Vol. 9 No. 1 June 1958

THAI SCIENCE BULLETIN

DEPARTMENT OF SCIENCE

MINISTRY OF INDUSTRY

BANGKOK, THAILAND

With the Compliments

of

Department of Science

Ministry of Industry

Bangkok, Thailand

Vol. 9 No. 1 June 1958

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Ministry of Industry, Bangkok, Thailand

Director-General : Dr. Charng Ratanarat

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HYDROGENATION OF PARA-RUBBER OIL

by

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Department of Science

Introduction

The molecules of natural rubber are intrinsically built up from a great number, 16 to several hundreds, of isoprene units, forming long open chains. In destructive distillation the larger molecules are broken up into smaller ones, comprising about 5% isoprene C_5H_8, 30% dipentene $C_{10}H_{16}$, 40% heveene $C_{15}H_{24}$, and other higher polymers. Gaseous products, such as carbon monoxide, ethylene, and methane are also produced in small quantities. The residue remaining in the flask is a black viscous substance resembling asphalt in appearance.

Para-rubber oil is, therefore, a combined distillate prepared from destructive distillation of raw rubber smoked sheets. The oil thus obtained, being composed mostly of unsaturated hydrocarbons, is unstable, easily oxidised, and capable of polymerization.

During the last World War the use of such oil was rather extensive because of the severe shortage of petroleum. Fractionation of the distilled product could improve its quality only insignificantly. Its use in internal combustion engine proved to be very troublesome, resulting in resinous clogging-up of mechanical parts and necessitating frequent and tedious cleaning up of the engines.

This investigation was, therefore, undertaken with a view to improve, by hydrogenation and fractionation, its properties for its eventual use as fuel in internal combustion engines.

Experimental

Destructive Distillation

Two hundred and fifty grammes of raw rubber smoked sheet, well cut into tiny pieces, was heated in a 1-litre distilling flask to which a condenser was connected. Special care was taken in the application of heat. The temperature was gradually increased allowing sufficient time for vapoured products to condense. The receiving flask for the distillate was cooled with ice on account of the low boiling point of the products.

The results of the distillation were as follows:—

1. The distillation was found to commence at 60°C. By 100°C, the distillate obtained was 18 ml., and the weight was 13 g., equivalent to 5.2% of the weight of the rubber used. The distillate first came out was cloudy, but shortly became clear with yellowish colour, which eventually turned dark.

2. The distillate obtained at 100°C—200°C was 95 ml. and weighed 77.5 g., or 31% of the weight of the rubber. At this stage, the distillate was yellowish in colour and darkened overnight.

3. The distillate obtained at 200°C—300°C was 119 ml., and weighed 100.8 g. which was about 40% of the rubber used. Upon standing, this fraction of distillate separated into two layers. The upper layer was brown in colour but the lower layer (about 10-30 ml.) was viscous dark brown oil.

All fractions of distillate described above had a strongly disagreeable odour. They were stored together in a dark coloured bottle for hydrogenation.

The residue left in the distilling flask was in a form of dark viscous liquid with similarly disagreeable odour.

Hydrogenation

Hydrogenation was carried out as soon as possible in order to minimise progressive polymerization and oxidation of the distilled oil. In this experiment, Parr high pressure hydrogenation apparatus and Raney nickel catalyst were used.

The bomb of the hydrogenation apparatus was filled with 200 ml. of para rubber oil and 5 g. of Raney nickel catalyst. After closing the bomb tightly, an appropriate amount of hydrogen was let in. After the shaker device had been turned on, the pressure was checked every 5 minutes to ensure that there was no leakage. When the pressure remained constant, heat was applied. Temperature and Pressure readings were recorded at intervals of 10 minutes. After the pressure had become constant for 30 minutes, both heat and shaking were cut off, and the bomb was allowed to cool overnight. The final pressure was taken on the following day.

Three experiments were performed using different pressures and temperatures in the hydrogenation.

Experiment I: Initial pressure of hydrogen was 1500 2000 lbs./sq.in. and temperature was between 100–150°C.

The results are tabulated below:

No. of Runs	Time		Max.Temp. °C	Pressure (lbs./sq.in.)		Pressure decreased	H_2 absorbed % by wt.	Remarks
	hr.	min.		Initial	Final			
1	2	5	135	1850	900	950	0.877	new catalyst
2	2	21	128	2000	500	1500	1.384	catalyst used for 2nd time
3	1	40	130	1950	940	1010	0.932	catalyst used for 3rd time
4	3	45	127	2000	1280	720	0.665	catalyst used for 4th time
5	2	8	127	2000	1075	925	0.854	new catalyst

Experiment II: In this experiment, the oil was hydrogenated at the temperature of 200-250°C. Since the reaction took place too rapidly at a high temperature, it was necessary to increase the temperature stepwise starting from 100-150°C. At the beginning of each step more hydrogen was added to the bomb to keep the pressure at 1500–2000 lbs./sq.in.

The results of this experiment are given below:

No. of Runs	Amount of oil (ml.)	Time		Pressure decreased (lbs./sq.in.)	H_2 absorbed (% by wt.)	Remarks
		hr.	min.			
1	200	15	30	2740	2.528	
2	200	14	25	2780	2.565	
3	200	20	25	2752	2.539	
4	200	20	—	2710	2.500	

Experiment III: The temperature and the pressure of hydrogenation in this experiment were higher than those used previously. At the early stage of hydrogenation the pressure of hydrogen was as high as 3500 lbs./sq.in., and in order to attain this high pressure a boaster pump was employed. The temperature was increased stepwise as was in the second experiment. But the initial pressure of hydrogen at the beginning of each step was somewhat decreased, however, to reduce the possibility of explosion.

The experiment was carried out as follows:

The oil was first hydrogenated at the temperature of 100–150°C using the initial pressure of 3000-3500 lbs./sq.in. The hydrogenation was continued until the pressure of hydrogen remained constant. More hydrogen was then added so that the pressure again reached 2500—3000 lbs./sq.in. The hydrogenation was then continued, but with a higher temperature, (150-200°C). The same procedure was repeated twice more, using the temperature of 200-250°C and 275°C but with the pressure reduced to 2000—2500 lbs./sq.in. The results are tabulated as follows:

No. of Runs	Amount of oil (ml.)	Time (hr.)	Pressure decreased (lbs./sq.in)	H_2 absorbed (% by wt.)	Remarks
1	200	35	3750	3.460	
2	200	42	3130	2.888	
3	200	33	3220	2.971	
4	200	30	3660	3.377	
5	200	30	3500	3.229	
6	200	30	3340	3.081	
7	200	45	3070	2.832	catalyst inactivated owing to high moisture content of oil.
8	200	33	3570	3.294	
9	200	41	3630	3.349	
10	200	33	3290	3.035	
11	200	46	3600	3.3321	
12	200	53	3720	3.432	catalyst renewed once
13	200	50	3570	3.294	,, ,, ,,
14	200	37	3770	3.478	
15	200	28	3740	3.451	
16	200	35	3740	3.451	

Hydrogenated oil obtained from the above three experiments were colourless and had pleasant odour. However, the oil from experiment I turned yellow after having been stored for about one month; and, likewise, the oil from experiment II turned slightly yellowish. These changes of colour and the amounts of hydrogen absorbed (0.8 and 2.5% compared to 2.8–3.4% in the

Experiment III) showed that they were not sufficiently hydrogenated. The oil from experiment III did not change colour at all even after 4 years of storage.

