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MINISTRY OF INDUSTRY

BANGKOK, THAILAND

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Ministry of Industry, Bangkok, Thailand

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Errata :

On verso of title page, 16th line.
For "(Minni)" *read* "(Minn.)"

p. 31, 14th line.
For "thoug hits" *read* "though its"

p. 44, 4th and 22nd lines.
For "FOA" *read* "FAO"

THAI SCIENCE BULLETIN

Department of Science

Ministry of Industry, Bangkok, Thailand.

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ABSTRACTS

STUDIES ON SOME THAI DAMMAR–TYPE RESINS AND THAI ROSIN

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SUMMARY

The aim of the work described in this report was to extend our knowledge of the nature and properties of certain Thai resins. The earlier work in this field is summarised in Section A of Part I which includes a short survey of the nature and properties of dammars.

The purpose of the experiments described in Section B of Part I was to discover whether all Thai dammar-type resins were the same as Singapore dammar. By means of a comparative study of physico-chemical data, it has been shown that they are but only in the case of the Ta-kian-ta-maeo and Ka-bak dammars, while the Teng, Rang, Dee-tak and Sa-ya resins could easily be East Indias. The results are discussed in Section C of Part I.

The spelling "dammar" is in accordance with the Oxford dictionary, and has been used by Joseph J. Mattiello, Ph. D., throughout his five volumes of "Protective and Decorative Coatings" (John Wiley & Sons, Inc., New York), nevertheless the spelling "dammar" will be found in some literature.

The second phase of the work is concerned with rosin (Part II). It has been shown that Thai rosin, if properly prepared, will rank with American and Bordeaux rosins.

PART I -- RESINS

Section A

Introduction

Natural resins are exudations of trees of many different genera and species, or of insects. Von Fischer ("Paint and Varnish Technology", (1948), p. 119) classified this group of natural products as fossil resins and recent resins.

Fossil resins are found in the ground as exudates of trees long dead. Generally, they are hard and friable, as most of the essential oil has evaporated. This group contains such resins as amber, kauri, congo, boea, manila, pontianak, etc.

Recent resins are collected from living trees as oleoresins which generally will harden rapidly on standing.

Natural resins are characterized by their great chemical stability and inertness, and are not easily attacked by acids or alkalies. A system for classification of natural resins introduced by Mattiello ("Protective and Decorative Coatings", J. Wiley & Sons, Inc., New York, (1946), pp. 2—6) proposed a border line between rosin and other natural resins as follows :

"Section A. Natural resins and modified natural resins.

Class 1. Natural resins other than rosin.

Group a. Woody origin

(1) Dammars and related East Indias.

(a) Batavia and Singapore dammars.

(b) Pale, Black, and Batu East India resins.

(2) Copals.

(3) Miscellaneous tree resins.

Group b. Insect origin. Shellac and other lacs.

Class 2. Rosin and modified rosin resins.

Group a. Gum and wood rosin.

. . . ."

The trade usually refers to the natural resins as "gum" which obviously is a misnomer.

From the technological point of view, Mantell, Kopf, Curtis, and Rogers ("Technology of Natural Resins", John Wiley & Sons, Inc., New York (1942), 5) divide resins into two classes, viz., spirit soluble and oil soluble.

Origin of Natural Resins

The following data are given in Mantell's "Tech. of Nat. Resins" p. 10, except details given in parenthesis which are taken from Mattiellos "Protective and Decorative Coatings", vol. I, 218. Present geographical names replace the former ones used by the original authors.

Name	Tree	Place of Origin
Dammar Class		
Batavia dammar	Hopea, Shorea	Sumatra, Borneo, Java, Indonesia
Batu	Hopea, Sharea, and Vatica	Malayan Federation, Indonesia
Black East India	Burseraceae	Malayan Federation, Indonesia
East India Macassar	DIPTEROCARPACEAE largely from Shorea	Macassar, Indonesia
East India Singapore	Balanocarpus	Sumatra, Borneo, Malayan Federation, Indonesia
Singapore dammar	Hopea, Shorea (DIPTEROCARPACEAE)	Indonesia (Malayan Federation)
Copal Class		
Manila	Agathis alba	Indonesia, Philippines
Kauri	Agathis australis	New Zealand
Congo	Copaifersa	Belgian Congo, Africa
Miscellaneous		
Accroides	Xanthorrhoea	Australia, Tasmania
Elemi	Canarium Inzonicum (C. communis)	Philippines
Mastic	Pistacia lentiscus	Is. of Chios, Greece
Sandarac	Tetraclinis articulata (CONIFERAE)	Mogador, North Africa (Australia)

Dammars

Among recent resins, dammar is one of the most important, judging by its wide industrial application. Dammars are generally pale in colour, ranging from strong yellow to water white (Mantell et al, ibid., 31). Dammars are tapped from trees of Hopea and Shorea species of the DIPTEROCARPACEAE family. An investigation by the Department of Forestry showed that Thai dammars were tapped from Anisoptera glabra (Ka-bak), Cotylelobium lanceolatum (Kiam), Hopea odorata (Ta-khian), Balanocarpus heimii (Ta-khian-ta-maeo), Shorea obtusa (Teng), Shorea hypochra (Pa-nong), Pentacme siamensis (Rang), Shorea spp. (Sa-ya), etc. (cf. "Siamese Plant Names", Part 1, Botanical names—local names, lst. Ed., Royal Forestry Department (1948)).

The present commercial system of classification is mainly based on places of shipping, not on their geographical or botanical sources, thus resulting in various varieties of dammar to be graded as Singapore or Batavia dammars (Mantell et al, ibid., 33). Exported Thai dammars, for instance, dammar from Shorea hypochra, are commercially designated as "Singapore dammar" (Table CXLIV, Mantell et al, ibid., 483).

Physico-Chemical Properties of Dammars

Data given for Singapore dammar No. 1 (Snell and Biffen, "Commercial Methods of Analysis" (1944), 475) are as follows :—

Specific gravity, 20°/20°C.	1.04 — 1.06
Refractive index, 20°C.	1.52 — 1.54
Acid value (direct)	17

Saponification value	36	—	39
Iodine value	103	—	123

Whereas those given by Mattiello are :—

Density, 25°C.	1.03	—	1.06
Refractive index, 25°C.	1.535	—	1.538
Acid value	17	—	33
Saponification value	27	—	50
Iodine value	95	—	127
Softening point (°C.)	67	—	80

Mantell et al gave data for Singapore No. 1 correlated to those given by Snell and Biffen, but deviations appeared in data for other grades.

