straw 277,278
 Roselle 285
 Rubber chlorohydrocarbons 21
 Rubber hydrochloride *see* Rubber
 processing
 Rubber processing 21
 Rubber seed 321
 Rubber seed oil 320
 Rubberwood 112,146,276
 Saffron cultivation 196
Salix tetrasperma 104,306
 Salt iodization 125,126,127
 Sanitary engineering 326
 Sanitary wares *see* Sanitary
 engineering
 Sausages 76
 Sesame flour 293
 Sewer pipes 334
 Ships 330
Shorea obtusa 213
 Silkworms 195
 Sodium silicate 28
 Soil analysis
 Northeast Thailand 139
 Soil fertility
 kenaf 35
 Soil surveys
 Sakaerat 202
 Soil stabilization 141,150
 Solar activity 161,163,167,
 169,170,175
 Solar eclipses 166
 Solar heating 157,159
 Solar physics 158
 Sorghum 312
 Soybeans 72,286,287,
 288,289,290,
 295,296,301
 beverages 297
 production 291
 Starches
 industries 24,247
 Steel production 20
 Sunflowers 352
 Sunspots 169,170,175
 Surface waters
 Sakaerat 201

- Takhian *see* *Hopea odorata*
 Tallow 322
 Tamarind 120
 beverages 122
 fruit pulp 117
 kernel powder 118
 sauce 121
 seed jellose 118
 seed testae 119
 Tannin formaldehyde *see* Tannin
 materials
 Tannin materials 124,143,144,
 145
 Tapioca *see* Cassava starch
 Telluric current exploration 168
 Teng *see* *Shorea obtusa*
 Tetrahydroxystilbene 103,123,124
 Textiles 362,363
 Tin coating 137,138,327,
 328
 Townville stylo 349
 Trans-2-hexenyl acetate 93
 Trans-2-hexenyl butyrate 93
 Transportation 200
 central plain Thailand 199
 Vegetable oils
 garlic oil 100
 industries 248
 kenaf seed oils 281
 Vegetable proteins 76,78
 Vegetation 350
 Nakhon Phanom 197
 Vegetation maps *see* Vegetation
Vermonia anthelmintica *see* Indian
 ironweed
 Vessels (ships) *see* Ships
 Vetiver 90
 Vinegar industry 16
 Waste water 292,376,377
 Water conservation
 kenaf retting 44
 Water heaters 157,159
 Water pollution 377
 Chao Phraya river 240,241
 Water treatment 376,377
 Wax 319
 Wheat 297
 Wood pulp 273

Xylia kerrii 371
 Yang-krat *see* *Dipterocarpus*
 intricatus
 Ya-phet *see* *Arundinaria*
 pusilla

RESEARCH PROGRAMME/PROJECT INDEX

(Figures refer to abstract numbers with the years omitted)

R P 1	38	R P 15/2	119
R P 1/2	49	R P 15/3	117,120,121,
R P 1/4	30,31,32,33, 34,35,43,263, 353	R P 15/4	122 118
R P 1/5	45,46,47	R P 16/1	125,126,127
R P 1/6	50	R P 17	107
R P 1/7	48	R P 17/1	106
R P 1/8	4,5	R P 17/3	108,110a
R P 1/10	1,6,243	R P 17/4	101,105,307
R P 1/11	51,52,53	R P 17/6	103
R P 1/12	44	R P 17/7	102,305
R P 1/14	37	R P 17/8	109,110
R P 1/17	36,39,40,42	R P 17/10	308,309
R P 1/18	264	R P 17/11	104,306
R P 3/1	224	R P 18/1	239
R P 4/1	161,162,163, 164,165,166, 167,169,170, 171,172,173, 174,175,345, 346,347	R P 19/3	150
R P 4/2	176	R P 19/6	141
R P 4/3	168	R P 19/9	139
R P 4/6	157,158,159	R P 20/1	156
R P 6/3	131,132	R P 21/3	155
R P 7/2	136	R P 21/6	337
R P 7/8	134,145	R P 21/8	25,250
R P 11/1	96,302,303	R P 21/12	154
R P 11/3	99	R P 21/13	149
R P 11/4	317	R P 21/14	142,331
R P 11/5	95	R P 21/15	330
R P 11/9	97,98	R P 21/16	341
R P 11/10	304	R P 21/17	338,339
R P 11/17	93,94	R P 21/18	333
R P 11/18	89,90,91,92	R P 21/19	342
R P 13/6	60,61,62,63, 64	R P 22/1	129
R P 14/3	24	R P 23/1	84,85,86
		R P 24	232,233,234, 235,355,356
		R P 24/1	231,236,237, 238
		R P 25/1	133