Estimation of Motor Gasoline Contents

1. The Standard Distillation Test adopted by the Institution of Petroleum Technologist and the American Society of Testing Materials was applied to 100 ml. of the hydrogenated para-rubber oil obtained from experiment III.

The results were as follows:—

Initial boiling point = 45°C

	Temp. °C	*Percentage by volume of distillate obtained at various temperature*
at	60	3.0
”	70	5.0
”	80	8.0
”	90	11.0
”	95	12.0
”	100	13.0
”	110	15.0
”	120	17.0
”	130	19.0
”	140	21.0
”	150	24.0
”	160	30.0
”	170	41.5
”	180	56.0
”	190	67.0
”	200	72.5
”	210	76.0
”	220	78.0
”	230	80.0
”	240	81.5
”	250	83.0
”	260	85.0
”	270	86.5

	Temp °C	*Percentage by volume of distillate obtained at various temperature*
at	280	88.0
„	290	89.0
„	300	90.5
„	310	91.0
„	320	92.0
„	330	92.5
„	340	93.0
„	350	93.5
„	360	94.0

The distillation was terminated at the temperature of 367.0°C.

The distillation standards of Motor Gasoline are as follows:

at	95°C	distillate not less than	10%
„	140°C	„ „ „ „	50%
„	200°C	„ „ „ „	90%
„	220°C	„ „ „ „	97%

From the Standard Distillation Test of hydrogenated para-rubber oil, using Engler's Flask the following results were obtained.

at	95°C	distillate obtained	12%
„	140°C	„ „	21%
„	200°C	„ „	72.5%
„	220°C	„ „	78%

Comparing to those of the standards, the distillate obtained at 140°C was the lowest. If the oil is to reach the standards of motor gasoline (i.e. 50% of the oil would be distilled at 140°C) only the first fraction of 42% should be collected. In the other words, there were 42% of the unfractionated oil reached the standards of motor gasoline.

2. With the "Four Points Control Method" which is a more precise method, the same oil gave the following results:

		Distillate obtained
at	95°C	15 %
„	140°C	19.3 %
„	200°C	72.7 %
„	220°C	74.7 %

These results showed that only 38.6 % of the oil reached the standards.

3. The test, using the 38.6 % distilled hydrogenated oil from experiment III in a gasoline water-pump engine, showed an excellent result.

The remainder after the motor gasoline fraction had been distilled was a safe substitute for diesel oil in the operation of diesel engines.

Conclusions

Hydrogenation could be used to improve the properties of the para-rubber oil. The best result of hydrogenation was obtained when the pressure of hydrogen was gradually decreased from 3500 lbs./sq.in. to 2000 lbs./sq.in while the temperature was increased from 100°C to 275°C. And as generally known, the activity of the catalyst and the purity of the oil affected the results considerably.

About 40 % of the hydrogenated para-rubber oil can be used as fuel in gasoline engines. The remainder is an excellent diesel oil substitute. The percentage of gasoline fraction may alter widely depending on the process of destructive distillation. For an example, the loss of a lighter fraction would occur, if precautions were not taken to avoid the vapour escaping condensation. Long storage and exposure to light and air of distilled oil may also affect the gasoline percentage. Hydrogenation affects only slightly on the percentage of gasoline.

Sufficiently-hydrogenated para-rubber oil is, however, stable. It does not change its colour and odour even after 4 years of storage.

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A NOTE ON MAENG DA–NA

(Lethocerus Indicus)