Chemical Composition of Dammars

The chemical composition of dammars has been studied by a number of investigators. The more important results obtained are :—

Constituent	Formula	M.P. °C.	%	Note
Dammarylic acid	$C_{56}H_{80}O_8$ or $C_{54}H_{77}O_3$ .OH $(COOH)_2$	—	23.0	(1)
α-Resene	$C_{11}H_{17}O$ or $C_{24}H_{34}O_2$	65	40.0	(1)
β-Resene	$C_{31}H_{52}O$	206	22.5	(1)
Water			2.5	(1)
Ash			3.5	(1)
Impurities			8.0	(1)
Losses			0.5	(1)
Dammarylic acid	$C_{36}H_{60}O_3$			(2)
Dammaryle (a terpene)	$C_{10}H_{16}$			(2)

Constituent	Formula	M.P. °C.	%	Note
Dagincoleic acid	$C_{22}H_{44}O_4$	170	35	(3)
Dagingenoleic acid	$C_{13}H_{26}O_3$	125-126	15	(3)
Resene	$C_{22}H_{28}O$		16	(3)
Oil		B.P. 165-200	15	(3)
	$C_{16}H_{26}O_2$	135	18	(4)
3 Acids	$C_{14}H_{32}O_2$	103-105	25	(4)
	$C_{12}H_{18}O_2$	120-122	18	(4)
Volatile oil			8	(4)
An acid	$C_{11}H_{20}O$		3	(4)
A resene	$C_{12}H_{22}O_2$		15	(4)

In general, dammar resin consists of two resin acids and α -and β -resene together with a small amount of an essential oil of a terpene type. Isolation of resin acids is affected by extraction with hot dilute aqueous sodium hydroxide, followed by precipitation with mineral acid. Extraction of the resin with ethanol yields α -resene in the alcoholic solution, whereas β -resene is unaffected. Removal

(1) Batavia dammar. Tschirch and Glimmann, Arch. Pharm., (1896), 585.

(2) These results are attributed to Franchimont, but no reference is given (cf. Mantell et al., ibid., 40).

(3) A Borneo dammar called "dammar duging" by the natives. Gottlieb, Bull. soc. chim., (1912), II, 719.

(4) A Borneo dammar apparently of semi-fossil nature. Gottlieb, Bull. soc. chim., (1912), II, 720; also see Zinke and Unter-Kreuter, Umv. Graz Monatsh., (1918), 39, 865-9: J. Chem. Soc.

of β-resene or "dammer wax" involves a "dewaxing process" which usually consists of dissolving the resin in an appropriate solvent, followed by precipitation of β-resene by addition of ethanol (Schultze, U.S. Patent (1945) 2,384,138 : de Hass. D.R.-P. (1950) 65604).

Physical Properties

Commercial Grading

The following grading systems are commercially accepted :—

Batavia Dammars :

Batavia dammar A/E standard
Batavia dammar A/D mixed
Batavia dammar A
Batavia dammar B
Batavia dammar C
Batavia dammar D
Batavia dammar E
Batavia dammar F
Batavia dammar dust

The letter designations for Batavia dammars are based primarily on size classifications and secondarily on colour and impurities. The gradings employ a set of screen designated A to E, the A dammar is retained on A screen and the F dammar passes through E screen. The A grade contains about 0.1 % non-resinous matter, the B, C, and D grades but slightly more, whereas the F grade may contain 3.5 % and the dust 4 to 6 %.

Singapore Dammars :

Singapore dammar No. 1
Singapore dammar No. 2
Singapore dammar No. 3

Singapore dammar chips
Singapore dammar seeds
Singapore dammar dust

The grading system for Singapore dammar is on the basis of colour and freedom from impurities, the No. 1 is almost white and translucent almost to the point of being transparent. The designation of chips, seeds and dust are size classification, but naturally, as the size decreases the impurities increase.

Scratch Hardness

Dammars are naturally softer than fossil resins. The usual order of hardness is as follows :-

1. Congo
2. Kauri
3. Boea
4. Pontianak
5. Accroides
6. Loba
7. Pale East India
8. Black East India
9. Batu
10. Manila malengkets
11. Dammar
12. Sandarac
13. Mastic
14. Elemi

Solubility

Solubility in commercial solvents is of prime importance. Various classes of natural resins show definite solubility types (Mantell and Allan, Ind. Eng. Chem., 1938, 30, 262). Dammars fall into the hydrocarbon soluble/alcohol insoluble type.

Batavia and Singapore Dammars :

Solubility Type :	Aryl and aliphatic hydrocarbons, terpenes.
Insolubility Type :	Alcohols, esters.

Soluble in :	Chlorinated compounds, coal tar hydrocarbons, petroleum, terpenes, carbon disulphide, tetralin, paraffin, hydrogenated and naphthenic petroleum naphthas.
Insoluble or Swollen in :	Alcohols, alcohol-ethers, alcohol-esters, Cellosolve acetate, acetic acid, aniline, ethylene glycol diethyl ether, ethylene oxide, glycol diacetate, hexalin, nitrobenzene, phenol, propylene oxide, tricresyl phosphate, diethylene oxide.

Viscosity

Commercial method for the determination of viscosity of dammar solutions is by means of the Gardner-Holdt bubble viscosimeter whenever possible.

The results may be summarized as follows (Mantell et al, ibid., 143) :-

(1) The more powerful solvents tend to yield slightly lower viscosities.

(2) The distillation ranges of petroleum solvents and hydrogenated petroleum solvents have an effect on the viscosities of Batavia dammar solutions; the solvents with higher distillation ranges give Batavia dammar solutions of higher viscosities.

(3) The viscosities of Batavia dammar solutions increase logarithmically with increase in concentration.

(4) Toluene is the best solvent of the three for dammar, with Solvesso No. 1 second, and solvent naphtha 55 third.

(5) Batavia dammars F and dust increase in viscosity enormously after the 50 per cent concentration point is reached.

Resins of Related Dammar Type

East India Resins

The East India resins are divided into three classes:-

Pale East India (Hiroe from Macassar, and rasak from Singapore)
Black East India
Batu

All three are derived from trees of the same family which produce Batavia and Singapore dammars, but the East India resins are of greater age and hardness, i. e. of the semi-fossil nature, and are sometimes classified as "hard dammar".

The East India resins are not tapped from the trees, but are collected where found. Batu is always a mixture of resins from quite a number of different tree species, including those of Shorea, Hopea and Vatica.