R P- 26/1	225,226,227 228,229	R P 36/5	282
R P 26/4	230	R P 38/1	293
R P 27	203,204,205, 206,207,208	R P 38/2	68,79
R P 27/1	201,202,209, 210,211,212, 214,217,218, 219,220,221, 222,370,372, 373,374,375	R P 38/3	72,295,296
R P 27/2	216	R P 38/4	283
R P 27/3	223	R P 38/9	69,70,73,74, 75,76,77
R P 27/5	215	R P 38/14	71
R P 27/8	213,369,371	R P 40/1	262,285
R P 28	183	R P 41/1	194,349
R P 28/1	177	R P 44/2	284,290
R P 28/2	181	R P 44/3	65,66,286, 287,288,289
R P 28/3	182	R P 45/1	197,198
R P 28/6	178,179	R P 46/1	188,189,190, 191
R P 28/7	180	R P 46/2	192,344
R P 29/1	54,55,56,57, 58,59	R P 46/3	343
R P 30/3	199,200	R P 47	232
R P 31/4	87,88,259, 260,261	R P 47/2	242
R P 31/6	258	R P 52/2	352
R P 32/7	80,81,82,83, 253	R P 54	357,358,359, 360,361,362, 363,364,365, 366
R P 32/8	254	R P 55/5	354
R P 34/2	241	R P 57/15	301
R P 34/3	240	R P 61/1	334
R P 35/4	143,144,145		

MISCELLANEOUS INVESTIGATION/STUDY INDEX

(Figures refer to abstract numbers with the years omitted)

Miscellaneous Investigations

M I 1	151,152,153	M I 38	116
M I 2	100	M I 40	160
M I 3	146	M I 41	147
M I 4	148	M I 42	327
M I 10	193	M I 44	332
M I 14	137,138	M I 46	329
M I 15	123,124	M I 47	336
M I 21	78	M I 49	335
M I 22	184,185,186	M I 50	281
M I 23	41	M I 53	319
M I 24	316	M I 57	324
M I 27	114	M I 60	318
M I 29	111	M I 64	311,312,313,
M I 30	112		314,315
M I 32	113	M I 72	368
M I 33	114	M I 74	367*
M I 36	348,351		

Studies

s 6	8,27	s 29	9
s 26	140	s 30	248
s 27	18		

APPRAISAL REPORT INDEX

(Figures refer to abstract numbers with the years omitted)

A R 1	128	A R 16	21
A R 2	130	A R 17	187
A R 3	16	A R 18	22
A R 4	7	A R 19	10
A R 5	67	A R 20	20
A R 6	19	A R 21	2
A R 7	28	A R 22	3
A R 8	12,13,14,15	A R 23	195
A R 10	196	A R 24	29
A R 11	23	A R 25	245
A R 13	11	A R 26	321
A R 14	17	A R 27	251
A R 15	26		

CLASSIFIED INVESTIGATION INDEX

(Figures refer to abstract numbers with the years omitted)

C I 1	297	C I 12	350
C I 2	265,266,267, 268,269,270, 271,272,273, 274,275,276, 277,278,279, 280	C I 13	325
		C I 15	252
		C I 16	246
		C I 18	310*
		C I 19	340
		C I 20	326
C I 3	291	C I 23	376
C I 5	249,255	C I 25	244
C I 7	256,257	C I 26	320
C I 8	297,299,300	C I 31	377
C I 9	328	C I 33	322*
C I 10	323	C I 34	294

ศูนย์ความรู้ (ศคร.)



BE37063