by

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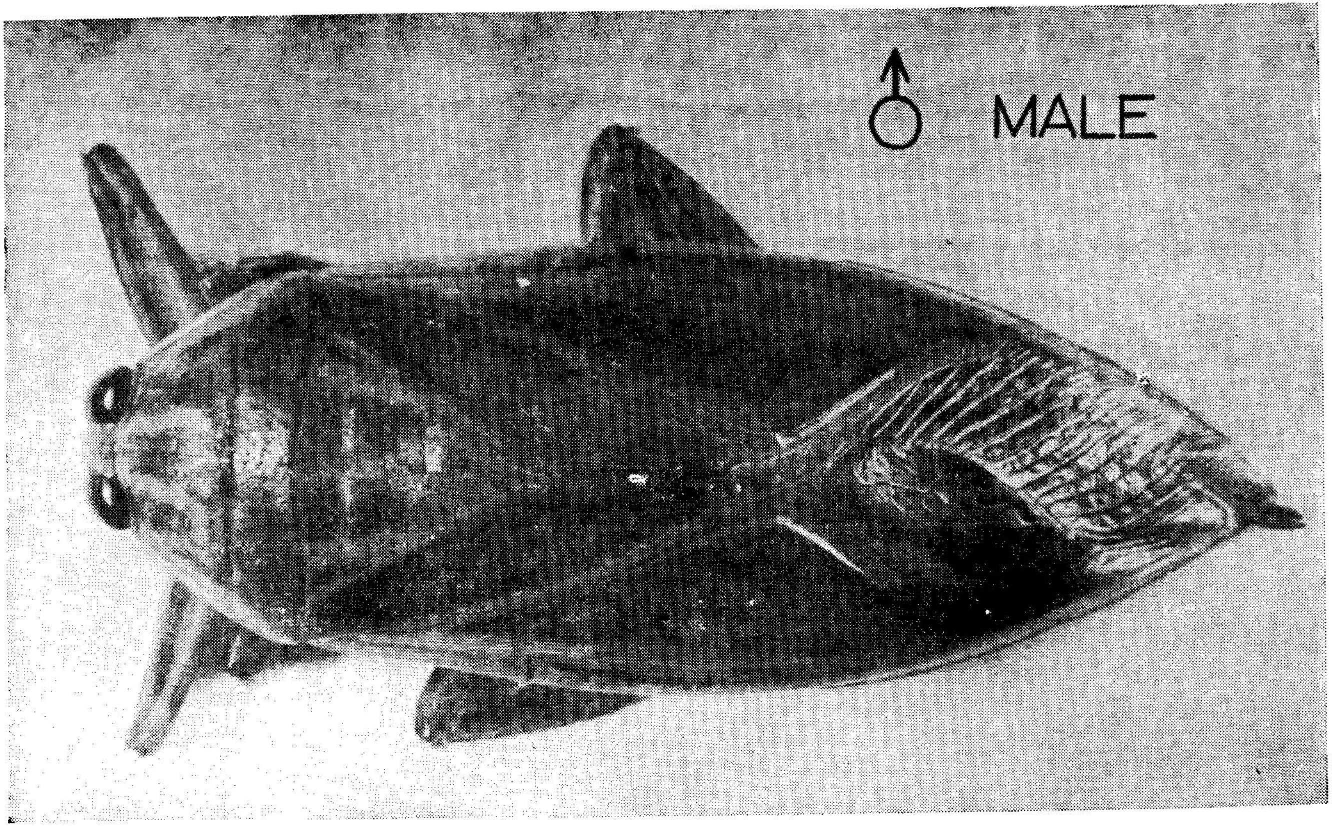
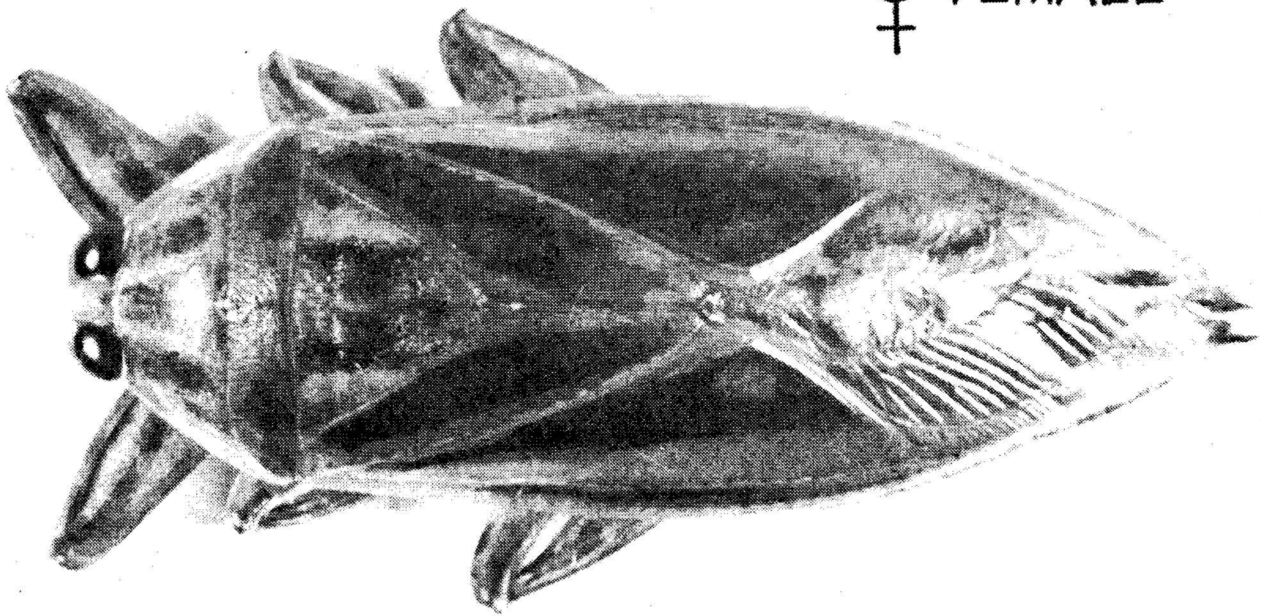
Maeng Da-Na is the Thai name for giant water-bug, the scientific name of which is Lethocerus Indicus. It is a kind of insect belonging to the family Hemiptera, the order of Belostomatidae. This insect is popularly used in this country as a flavouring agent for food, especially chilli paste and fish sauce. There is no evidence as to when this insect has been introduced into such preparations.

The common practice is to cook the insect by steaming, and pickle it in fish sauce. When it is to be used as flavouring, the water-bug is cut into small pieces, then added to the chilli paste or other dishes according to tastes. The said practice has been carried out for years without any further modification. Unfortunately, this insect is seasonal, and more over, it preservation by the above method could only retain its essence for 3 to 4 weeks at the most.

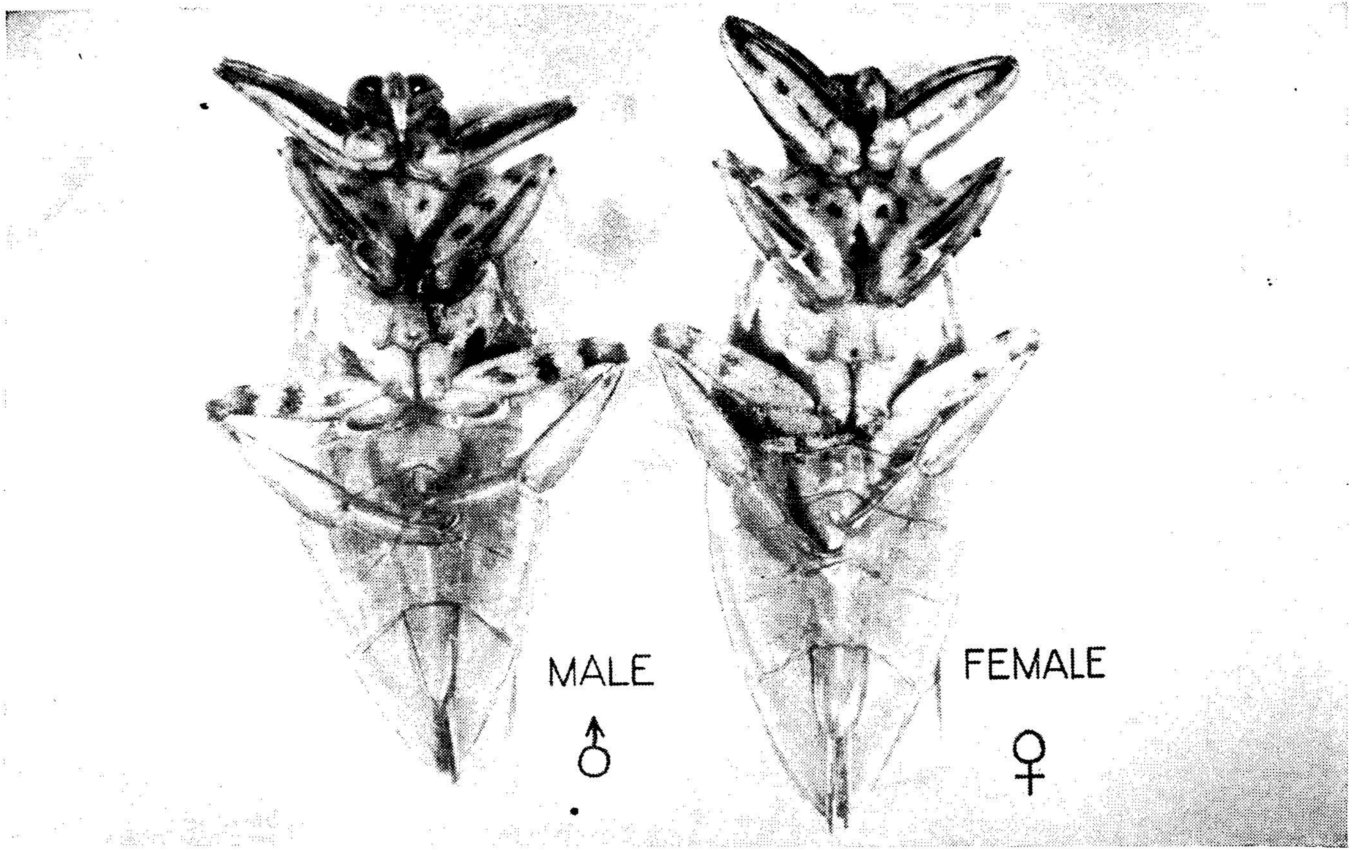
In 1955 H.E. Lt.-Gen. Banyat Devahastin, then the Minister of Industry, suggested to the Department of Science that a study be made on the preservation of giant water bug's essence, so that it would be available the whole year round. It might also be a commercial possibility, since the people in our neighbouring countries, e.g. the Burmese, the Cambodians, as well as the Vietnamese prefer some of their dishes, flavoured with this essence.