Native Designations of Dammar

(Present geographical names are used in the column "Place of Origin")

Name	Place of Origin	Type	Present Day Classification
Batavia dammar	W. Java, E. Sumatra Indonesia	Dammar	Batavia dammar
Batjan dammar	The Moluccas	Dammar	
Batu Batu dammar	Indonesia	Dammar	Batu
Bengkong dammar	Malacca, Malayan Federation	Dammar	Dammar
Black dammar	India	Dammar	Black East India
Borneo dammar	Borneo, Indonesia	Dammar	Dammar
Cambodian dammar	Cambodia	Dammar	Singapore dammar
Celebes dammar	Celebes. Indonesia	Dammar	Batavia dammar
Chan	Thailand	Dammar	Singapore dammar
Cochin-China dammar	Vietnam	Dammar	Dammar
Daging dammar	Malayan Federation, Borneo, Indonesia	Alc. sol. copal	Native designation for pontianak manila

Dead dammar	Malayan Federation	Semi-fossil	Dammar
Duging dammar	Borneo, Malayan Federation	Dammar	Dammar
East Indian dammar	Indonesia	Dammar	Batavia dammar
Hiroe dammar	Malayan Federation	Dammar	Pale East India
Hitam dammar	Malayan Federation	Dammar	Black East India Dammar
Indian dammar			
Kala dammar, see Black dammar			
Kekulot dammar	Malayan Federation	Dammar	Dammar
Kepong dammar	Malayan Federation	Dammar	Dammar
Kumus dammar	Malacca, Malayan Federation	Dammar	Dammar
Lal dhuna	India	Dammar	
Meta Kuching dammar	Malayan Federation, notably Malacca; Java, Sumatra, Indonesia	Dammar	Batavia dammar
Mati dammar, see Dead dammar			
Melanti dammar	Kedah	Dammar	

Name	Place of Origin	Type	Present Day Classification
Meranti dammar	Malacca, Malayan Federation	Dammar	
New Zealand dammar, see Kauri			
Nubian copal, see Selan dammar			
Padang dammar	Sumatra, Indonesia,	Dammar	Dammar
Papuan dammar	New Guinea	Dammar	Black East India
Pedang dammar, see Padang dammar			
Penak dammar	Malayan Federation	Dammar	Singapore dammar
Penang dammar	Malayan Federation	Dammar	Singapore dammar
Panjaoe dammar	Borneo	Dammar	
Perak dammar	Malacca, Malayan Federation	Dammar	
Piney resin (or gum) see White (Indian) dammar			

Pontianak dammar	Borneo	Dammar	Batavia dammar
Puti dammar	Probably obtained from Sumatra	Dammar	
Raja dammar	Borneo	Dammar	Batavia dammar
Rasak dammar	Borneo, Malayan Federation	Dammar	Pale East India Singapore
Rock dammar	India, Malayan Federation, Borneo, Burma, Indochina	Dammar	Dammar
Sal dammar	India, Burma	Dammar	
Saraya dammar	Malayan Federation	Dammar	
Selan dammar	Molucca Islands, Philippines, Java and Sumatra	Dammar	
Sengai dammar	Malayan Federation	Dammar	Black East India
Siamese dammar	Thailand	Dammar	Singapore dammar
Singapore dammar	Malayan Federation	Dammar	Singapare dammar
Siput dammar	Malayan Federation	Dammar	
Songyi dammar	Malacca, Malayan Federation	Dammar	

Name	Place of Origin	Type	Present Day Classification
Soongyi dammar, see Songyi dammar			
Strayah dammar	Malacca, Malayan Federation	Dammar	
Sumatra dammar	Sumatra, Indonesia	Dammar	Singapore dammar
Tamak dammar	Malayan Federation	Dammar	
Tawao dammar, see Hiroe dammar			
White (Indian) dammar	India	Dammar	Dammar (used locally)
Yang Panawng dammar			The native name for a Siamese dammar

(From Mantell, Kopf, Curtis and Rogers, "Technology of Natural Resins" p.p. 477-483. This list includes many resin names not in commercial use.)

Section B

Experimental Part

It has been described in Section A that physico-chemical data available in the literatures are only of commercial or industrial value, since investigations have been made on specimens graded by commercial sources, i.e. point of entrance into commerce, not by scientific sources. The question then arose as to the conformity of Thai dammar-type resins' properties to the available data. Additional ambiguity was contributed by confusion in the nomenclature "*chan*". Originally it was understood that "chan" was a resin of the dammar type, but later on specimens such as rosin, gamboge and gum benzoin were received labelled "chan...," as well as true dammar type resins.

Methods of Analysis

(1) *Sampling*

Representative specimens of resin received from the Department of Forestry were finely ground (to pass 80 mesh screen) and kept in clean containers.

The possibility of adulteration was excluded since these specimens could be regarded as authentic.

(2) *Specific Gravity*

It has been found that specific gravity of a given resin usually varies inversely with the temperature and with the hydrocarbon chain length. It varies directly with the ratio of oxygen, halogens, and sulphur content, and in most instances, with the degree of unsaturation and the degree of polymerization and cyclization.

The determination of specific gravity was carried out by means of a pycnometer. Mattiello ("Protective and Decorative Coatings", vol. V, Analysis and Testing Methods, p. 118) suggested the addition of a wetting agent to facilitate wetting of the resin fragments, and to insure the removal of air bubbles.

With the present available facilities, the above technique would not be developed.

The specific gravity was calculated from the obtained data as follows:—

If a = weight of pycnometer, dry,
b = weight of pycnometer filled with water,
c = weight of pycnometer plus sample,
d = weight of pycnometer plus sample plus water,
t = temperature at which the weighings were made = 25°C. then

$$\text{Sp. gr.}_t = \frac{c-a}{(b-a)-(d-c)}$$

Conversion of sp.gr. $_{25°/25°}$ to density, $d_{25°}$, could be achieved by multiplying sp. gr. $_{25°/25°}$ with 0.99707.

(3) *Refractive Index*

The refractive index is a constant for any given substance of definite composition. This constant varies inversely with the temperature (Mattiello, ibid., vol. V, 113). An Abbe refractometer could be satisfactorily used for the refractive index determination of solid resins (Bhattacharya, Indian J. Phys., (1940), 14, 237; West, Ind. Eng. Chem., Anal. Ed., (1938), 10, 627).

Data shown in this report were obtained indirectly by the method described by Mantell, Kopf, Curtis and Rogers ("Technology of Natural Resins", p. 465). A series of resin solution was prepared using the same solvent with concentrations ranging from 10 % upwards. The indices were measured by means of an Abbe refractometer (Zeiss) equipped with a Hoeppler thermostat. By plotting the values of refractive index against resin concentrations, the value for pure resin was obtained by extrapolation to the ordinate representing 100 % resin concentration.

It was found that satisfactory readings could not be obtained from most samples unless the resins were primarily purified until free from foreign heterogeneous matters. Temperature selected was 40° C. which was conveniently attained, and toluene was employed as a solvent.

It should be mentioned that the refractive indices given by Mantell et al (loc. cit.) are not accompanied by any specified temperature. Snell and Biffen ("Commercial Methods of Analysis", 475) gave values at 20°C. whereas Mattiello (ibid., vol. V, 115) gave values at 25°C.

Nevertheless, the refractive index at any desired temperature can be calculated from the following formula (Mattiello, ibid., vol. V, p.183) :—

$$n = n' + K(T' - T)$$

where n = refractive index at the desired temperature,
n′ = refractive index as measured,
T = desired temperature,
T′ = temperature as measured,
K = constant, equivalent to 0.00038 scale division per °C.

(4) *Moisture Content*

This determination usually produces a result which will include a certain amount of volatile oil together with the true water content. Mantell et al (ibid., p. 465) suggested two methods for determination of moisture content. In this investigation, his first method— heating above the boiling point of water— was selected, since existing apparatus could be conveniently employed.