The author has been assigned to investigate this problem. The first object is to study the life cycle of the insect, and to

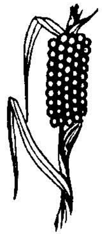

♂ MALE



♀ FEMALE


MALE ♂
FEMALE ♀

แมงดานา
LETHOCERUS INDICUS
FAM. BELASTOMATIDAE



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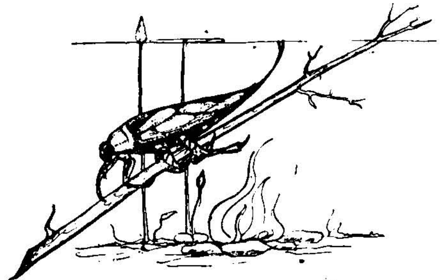
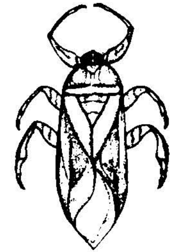
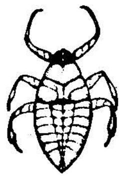
EGGS



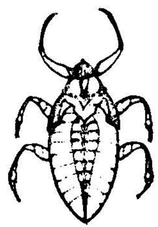
ท่าของแมงดาในขณะอยู่ในน้ำ
NATURAL RESTING POSITION IN WATER



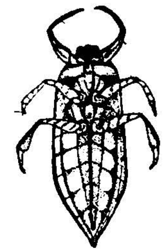
ด้านหลังของแมงดา
DORSAL SIDE



ลูกแมงดา ภายหลังลอกคราบ ครั้งที่ ๒
AQUATIC NYMPH
AFTER 2nd. MOLTING

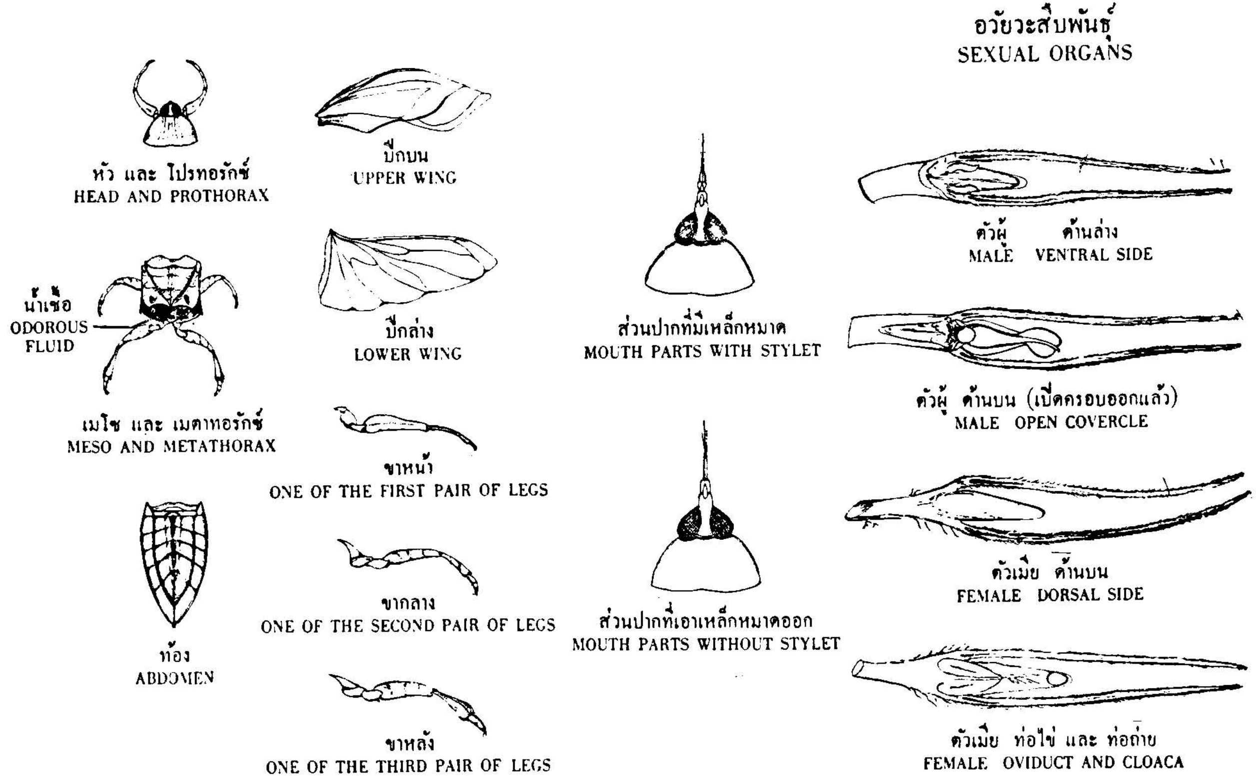


ลูกแมงดา ภายหลังลอกคราบ ครั้งที่ ๔
AQUATIC NYMPH
AFTER 4th. MOLTING



ด้านหน้าของแมงดา
VENTRAL SIDE

ส่วนต่าง ๆ ของอวัยวะ
DETAIL OF ORGANS



raise them in large quantity, similar to the raising of honey bees or silk worms, in order to maintain a constant supply at a reasonable price. In the later stages the composition of the flavouring essence will be studied and its synthesis might be attempted.