Two to three grammes of sample was spread out in a Petri dish and left for 3 hours in an oven at 105°C. The sample was weighed after it had been left in a desiccator to cool to room temperature. The loss in weight was considered to be the moisture content.

(5) *Melting Point*

A small amount of ground sample was placed in a capillary melting-point tube and heated in a liquid bath. The range of temperature at which melting occurred was recorded.

(6) *Ash Content*

Ash content indicates the amount of mineral matter present, and should be negligible for the better grades of resin.

Crushed resin (2 gm.) was placed in a weighed crucible and ignited. The residue was then ashed to a constant weight after the flame had subsided. The residue represented the ash content and was reported as a percentage of the original sample (Mantell et al, ibid., p. 460).

(7) *Toluene-insoluble Content*

(cf. Mantell et al "Technology of Natural Resins", 458)

Five to ten grammes of sample was placed in a weighed, dry, extraction thimble (Whatman "Fat Extracted") and extracted with toluene in a Soxhlet extractor. When the extraction was completed, the thimble and its content was removed, dried in an oven, let stand to cool in a desiccator, and weighed. The residue represented the toluene-insoluble content, and was reported as a percentage of the original sample.

(8) *Toluene-soluble Content*

The percentage of toluene-soluble content was obtained by difference of the toluene-insoluble content.

(9) *Dammar Resene Content*

Determination of the amount of β-resene or "dammar wax" can be achieved by two recognized methods producing different results. The first method produces a result in which any dirt in the original sample is reported along with the wax as per cent "wax". The second method involves separation of extraneous matter from the wax and the result reported as per cent β-resene.

In this investigation the latter method was used (cf. Mantell et al, ibid., 465). The solution of resin in toluene from (7) was concentrated and an equal volume of ethanol was then added. The mixture was set aside for 48 hours to allow β-resene precipitate to settle. The supernatant liquid was decanted and the residue washed several times with 3:1 ethanol-toluene mixture, then dried in an oven at 105°C. for an hour, cooled, and weighed. Results of β-resene determination were reported as percentage of the original sample.

(10) *Acid Value (Direct)*

(Mantell et al, "Technology of Natural Resins", 456: Mattiello, "Protective and Decorative Coatings", vol. V, 122).

One gramme of sample was dissolved in toluene (50 ml.), and ethanol (50 ml.) was then added to the solution. The mixture was allowed to stand from 2 to 4 hours, then the cloudy suspension was titrated with standard alcoholic potassium hydroxide solution (0.1 N), using phenolphthalein as an indicator. Blank determinations were run at the same time.

Acid value was expressed as the number of milligramme of potassium hydroxide required per gramme of resin.

$$\text{Acid value} = \frac{\text{Normality x volume of alkali x 56.1}}{\text{Weight of sample}}$$

(11) *Saponification Value*

One gramme of resin was dissolved in the same manner as in (10), in a 300-ml. flask. Standard alcoholic potassium hydroxide (0.5 N, 10 ml.) was added by means of a pipette. An air condenser was fixed to the flask, and the content refluxed for 45 minutes. Phenolphthalein indicator was added, and the mixture titrated with standard aqueous sulphuric acid (0.3 N). A blank determination was run with each set of samples. The saponification number was reported as the milligrammes of potassium hydroxide per gramme of resin.

$$\text{Saponification value} = \frac{\text{(N x ml. alkali)} - \text{(N x ml. acid) x 56.1}}{\text{Weight of sample}}$$

Note

(a) Ester value = Saponification value—Acid value

(b) Neutralization, saponification, and ester equivalents were calculated by dividing 56100 with the acid, saponification, and ester values, respectively.

(c) A shorter procedure for the determinations of acid and saponification values was also carried out as follows :—

A sample of resin was weighed, dissolved, and titrated with standard alkali as described in (10). The titre was accurately noted, and an additional volume of the same standard alkali was added to make up a certain volume. The mixture then refluxed as described in (11). Back titration with standard acid was carried out as in (11). Saponification value was calculated on the basis of the total volume of alkali used, while acid number was calculated from the first titre.

(12) *Iodine Value*

Following Mantell's recommendation (ibid., 467), the Hübl method was employed.

The procedure was described by Mantell as follows:

"Twenty-five grammes of iodine is dissolved in 500 ml. of 95 per cent ethyl alcohol. Thirty grammes of mercuric chloride is dissolved in 500 ml. of 95 per cent ethyl alcohol. The iodine solution is prepared by mixing these two solutions and allowing to stand for 12 to 24 hours. A 0.2-gm. sample is dissolved in 10 ml. of pure carbon tetrachloride in a 500-ml. flask. Twenty-five cubic centimetres of the iodine solution is run in from a pipette and the flask stoppered and allowed to stand in the dark overnight. Fifteen cubic centimetres of a 10 per cent aqueous solution of potassium iodide is then added, the liquid well shaken, and diluted with 250 ml. of water. The excess of free iodine is titrated with a standard solution of sodium thiosulphate. A few drops of starch solution is used as the indicator."

The iodine number was reported as centigrammes of iodine absorbed per gramme of resin. A blank determination was run with each set of samples.

TA–KHIAN–TA–MAEO RESIN

Botanical source : Balanocarpus heimii (Ta-khian-ta-maeo)

Place of origin : Southern Thailand, notably Yala and Naradhivas

Physical appearance : Sample received in large lumps, almost transparent, and pale yellow in colour

Commercial designation : White dammar

Physico-chemical properties :

(1)	Specific gravity	1.07
(2)	Refractive index	1.5385
(3)	Moisture content, %	0.8
(4)	Melting point, °C.	87—96
(5)	Ash content, %	0.05
(6)	Toluene-insoluble content, %	2.65
(7)	Toluene-soluble content, %	97.35
(8)	β-resene content, %	19.94
(9)	Acid value	38
(10)	Saponification value	42.5
(11)	Iodine value	76.8—100.9

TENG RESIN

Botanical source : Shorea obtusa (Teng)

Place of origin : Forests all over Thailand, with an exception of the Southern provinces.

Physical appearance : Sample received in large yellow lumps of waxy appearance, almost opaque with shiny surfaces and brittle.

Commercial designation : Teng dammar

Physico-chemical properties :

(1) Specific gravity	1.1
(2) Refractive index	1.5545
(3) Moisture content, %	1.5
(4) Melting point, °C.	145 — 150
(5) Ash content, %	0.03
(6) Toluene-insoluble content, %	1.33
(7) Toluene-soluble content, %	98.67
(8) β-resene content, %	29.7
(9) Acid value	37
(10) Saponification value	65.9 — 70.5
(11) Iodine value	64.3 — 68.2

RANG RESIN

Botanical source : Pentacme siamensis, Kurz. (Rang)

Place of origin : Nakorn Rajsima

Physical appearance : Samples received differed in size and appearance. Some transparent pieces were dark brown in colour, while some were opaque and the whole piece appeared waxy.

Commercial designation : Ingyin dammar

Physico-chemical properties :

(1)	Specific gravity	0.97
(2)	Refractive index	1.5410
(3)	Moisture content, %	0.67
(4)	Melting point, °C.	146 — 163
(5)	Ash content, %	0.33
(6)	Toluene-insoluble content, %	2.72
(7)	Toluene-soluble content, %	97.28
(8)	β-resene content, %	47.4
(9)	Acid value	21.4 — 22.5
(10)	Saponification value	32 — 38
(11)	Iodine value	51.8 — 65.1

SA – YA RESIN

Botanical source : Shorea spp. (Sa-Ya)

Place of origin : Southern Thailand, notably Yala and Naradhivas. (Sample investigated was from Yala)

Physical appearance : Large, opaque, heterogeneou spieces ; dark brown in colour, with considerable proportion of white waxy streaks.

Commercial designations : Seraya or Meranti dammar

Physico-chemical properties :

(1)	Specific gravity	1.15
(2)	Refractive index	1.5445
(3)	Moisture content, %	2.27
(4)	Melting point, °C.	119 — 128
(5)	Ash content, %	2.74
(6)	Toluene-insoluble content, %	11.4
(7)	Totuene-soluble content, %	88.6
(8)	β-resene content, %	13.82
(9)	Acid value	37
(10)	Saponification value	58 — 62
(11)	Iodine value	68.4 — 72.1

KA—BAK RESIN

Botanical source : Anisoptera glabra (Ka-bak)

Place of origin : Ubol Rajdhani

Physical appearance : Small pieces, varying in colour and appearance, from clear yellow to dark brown and waxy white.

Commercial designation :

Physico-chemical properties :

(1)	Specific gravity	0.94
(2)	Refractive index	1.5555
(3)	Moisture content, %	3.60
(4)	Melting point, °C.	82—93
(5)	Ash content, %	0.33
(6)	Toluene-insoluble content, %	2.12
(7)	Toluene-soluble content, %	97.88
(8)	β-resene content, %	2.12
(9)	Acid value	34
(10)	Saponification value	50—54
(11)	Iodine value	78.2

DEE–TAK RESIN

Botanical source : Shorea spp. (Dee-tak)

Place of origin : Chasherngsau

Physical appearance : Large brown pieces, opaque in appearance, covered with white, waxy coat. Brittle.

Commercial designation :

Physico-chemical properties :

(1)	Specific gravity	1.103
(2)	Refractive index	1.5530
(3)	Moisture content, %	2.3
(4)	Melting point, °C.	160—165
(5)	Ash content, %	0.1
(6)	Toluene-insoluble content, %	0.22
(7)	Toluene-soluble content, %	99.78
(8)	β-resene content, %	38.22
(9)	Acid value	42
(10)	Saponification value	51.32
(11)	Iodine value	59.3

SECTION C

Discussion

The resin from Balanocarpus heimii (Ta-khian-ta-maeo) is the only Thai dammar-type resin found described in some detail in the literature. Foxworthy (Mal. For. Rec., (1932), 10, 149) considered this resin to be one of the finest qualities of dammar known, and gave its Malayan name as "dammar penak". He also found that the dammar changed when aged, as could be detected by its increasing acid value and changes in colour (cf. Burkill, "A Dict. of the Econ. Prod. of the Malay Pen.", vol. I (1935), p. 286).

Penak dammar is classified as a Singapore dammar (see p. 15), thoug hits Balanocarpus origin might easily lead to the belief that it belongs to the East India type (see p. 4). Our specimen shows an acid value of 38, which is slightly higher than the value for Singapore No. 1. Other physico-chemical data correlate in general to the values given for Singapore dammar.

If the melting points are to be taken as a primary means of distinguishing the rest of our resins, a basis for comparison with known melting points of various resins in the dammar class is established.

Mattiello ("Protective and Decorative Coatings", vol. I, pp. 220-221) gives a table which can be summarized as follows :

Pale East India, Macassar (Hiroe)	127—156°C.
Rale East India, Singapore (Rasak)	138—156°C.

Batu East India	165—180°C.
Black East India	159—164°C.

It appears that East India resins melt from 127°C. upward, and dammars melt below this temperature.

Resins under investigation with melting point higher than 127°C. are those from Shorea obtusa (Teng), Pentacme siamensis (Rang), and Shorea spp. (Dee-tak). The resin from Shorea spp. (Sa-ya or Seraya) is a border-line case, having a melting point range of 119—128°C. Those that melt below 127°C. are resins from Balanocarpus heimii (Ta-khian-ta-maeo) and Anisoptera glabra (Ka-bak).

From above deduction, the so-called Teng dammar, Rang dammar and Dee-tak dammar, when necessary maturity is attained, should be classified as "East India" rather than Singapore or Batavia dammars. Similarly, the Ka-bak dammar is confirmed to be a true dammar. Ambiguity remains regarding the Sa-ya dammar, because an attempt to postulate any classification will be disadvantageous owing to its heterogenity.

Evidence supporting the contention that maturity has not yet been attained by Teng, Rang and Dee-tak resins is their comparatively high moisture content, which naturally includes some percentage of the volatile essential oil retained in the resins. This was found to be 1.5% for Teng resin, 0.6% for Rang resin and 2.3% for Dee-tak resin.

An attempt to classify these three resins any further would be entirely premature, except on the colour basis, which is not likely to be much affected by time. Thus Teng resin is likely to fall in the "Pale East India" category, while the Rang and Dee-tak resins should be either "Batu" or "Black East India" class.

PART II - - ROSIN

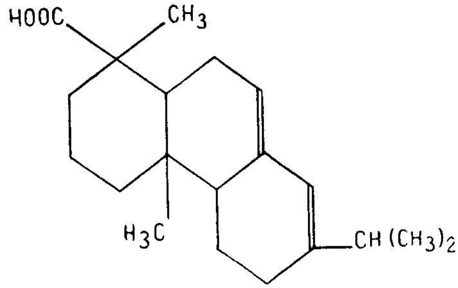
Introduction

Sources of rosin are trees of the Pinus species which includes P. palu tris, P. maritima, P. pinaster, P. australis, P. laricis, and P. taeda (Chatfield, "Varnish Constituents", Leonard Hill Ltd., London, (1947),101). Resins from P. insularis, P. caribaea, P. insignis, P. pithyusa and P. sylvestris have been previously examined (Kurth and Sherrard; Ind. Eng. Chem., (1932), 24, 1179: Kurth, ibid., (1933), 25 192: Tanchico, Philippine J. Sci., (1932), 47 481 and 48, 1: Arbusov, J. Appl. Chem. Russ., (1932), 5, 787).