The Maeng Da-Na or giant water-bug is found in Thailand as well as in the neighbouring countries such as Burma, Laos, Vietnam and Cambodia during the rainy season, which begins around May—June and lasts until October. During this season, the female lays a cluster of about 200 eggs on leaves or stems of rice and grass, about 10 to 15 cm. above the water surface.

After one week, the young insects or nymphs, will emerge from the eggs. The nymph, being an incomplete insect, has no wing and breathes by means of tracheae which open to the side of the abdomen. The young insect exhibits interesting adaptations for swimming and breathing in water. It comes to the surface to take in a supply of air by exposing its abdominal part above the surface of water, and the air is retained for breathing while submerged. During its growth, the water-bug sheds its cuticle five to six times before the adult conditions are fully attained.

This giant water-bug is amphibious and carnivorous, feeding upon small fish, tadpoles and other insects, including its own kind. It is a night insect and is attracted by light, thus providing a means for luring them to be caught.

The size of adult giant water-bug is about 10 cm. long and about $2\frac{1}{2}$ cm. wide. The head bears a paired compound eyes. The mouth-parts are used for piercing and sucking with stylet-like rostrum enclosed in a labrium. Next to the head is the prothorax which is a hard carapace. The mesothorax lies next to the prothorax, and the end part of its thorax is the metathorax. The upper wings are semihard and are connected to the mesothorax. The lower wings are attached to the metathorax. There are three pairs of hairy legs, the first pair of which are attached to the prothorax and are very strong, used for fighting as well as for catching its preys. The second pair of legs are attached to the mesothorax, and are used for holding itself to places and also for balancing the body. The last pair are connected to the metathorax, and have an oar-like shape providing for swimming.

It is somewhat difficult for those who are not experienced to differentiate between the male and the female. Generally the male is smaller than the female, but in order to be certain as to the sex of the insect, the organ at the end of the abdomen, which is used for breathing, must be removed, and the difference between the male and the female would then be apparent.

When the insect is in water, its wings are kept closed to the body. There is a sort of needles holding the wings to the mesothorax. During flight, the upper and the lower wings join together and form only a single pair of wings, so that it will be suitable for flying at a great distance.

The male insect has a small pair of bag-like glands which are located in the metathorax, and filled with odorous fluid. These glands are found only in the male and are the only organ which gives the desired flavouring essence.

Dr. M. van Eekelen, the FAO Food Expert who was attached to the Department of Science during his assignment in 1955 – 1956 had helped to locate the cavity where this odorous fluid is released from the insect. It was found between a broad coxa, hinging on the thorax.

The blood of the giant water-bug is green because of the presence of copper. It has a long tubular, thread-like heart, which is situated in the mesothorax.

The giant water-bugs are found in swamp or shallow water such as in rice field during the rainy season, and gradually disappear at its end. After October the water-bugs live through a period of hibernation, which lasts at least three months.

The author has been trying to raise the insects in laboratory without the use of an incubator. The giant water-bug's eggs were placed in a container, specially built to have the conditions similar to those of the rice field. In this way the life cycle and habits of the insects, since hatching up to the fourth stage of the nymph, were observed. After emerging from the eggs for about 1 to 2 hours, the nymphs fed themselves voraciously. When foods were scarce, they fed on one another, and as usual, the strongest survived. It was found also that natural river water was better suited than rain water, and the suitable pH-value was about 8.5.

In Thailand the giant water-bugs are abundant in the North-east and the central part of the country. They are found as far down south as Prachuab Khirikhan, as north as Chiang Mai, and as east as Rayong. The trading centres are in Nakorn Pathom and Nakorn Ratchasima. The price varies according to the supply, usually it is about 1 to 1.50 Baht each.

The author has been successful in preparing an alcoholic extract of the fluid from the gland of the male insect, and has already put this product on trial in the market. The result has so far been encouraging but, from the technical point of view, there remains a great deal to be studied and developed. During the 9th Pacific Science Congress held in Bangkok in November 1957, the author was fortunate to have a chance to meet Dr. Trin, Rector of the University of Saigon, who was one of the delegates to the Congress. The author was informed that a Vietnamese scientist was successful in synthesizing the essence of the giant water-bug. Since there was no sample made available to him, the author was not ascertained whether the synthetic product could replace the natural in all respects.

VITAMIN C
in
Some Thai Fruits and Vegetables

by

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Summary

Scurvy, once, a dreadful disease of the sea, is now known to be due primarily to the lack of Vitamin C. It is characterised by soreness and stiffness of joints, a tendency to hemmorhages, loose teeth and in the final stages fragile bones. The treatment consists of giving Vitamin C and large quantity of fruit juices and vegetables. Latent scurvy is the more common form of this disease. Poverty, ignorance and food dislikes may be responsible for its occurence. Food with almost no Vitamin C are: bread, cereals, dried vegetables and dried fruits, fats and meat. Vitamin C is not stored in the body but is used up from day to day, therefore it is essential that the daily requirement must be met. Adults need about 100 mg. daily while children about 25-50 mg.

Vitamin C, also known as ascorbic acid, crystallises in rectangular plates, soluble in water, stable in mild acid media, is a strong reducing agent and is destroyed by heat. Sufficient Vitamin C in infant-feeding milk is very essential. Babies, deficient in Vitamin C, may show loss of weight, loss of appetite, anaemia, bad teeth and swollen gums. As is the case with all the known vitamins, Vitamin C is essential to growth in youth and for good health in all ages. It is concerned with the development and maintenance of the capillary blood vessels. Cells and tissues depend upon the proper intake of this vitamin. Good strong teeth, healthy gums and well-formed bones are also dependent upon Vitamin C in the diet.

Because of the importance of this vitamin in the diet, the Department of Science has made an investigation in the Vitamin C contents of some of the commoner Thai fruits and vegetables, the result of which is given in the table. It was found that our citrus fruits from pomelos to the common tangerines are rich in Vitamin C. Mangoes, tomatoes, guavas, papayas, longans, and custard-apples are also rich in Vitamin C. Vegetables possessing high Vitamin C content are sesbania grandiflora, moringa oleifera, momordica cochinchinensis, azadirachta indica, acacia insuavis, capsicum annuum, capsicum minimum, capsicum frutescens, brassica oleracea, and canarium album.