Various methods of production are available. A rather primitive method of tapping to collect oleoresin is carried out in this country. The "gum" or oleoresin usually contains about 68% rosin, 20% turpentine and 12% water (Romain, Chem. Industries, (1939), 45, 402). The oleoresin is then subjected to treatments, such as steam-distillation, to separate turpentine from rosin. Hitch (Ind. Eng. Chem., (1931), 23, 1275) has shown that a certain amount of turpentine is left in rosins and that the lighter grades often have a higher turpentine content.

There are two different types of rosin, namely, gum rosin and wood rosin (Chatfield, ibid., 101). Gum rosin is an exudate of living trees obtained from the oleoresin, whereas wood rosin is obtained by treatment of dead stumps. Thai rosin should be of the gum rosin type.

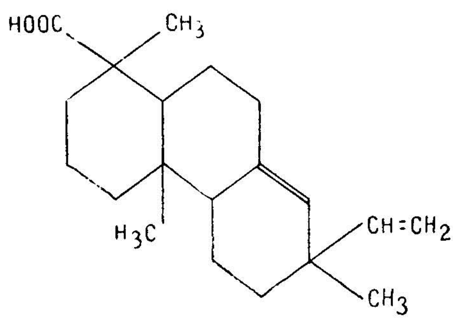
Rosin consists of approximately nine parts of isomeric acid and one part of unsaponifiable matter (Smith, Ind. Eng. Chem., (1936), 28, 408). The principal constituents of rosin are abietic acid or its isomer.



ABIETIC ACID

(*Zeiss, Chem. Rev., 1948, 42, 165*)

Kemner (Farben-Ztg., (1936), 41, 889) has shown that the chief acid of most European rosins is pimaric acid.



PIMARIC ACID

(*Hasselstrom and Hampton, J. Amer. Chem. Soc., (1939), 61, 967: Harris, Paper presented at the 110th Meeting of the Amer. Chem. Soc., Sept. 1946*)

Tochirch (C.A., (1921), 15, 767) divides rosins into two groups depending upon whether they contain pimaric or abietic acid. American rosin (chiefly from P. palustris) contains abietic acid, and French rosin (chiefly from P. maritima) contains pimaric acid. An excellent review of rosin acids appears in the Chemical Review, (1948), 42 pp. 163—187, by H.H. Zeiss.

Thai rosin is tapped from Pinus merkusii (Kia) and Pinus khasya (Son).

Experimental Part

A sample of Thai rosin was studied with results as follows:—

Botanical source: Pinus merkusii (Kia).

Place of origin: Northern, North-eastern and Central regions of Thailand.

Physical appearance: Large, brown pieces, almost transparent.

Commercial designation: Chan-son

Physico-chemical properties: (For methods of analysis, see pp. 17—24)

(1)	Specific gravity	1.08
(2)	Refractive index	1.5085
(3)	Moisture content, %	1.3
(4)	Melting point, °C.	79—81
(5)	Ash content, %	0.63
(6)	Toluene-insoluble content, %	1.2
(7)	Toluene-soluble content, %	98.8
(8)	Acid value	174.7
(9)	Saponification value	178—183
(10)	Iodine value	73.7—84.6

Chemical Test: Positive Liebermann-Storch test (Liebermann, Ber., (1884), 17, 1884: Storch, Ber. osteri. Ges. chem. Ind., (1887), 9, 93: Morawski, Chem.-Ztg., (1888), 12, 1321: Mantell et al, "Tech. of Nat. Resins", pp. 441-444).

Solubility: Soluble in ethanol.

Discussion

Comparison of Thai rosin with Indian, American, and Bordeaux rosins is as follows:—

	Indian 1.	*Indian* 2.	*American*	*Bordeaux*	*Thai*
M.P., °C.	75—85	74	—	—	79—81
Sp. gr.	1.067		—	—	1.08
Moisture content, % . . .	—	0.80	—	—	1.3
Ash, %	0.125	0.15	—	—	0.63
Saponification value	190	184	184	184	178—183
Acid value	165	174	176	175	174.7

(Data for Indian, American and Bordeaux rosins are taken from Imperial Institute Reports of the Indian Trade Enquiry on Lac, Turpentine and Rosin, John Murray, London (1922)).

It can be seen that Thai rosin possesses a chemical quality rivalling the American or Bordeaux rosins. If it were properly prepared the colour could be made paler and the percentage of moisture (including turpentine) and ash could be considerably reduced.

DIETARY SURVEY IN THE CHOLBURI PROVINCE, THAILAND

By

Uthai Bisolyaputra, B. Sc.

Rabieb Vachanond, B.Sc., C.P.H. and Vina Vatanasarn, B.Sc.

Department of Health

This piece of work concerns the study of the diet of a group of rural folks living in a subdistrict of Cholburi Province. It clearly shows poor diets and urges greater efforts to balance these rural diets in a prosperous province as that of Cholburi Food is now recognized as the foundation of health and I believe it is timely to publish this article so that more interest could be aroused in nutrition. *—Yong Chutima, M.D., Director of Nutrition Division.*

In cooperation with the Health Development Project aided by FAO to Thailand. A Health Demonstration and Training Center has been established in Cholburi. The objectives of this Center are to demonstrate a modern public health program as adaptable to the needs of Thailand and to use the Demonstration for the training of public health workers. Some of the sanitation activities of the Center were being carried out in the Community of Bansurd in the Panusnikom district in the province of Cholburi. An intestinal parasite survey is being carried out by the Division of Communicable Disease Control and it was decided to also include a nutrition survey carried out by the Division of Nutrition in the work at Bansurd.

Nutrition activities in Cholburi were started with dietary survey which is important as a basis for development of health of the people in the said area. Since dietary surveys reveal clearly the condition of diets and consumption levels of the people, the result of these would thus be informative and would serve as a background for proper measures and developments which might be established in the future. It is believed also that this would help much in planning other health programs of this area as well.

Cholburi is one of the administrative and prosperous provinces of Thailand, about 100 kilometers south-east to Bangkok. The province is somewhat flat and fertile lying along the east coast of the country. Most of the inhabitants comprise farmers and fishermen. In addition to their main activities, sugar-canes, coconuts, fruits, tapioca as well as nut and bean crops are also cultivated.

Bansurd is a community belonging to Panusnikom District in the Province of Cholburi and consists of 8 villages with 313 families of 1,500 population. The community is situated on both sides of the highway connecting the districts of Cholburi and Panusnikom. Inhabitants comprise mostly farmers with somewhat low standards of living. Their chief economic resources are derived from rice with the exception of a few families who earn their incomes partly from bullock-cart construction.

METHOD OF STUDY

Following the suggestion of the Director of Health Demonstration and Training Center in Cholburi whose information had been made known to us that, owing to poor communication, it was impossible to reach some villages by ordinary transportation means, 4 villages were then selected for this study, numbering 139 families of 523 population and, out of these, half of the number were taken as samples.

The survey was made twice during 1952 by officials of the Nutrition Division under supervision of Rabieb Vachanond and Vina Vatanasarn, the nutritionists of the Division. Work was started on October 14th and finished on November 15th, 1952. It was again repeated on February 3rd to February 10th, 1952, numbering altogether 40 working days. General informations, concerning economic levels, standards of living and efficiency of the people in the area, were collected during the first survey. Foods consumed at each meal of the families were weighed and recorded. It is a custom in the rural areas throughout the country that meals are usually prepared only twice a day; weighing of foods were then performed in the early morning and also in the evening before preparation of each meal.

Amounts actually consumed of each item of foods as calculated were taken for analysis. Analysis of each item of foods thus taken was based on Food Value Tables of some Asiatic Countries especially "The Food Composition Tables for Far Eastern Countries" compiled by U.S. Department of Agriculture. Items which were not found in the tables had been analysed by the use of Malayan Food Composition Table, whose arrangement has been made so that vegetables are grouped as deep green, light green varieties, and fish as fatty and non-fatty. This would make our results fairly acceptable for practical purposes.

RESULTS OF ANALYSIS

TABLE I

DIETARY PATTERN

Actually consumed per capita per day

	Weight in grammes
Rice (mostly home-pounded)	425
Meat	5
Fish	69
Egg	5
Pulses and nuts	4
Vegetables — leafy	30
— non-vegetable	41
Oil and Fat	5
Sugar	1
Condiments	24

TABLE II

Food Value of Diet per capita per day

Calories	1746	
Protein — animal	15	gm.
— vegetable	33	gm.
Carbohydrate	349	gm.
Fat	13	gm.
Calcium	0.132	gm.
Phosphorus	0.228	gm.
Iron	7	mgm.
Vitamins — A	2006	I.U.
— Thiamin	0.78	mgm.
— Riboflavin	0.46	mgm.
— Niacin	11.14	mgm.
— C	30	mgm.

DISCUSSIONS

The results of analysis as shown above indicates that food consumption level of the people in this area is somewhat low in quality; about 84 per cent of total calories were derived from rice. These very unbalanced diets have been found universal throughout the kingdom even in Bangkok itself.

The quantity of diet as indicated is slightly below the standard; abount 1746 calories per capita per day is figured out (average standard of calorie requirement for the Thai people which has been worked out, basing upon the Report of the Committee on Calorie, Food and Agriculture Organization of the United Nations, being 1912 calories per capita per day). The total protein is somewhat low, averaging about 48 grammes per day, and out ot this protein about 50 per cent were of animal origin. The amount of fish consumed was 69 grammes per day: most of these were of the small varieties and obtained from nearby canals.

It is interesting to note that pulses are almost not found in the diets of the people and this is the case all over Thailand. Evidences from the results of our surveys in various parts of the country, even in Chiengmai the home of pulses and beans, showed that pulse consumption was low thus making a ratio of cereals to pulses considerably high. The higher the ratio the less consumption of pulses is indicated. (See "Per caput consumption of cereals and pulses in some countries in Asia and the ratio of cereals to pulses consumed", Jean Ritchie and Amara:- A Nutrition Survey in North Thailand : J.M.A.T., Vol. XXV, No. 5, October 1953).

Egg forms one of the most important foods to be included in the diet because of its high quality. We could find from each of our surveys, that eggs can be produced in almost every homestead of the rural areas; but still they are not as much consumed by the families; most of the eggs are often sold out to the market. As the egg is as good in nutritive quality as cow's milk, it would no doubt be of great benefit to health if consumption of eggs could be raised to a certain level. Owing to lack of education and proper knowledge on the quality of food, the Thai people still neglects to eat eggs; moreover especially for pregnant and nursing women, eggs are considered as food taboos to be avoided. This applies also to babies and children whose diets are badly in needs of such good food as egg for their proper growth and optimal health. According to the modern feeding procedure, egg forms one of the most important supplementary foods to be added in the diet of the baby from the age of 3 months. Greater efforts should be made, therefore, to raise the consumption of eggs in Thailand so that people can understand and make use of eggs for their own health.

CONCLUSIONS

1. The Nutritional status of the people of Bansurd Subdistrict is generally similar to those of other parts of the country.

2. Diets still lack quality and are unbalanced, most calories being derived from rice, while other protective foods in the diets are below minimum standard.

3. The area is situated along the highway about 30 kilometres from the city and being comparatively near

to the sea-shore, has thus a slightly better standard of living as compared to the other remote and mountainous parts of the country.

4. According to recent study of Dr. Sadun of FOA on parasitic infestation of the people in this area, about 85 per cent were reported to be infested.

5. Attempts should be made to raise the consumption of egg and pulse.

6. Diets do not contain sufficient fruits, although they are grown abundantly in the area.

7. Improper feeding of babies, pregnant and nursing women are still in practice. Food prejudices are widespread.

8. There is a considerable room for educating the people in this area as most of them are receptive to modern knowledge.

ACKNOWLEDGEMENT

Acknowledgements are given to Dr. Luang Bhayung Vejjasastr, the late Director-General of Health for his approval and also to Dr. Tanong Viriyajat, the Director of Cholbuii Health Demonstration and Training Center for his cooperation and suggestion to this survey. Also great help was obtained from FOA in providing us with equipments partly used in this survey and from Miss Jean Ritchie of the FAO whose initial suggestion has given us a good start. Appreciation should be given to the officials of the Nutrition Division, for the tedious jobs in carrying out this survey and collecting all necessary data for this report.

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3. Elvio H. Sadun :- Report on Study of Helminthic Infection in Cholburi, STEM 1953.

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5. Malayan Food Composition Tables :- Federation of Malaya, Department of Agriculture Scientific Series No. 23, 1949.

STUDIES ON THE FOWL SEMEN : LIQUID ALBUMEN AS A DILUENT OF COCK SEMEN (in English)

M.L. Subhanidhi Xumsai, Department of Animal Husbandry, Kasetsart University, Thailand (9th Pacific Science Congress).

Liquid albumen was aseptically collected from freshly laid eggs by draining through a sterile gauze into a measuring cylinder. Equal amount of phosphate buffer was added and kept at 5° to 10°C as a stock diluter. Semen was collected and diluted with the stock diluter in the proportion of 1:2. The diluted semen was sealed in vials and stored at 5° to 10°C. A fairly good percentage of motility of the sperms could be maintained for a period of over 10 days. It was observed that no antibiotic was required in the preservation of semen using this diluter. Except when used as fresh, however, the diluted semen could not produce any fertility.

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THE MORE IMPORTANT RICE PESTS OF THAILAND (in English)

Chainarong Butrobol, Chief, Pest control Section, Rice Department, Ministry of Agriculture, Bangkok, Thailand. (9th Pacific Science Congress).

Among the 25 species of insects that are injurious to rice in Thailand, three groups of species among them are considered the most destructive and widespread,

namely : (1) Seedling armyworms or cutworms (Spodoptera mauritia Boisd. and S. pecten Guen.). (2) Rice Fall-armyworms or cutworms (Cirphis unipuncta Haw., C. venalba Moore, C. loreyi Dup. and C. irregularis Walk.). (3) Rice stem borers (Schoenobius incertellus Walk., Chilotraea polychrysa Meyr., Sesamia inferens Walk. and Diatraea sp.).