ANALYTICAL RESULTS[1]

Vitamin C in Some Thai Fruits and Vegetables

No.	*Botanical Name*	*Common Thai Name*	*mg. Vitamin C per 100 g. Sample*
1	Acacia insuavis, Lace.	*Cha-om*	186 [2]
2	Achras zapota, Linn.	*La-mud*	45 [2]
3	Aegle marmelos, Correa.	*Ma-toom*	1 [2]
4	Allium ascalonicum, Linn.	*Hom-hua-lek* *Tone-hom*	9 [2] [3] 57 [2] [4]
5	Allium cepa, Linn.	*Hom-hua-yai* *Dok-hom*	11 [2] [3] 57 [2] [5]
6	Allium sativum, Linn.	*Ka-thiam*	17 [2]
7	Allium tuberosum, Roxb.	*Phak-kui-chai*	43 [2]
8	Amaranthus gangeticus, Linn.	*Phak-khom*	54 [2]
9	Amaranthus spinosus, Linn.	*Phak-khom nam*	21 [2]
10	Ananas comosus, Merr.	*Sap-pa-rod*	35
11	Annona squamosa, Linn.	*Noi-na*	55 [2]
12	Artocarpus heterophyllus, Lamk.	*Kha-noon*	42 [2]

No	Botanical Name	Common Thai Name	mg. Vitamin C per 100 g. Sample
13	Averrhoa carambola, Linn.	*Ma-fu'ang*	13 (2) (6)
14	Azadirachta indica, A. Juss.	*Yord-sa-dao* *Dok-sa-dao*	191 (2) (6) 98 (2) (5)
15	Baccaurea sapida, Muell.	*Ma-fai*	17
16	Bambusa arundinacea, Willd.	*Nor-mai*	18 (2) (7)
17	Beta vulgaris, Linn.	*Hua-phak-kad-daeng*	47 (2)
18	Bouea burmanica, Griff.	*Ma prang ma-yong* *Ma-prang ka-wang*	44 29
19	Bouea microphylla, Griff.	*Ma-pring*	14
20	Brassica chinensis, Linn.	*Phak-kat-khao*	25—91 (2)
21	Brassica juncea, Coss.	*Phak-kat-khieo-pli*	84 (2)
22	Brassica oleracea, Linn.	*Dok-brocculi*	94—163 (2)
23	Brassica oleracea, Linn., var. acephala.	*Phak-ka-na*	140 (2)
24	Brassica oleracea, Linn., var. botrytis, Linn.	*Dok-ka-lam*	92—125 (2)
25	Brassica oleracea, Linn., var. capitata, Linn.	*Ka-lam-pli* (white) *Ka-lam-pli* (red)	92—125 (2) 96—135 (2)
26	Brassica oleracea, Linn., var. caulo-rapa, D.C.	*Ka-lam-pom*	79 (2)
27	Capsicum annuum Linn., var. grossum, Sendt.	*Phrik-yak* *Phrik-yuak*	136—241 (2) 42 (2)
28	Capsicum frutescens, Linn.	*Phrik-chi-fa*	100—137 (2)
29	Capsicum minimum, Linn.	*Phrik-khi-noo*	45—144 (2)
30	Carcinia schomburgkiana, Pierre.	*Ma-dan*	11
31	Carica papaya, Linn.	*Ma-la-kor*	57—91 (2)

No.	Botanical Name	Common Thai Name	mg Vitamin C per 100 g. Sample
32	Chrysanthemum coronarium, Linn.	*Tung-o*	32 [2]
33	Citrullus vulgaris, Schrad.	*Taeng-mo*	11 [2]
34	Citrus aurantifolia, Swingle S.	*Ma-nao*	28–40 [8]
35	Citrus hystrix, D.C.	*Ma-krood*	49–77 [8]
36	Citrus maxima, Merrill	*Som-o Khao-puang*	44–108 [8]
		Som-o Khao-jeeb	50– 89 [8]
		Som-o Thong-dee	42 – 66 [8]
		Som-o Khun-non	50 – 61 [8]
		Som-o Khao-nam-pu'ng	54– 60 [8]
		Som-o Na-korn-chai-si	59 [8]
37	Citrus medica, Linn., var. limetta, Hook f.	*Som-sa*	21–56 [8]
		Ma-nao-wan	35 [8]
		Ma-khun	35 [8]
38	Citrus nobilis, Lour.	*Som-dhep-pa-rod*	39 [8]
39	Citrus sinensis, Osbeck.	*Som kliang*	55 - 77 [8]
40	Coccinia indica W. & A.	*Tam-lu'ng*	59 [2]
41	Cocos nucifera, Linn.	*Nam-ma-phrao-on*	3 [8] [9]
42	Coriandrum sativum, Linn.	*Phak-chi*	96 [2]
43	Cucumis melo, Linn.	*Taeng-thai*	24 [2]
44	Cucumis sativus, Linn.	*Taeng-kwa*	18 [2]
45	Cucurbita moschata, Duchesme.	*Fak-thong*	27 [2]
46	Dillenia, Linn. spp.	*Ma-san*	52 [2]
47	Eugenia javanica, Lamk.	*Chom-phoo-nok*	10
		Chom-phoo-kaem-maem	7
48	Eugenia malaccensis, Linn.	*Chom-phoo-sa-raek*	29
49	Eugenia malaccensis, var. purpurea, Hook. f.	*Chom-phoo-ma-mieo*	62

No.	Botanical Name	Common Thai Name	mg. Vitamin C per 100 g. Sample
50	Garcinia mangostana, Linn.	*Mang-khut*	27
51	Hibiscus sabdariffa, Linn.	*Ka-chiap*	17 (2)
52	Ipomoea reptans, Poir.	*Phak-bung*	22 (2)
53	Lactuca sativa, Linn.	*Phak-kat-horm*	66 (2)
54	Lagenaria leucantha, Rusby.	*Nam-tao*	17 (2)
55	Lansium domesticum, Corr.	*Lang-sard*	8
56	Luffa acutangula, Roxb.	*Buap (-liam)*	18 (2)
57	Lycoperscim esculentum, Mill.	*Ma-khu'a-thet*	32
58	Mangifera indica, Linn.	*Ma-muang Sam-pan*	178
		Ma-muang Pim-sen-priew	112
		Ma-muang Kam-pan	77
		Ma-muang Kaew	60
		Ma-muang Pim-sen-man-khao	59
		Ma-muang Nang-klang-wan	51
		Ma-muang Pim-sen-man	44
59	Momordica charantia, Linn.	*Ma-ra*	58 (2)
60	Momordica cochinchinensis, Spreng.	*Fak-khao*	219 (2)
61	Moringa oleifera, Lamk.	*Ma-rum*	220 (2)
62	Musa sapientum, Linn.	*Kluai*	1 (2)
63	Nephelium lappaceum, Linn.	*Ngoh*	48
64	Nephelium litchi, Camb.	*Lin-chi*	42
65	Nephelium longana, Camb.	*Lam-yai*	85 (2) (10)
66	Ocimum basilicum, Linn.	*Maeng-lak*	32 (2) (10)