General notes on habits, biology, control, parasites and predators of each group are mentioned.

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STRATIGRAPHY OF THAILAND (in English)

Saman Buravas, Chief Geology Division, Royal Department of Mines, Bangkok, Thailand. (9th Pacific Science Congress).

The present Stratigraphy of Thailand was built up almost entirely on fossil evidences. Late Cambrian, Ordovician, Silurian probably including Devonian, Carboniferous, Permian, Triassic, probable Jurassic, Tertiary, Pleistocene and findings of ancient man's implements are briefly described.

Correlation of Thailand's geological history with those of neighbouring countries is attempted by the author. He sincerely hopes that this venture may serve as a useful basis for an immediate future discussions and final recommendations.

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CAUSES OF DEATHS FOUND IN THE SIRIRAJ HOSPITAL (in English)

Pradit Tansurat, Siriraj Hospital, Bangkok, Thailand. (9th Pacific Science Congress).

The paper is an analysis of the autopsies performed at the Department of Pathology, Siriraj Hospital, Bangkok. It is not intended to represent the causes of deaths of the whole country, but it merely gives some ideas regarding the prevalence of diseases and causes of death recorded at Siriraj Hospital. The study is divided into two periods, namely the period before and after the World War II. There is a striking difference in the causes of deaths of some diseases before and after this World War II. Causes of deaths in general are due to diseases of the gastro-intestinal and respiratory systems. In the period before the World War II the common causes of deaths were typhoid fever, bronchopneumonia, cancer, diarrhea, amoebic and bacillary dysentery and pulmonary tuberculosis. Since the War typhoid fever, diarrhea, bacillary dysentery and pulmonary tuberculosis have decreased; syphilitic infections have markedly decreased, but incidence of cancer appears to increase.

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REVIEW ON THE PRODUCTION AND USE OF RABIES VACCINE AT SAOVABHA INSTITUTE (in English)

Sriprapai Phong-Aksara, The Queen Saovabha's Memorial, (Pasteur Institute), Bangkok, Thailand (9th Pacific Science Congress).

A review is made of the production and use of rabies vaccine at Saovabha Institute from the start since 1913 up to 1956 inclusive.

In the beginning dried-cord vaccine (Pasteur method) was the only type of rabies vaccine use until 1930 when phenolized vaccine (Semple method) was introduced. Then both types of vaccine were employed in rabies prophylaxis at the Institute till 1944 when the Pasteur method was discontinued and now Semple vaccine is the only type used. Phenolized vaccine is at present prepared from either rabbit or sheep brains as a 5% suspension. The methods of preparation and administration of both dried-cord and phenolized vaccines are described.

Mortality rate of rabies after vaccine treatment can be taken as an index in evaluating the efficacy of rabies vaccine. The rate is 0.50% for dried-cord vaccine and for 1%, 3% and 5% phenolized vaccine the rates are 0.55%, 0.23% and 0.06% respectively.

Postvaccinal complications may result after treatment with rabies vaccine. The incidence of neuroparalytic accidents is higher with the use of dried-cord vaccine than with phenolized vaccine; the rate per 1000 treated with dried-cord vaccine is 1.21, and with 1%, 3% and 5% phenolized vaccine the rates are 0.20, 0.22 and 0.36 respectively. To avoid such accidents from indiscriminate use of rabies vaccine and yet to benefit from the vaccine treatment in cases of exposure to rabies, a guide is outlined giving indications for antirabies vaccination.

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THE BIOSEROLOGICAL CONSIDERATION OF THE MIGRATION OF THE THAI RACE II. FURTHER EVIDENCES SUPPORTING THE NEW CONCEPT (in English)

Somsak Phansomboon, University of Medical Sciences, Bangkok, Thailand.

In the first paper read at the Siam Society on June 27, 1957 and dealing with the distributions of the six blood groups, namely the A-B-O, MNS, Rh, Duffy, Lewis and Kell blood systems in the Thai individuals, it was postulated that by comparison with the data of other South Eastern people and under the present available evidences, the Thais migrated more likely from the South (Java) or from the West (India) rather than from the North (China). The second paper concerns itself with the distribution of abnormal hemoglobins is South Eastern countries including Thailand, and it will be shown that the results of blood tests for such hemoglobins support substantially the above new concept.

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SEASONAL VARIATIONS IN THE EXCRETION OF WATER AND NITROGENOUS WASTE SUBSTANCES (in English)

Ouay Ketusinh, Chandranivat Kashemsant, Duangmanee Viseshkul, Srisamang Srisorasastr, Ath Ketusinh, and Damrong Bejrblaya, Department of Physiology, Siriraj Hospital, Bangkok, Thailand. (9th Pacific Science Congress).

Urinalyses were made on volunteers throughout one calendar year comprising (a) weekly analyses (12 subjects), (b) occasional analyses (49 subjects). Each subject had his urine analysed consecutively all through the year. Studies included 24 hour output, specific gravity, and total nitrogen. Results were grouped into monthly and seasonal data and referred to weather characteristics recorded for each period by the Meteorological Department. The study shows that: (1) the 24 hour output is most closely related to the mean air temperature, in an inverse manner, and to relative humidity, in a converse manner; next in relationship come rate of evaporation, inversely, and the amount of rainfall and the number of days with rain, both conversely (2) the nitrogen excretion varies directly with the total volume of the urine; (3) the specific gravity varies, within narrow limits, with the 24 hour volume. The largest output of urine is seen in the cool season (November to February; average 1276 ml.), the lowest in the hot season (March to May; average 960 ml.). The output rises steadily during the rainy season (June to September; average 1168 ml.), changing but slightly during the period of transition (October; average 1090). The mean daily excretion of nitrogen for the quoted periods was 9.43, 7.95, 8.07, and 7.42 gm. respectively. The urine specific gravity varied from 1.017 in the transitional period to 1.022 in the hot season, when the urine was most concentrated. (Values given are for men; those for women are slightly different, but show the same variations.) Perspiration very probably accounts for most if not all of the variations. Relationship with the etiology of urinary calculi, the incidence of nephritis, and the ingestion of protein is discussed.

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QUALITATIVE EXAMINATION OF VESICLE RENAL AND URETHRAL CALCULI *(in English)*

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A chemical analysis was made of 112 samples of calculi collected from various parts of Thailand. Most of these calculi were of vesicle origin, others of renal and urethral origin. In addition to the overall analysis, the different layers of the calculi were investigated.

The main constituents of vesicle calculi were found in most instances to be ammonium urate, calcium oxalate, and calcium phosphate. Usually the inner layer consisted mainly of ammonium urate. In most cases the renal calculi consisted mainly of calcium oxalate, with some calcium phosphate. Urethral calculi are composed mainly of ammonium urate.

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