No.	Botanical Name	Common Thai Name	mg. Vitamin C per 100 g. Sample
67	Ocimum gratissimum, Linn.	*Ho-ra-pha*	14 (2) (10)
68	Otophora fruticosa, Blume.	*Cham-ma-liang*	45
69	Phaseolus aureus, Roxb.	*Thua-ngog*	32 (11)
70	Psidium guajava, Linn.	*Fa-rang*	25—103 (2)
71	Psophocarpus tetragonolobus, D.C.	*Thua-phoo*	17 (2)
72	Punica granatum, Linn.	*Thap-thim*	18
73	Raphanus sativus, Linn.	*Hua-phak-kad-khao*	43 (2)
74	Sandoricum indicum, Cav.	*Ka-thon*	23
75	Sesbania grandiflora, Pers.	*Yord-khae*	241 (2) (6)
		Dok-khae	37 (2) (5)
76	Solanum melongana, Linn.	*Ma-khu'a-yao*	17 (2)
		Ma-khu'a-muang	16 (2)
		Ma-khu'a-chao-ma-phrao	10 (2)
77	Solanum torvum, Swartz.	*Ma-khu'a-phuang*	35 (2)
78	Solanum tuberosum, Linn.	*Man-fa-rang*	28 (2)
		Ma-khu'a-leong	16 (2)
79	Solanum xanthocarpum, Schrad.	*Ma-khu'a-proh*	16 (2)
80	Spondios dulcis, Forst. f.	*Ma-kok-fa-rang*	35
81	Vigna sinensis, Savi.	*Thua-fak-yao*	24 (2)
82	Volvaria esculenta, Bresadola.	*Hed-fang*	32 (2)
83	Zalacca wallichiana, Mart.	*Ra-kam*	8
84	Zingiber officinale, Rosc.	*Khing*	19 (2)

Notes:

(1) The method used was that of J.W. Stevens: "Estimation of Ascorbic Acid in Citrus Juices", Industrial and Engineering Chemistry, Analytical Edition, 10, 269 (1938).

(2) One-half per cent oxalic acid was added to stabilize the extract.

(3) Bulb.

(4) Green onion.

(5) Flower.

(6) Young leaf.

(7) Bamboo shoots.

(8) mg. Vitamin C per 100 ml juice.

(9) Coconut juice.

(10) Leaf.

(11) Bean sprout.

ABSTRACTS

PRELIMINARY STUDIES OF THE SEXUAL CYCLE IN THE BITCH AS REVEALED BY VAGINAL SMEARS (in English)

Mani Bayakananda B.V.Sc., M.S. and Kamhaeng Balangkura M R.C.V.S., Ph.D. Kasetsart University, Thailand. (9th Pacific Science Congress).

Investigation has been made into the correlation between different types of cells found in the vaginal smears and the stages of sexual cycle in the bitch. The experiments were carried out in order to obtain some indications of the appropriate time of mating in order to ensure high percentage of pregnancy.

The technique includes the preparation of vaginal smears taken daily from bitches for four months. The smears were fixed in alcohol ether, stained with Harris haematoxylin and counter-stained with orange G. and light green. The smears were examined microscopically. Different types of cells, and their numbers were noted in pro-oestral, oestral, metoestral and other stages.

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NOTES MADE FROM LOCAL KNOWLEDGE OF THE USE OF POISONOUS PLANTS BY THE THAI PEOPLE (in English)

Tem Smitinand Chief, Section of Botany and Zoology, Forest Products Research Division, The Royal Forest Department, Bangkok, Thailand. (9th Pacific Science Congress).

The Thai people are, by nature, migratory, as can be seen from their history, and during their migrations they learned much from nature around them. At one time, however, they did settle

down, but hostile and aggressive neighbours forced them to move. Their migration over a period of thousands of years, stretched from the Altai Mountains in Mongolia to the present Thailand.

Throughout their history, the Thai people made much use of poison in both war and peace time. Most of the poisons used came from plants and in spite of the impact of Western civilization upon the Thai, these poisons are still used today.

Botanical names, local names, habits, habitats and parts of plants are listed.

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TIN AND TUNGSTEN DEPOSITS OF THAILAND (in English)

Sangob Kaewbaidhoon and Payome Aranyakanon. Royal Department of Mines, Thailand. (9th Pacific Science Congress).

Tin and Tungsten deposits occur locally in many parts of country except in the area east of Bangkok's Longtitude where a few doubtful occurrences were reported. The most important and productive areas occur in southern, western and northwestern Thailand.

Important tin deposits are mainly placer, whereas the main tungsten deposits are detrital and primary. As the placer has been exploited and mined for more than a century it is steadily depleting and primary deposits become more and more important.

Placer and primary type of deposits are described. The latter is subdivided into Hydrothermal and Magmatic Segregation origins. These are generally closely related to granitic intrusions. Granite of possibly late Cretaceous age originated most of the deposits. Only a few occurrences of tin were related to an older granite of probable Permo-Triassic period.

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THAI PROCESSED FOOD PRODUCTS (in English)

Phannipha Varavej and Kliau Bunnag. Faculty of Pharmacy Medical University, Bangkok, Thailand (9th Pacific Science Congress).

(A) Fishery Products

(1) Salting and Drying

This method which is generally applied to marine fish can be divided into two:—

(a) Short-dried products made from the most common fish. The product is a wet salted gutted "*Pla thu*" (Chub mackerel).

(b) Long-dried products made from larger fish. An example of such a product is a splitted dried salted fish, "*Pla sala*" (Caranx spp.)

(2) Enzyme Hydrolysis Salted Products

Made from smallest kind of shrimps with repeated grinding and exposing to sunlight: shrimp paste.

Heavily salted and made from the smallest fish by maceration and then drawing off the liquid portion known as fish sauce.

(3) Enzyme Hydrolysis Salted Products with carbohydrates

(a) Added with roasted and ground rice and rice bran for flavouring.

(i) Heavily salted but not as much as in the case of fish sauce and made from stale or left-overnight fish: "*Pla-ra*".

(ii) Lightly salted and made from small fish: "*Pla-chom*", or shrimps: "*Kung-chom*".

(b) Added with a large amount of fermenting or readily fermentable carbohydrates, lightly salted, and made from fatty fish: "*Pla-chao*", or shrimps: "*Kung-chao*".

(c) Added with steamed glutinous rice and made from small fish, lightly salted and compactly wrapped in banana leaves: "*Som-fuk*". That which is made from pork is called "*Naem*".

(4) Pre-Cooked Products

(a) Salted shrimps made by steaming of lightly-brined small shrimps: "*Kung-kem*".

(b) Dried shrimps made by boiling small shrimps in brine, drying and separating the meat from the shell: "*Kung-hang*".

(c) Steamed "Pla thu" made by steaming very lightly-brined "Pla thu".

(d) Fish meal.

Recently fish meal industry was introduced and developed by the co-operation of the Department of Fisheries, ICA, FAO, and a private concern.

(5) Smoked Fish

A few kinds of medium size fresh water fish are smoked in large quantities.

(6) Quick-Process Fish Sauce

The Department of Science has been successful in the experiments on the laboratory preparation of fish sauce by quick process. It is an open-kettle method of acid hydrolysis of fish in an oil bath.

(B) Soya Bean Products

(1) Products fermented by Aspergillus orysae.

(2) Soya bean curds.

(3) Fermented soya bean paste: "*Toa-nau*".

(C) Acid Hydrolysis Sauce from Oil-Seed meal

A few private factories are making soya sauce by acid hydrolysis in the open-kettles.

(D) Prepared Hot Condiments

There are three kinds of prepared hot condiments available in the markets. One of them is paste, the other two are liquids.

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A PRELIMINARY STUDY OF THE SEA TURTLES IN THE GULF OF THAILAND (in English)

Amporn Penyapol, Commander R.T.N. Hydrographic Department, Royal Thai Navy, Bangkok, Thailand (9th Pacific Science Congress).

A preliminary study of the Green Turtles (Chelonia mydas) and the Hawksbills (Erethmochelys imbricata) at Goh Kram and Goh Kra during the year 1956-57, their breeding and embryological development, and their distribution in the Gulf of Thailand.

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REPORT ON OCEANOGRAPHIC SURVEYS CARRIED OUT IN THE GULF OF THAILAND DURING 1956–57 (in English)

Amporn Penyapol, Commander R.T.N. Hydrographic Department, Royal Thai Navy, Bangkok, Thailand (9th Pacific Science Congress)

A report on the oceanographic surveys carried out from February 1956 to November 1957 by the use of two oceanographic ships of about 90 tons each, and cross-sections of the Gulf of Thailand by a 400-ton vessel during the period November-December 1956. Charts showing oceanographic stations and surface water salinities in the Gulf are included.

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SOME ASPECTS OF SEROLOGIC EPIDEMIOLOGY OF INFLUENZA IN A GROUP OF SOLDIERS (in English)

Charas Yamarat, Pairatana Ujjin and Pradith Sithichai. School of Public Health, Bangkok, Thailand. (9th Pacific Science Congress).

During the latter half of May and early half of June 1957, an influenza epidemic occurred in Bangkok and the adjoining city of Thonburi. First appearing in sporadic form and quickly becoming epidemic, the disease involved more than half of the population during a period of a few weeks. The Faculty of Public Health undertook a study on some aspects of serologic epidemiology of the disease in a small group of people in a closed community. A barrack of soldiers close to the school was selected for the purpose.

The rate of clinical infection was obtained by interrogation. The characteristics of the epidemic, including its peak incidence, are described. Sub-clinical infections were determined by serologic tests. The total rate of infection, including both clinical and subclinical manifestation, was found to be 80.5 percent. The persistence of hemagglutination inhibition antibody was partly evaluated by examination of sera of the same patients at intervals after the onset of illness.

The antigen for the hemagglutination inhibition tests were prepared from a strain of influenza virus, isolated in this epidemic. The virus was identified by the World Influenza Centre in London to be a strain of Asian influenza virus, which belongs to type A. Some interpretations and conclusions are presented.

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GENERAL ASPECTS OF THE PROBLEMS OF PUBLIC HEALTH AND MEDICAL SCIENCE IN THAILAND (in English)

Svasti Daengsvang. Director - General of the Department of Health, Ministry of Public Health, Bangkok, Thailand. (9th Pacific Science Congress).

Among the leading causes of death in Thailand, malaria, tuberculosis, intestinal infections, certain diseases of early infancy have always had their places at the top of the list. Since most of the health problems in Thailand are related to poor sanitary conditions and inadequate medical services in rural provinces, much of the health organization planning in this country has always been directed towards the rural population. Since 1953, with the assistance of WHO, UNICEF and USOM, the Department of Health has gradually improved and reorganized a large number of health centers. At present there are nearly 1000 existing health centers and midwifery clinics all over the country. As it is estimated that each center can cover only a population of 5000, mobile health units have been provided to serve those populations in isolated districts inaccessible to health centers. As the result of tremendous improvement in maternal and child activities, to date, infant and maternal death rates have been brought down from 108 and 10 (1935) to 56 and 5 (1955) respectively. Attempt is being made to put more trained midwives and multi-purpose health workers into our rural welfare scheme. To encourage community organization and active citizen participation in rural health programs, "demonstration villages" have recently been developed in many provinces, special emphasis being laid on health education, environmental hygiene, maternal and child health, communicable diseases control under an overall integrated health service planned at local levels.

Post-war mass campaigns against many infectious diseases prevalent in Thailand have virtually brought malaria and yaws under control, while mass B.C.G. campaign is steadily making progress. Although the leprosy control project, aiming at ambulatory treatment, has just been started, the outcome of work done in this early stage is very impressive. Specific programs have also been undertaken to control intestinal infections on a nation-wide basis. It has to be admitted, however, that the success in controlling this group of diseases must depend upon improved environmental sanitation which is, unfortunately, rather slow in developing.

Epidemics of smallpox, cholera and plague during the past decade have ceased to be serious scourges to the Thai people. This can be attributed to effective health education and extensive vaccination programs, as well as the alertness of health officials.

Now that the foundations of public health work, have been laid, greater concentration on the quantity and the quality of services should be made. Broadly speaking, there are urgent needs for more trained midwives, sanitarians and other auxiliary health workers to be dispersed into all rural districts well-equipped health centers to serve all communes adequately, and a sufficient number of qualified physicians to minister to the rural population. To date there are only 2665 physicians and 7587 qualified nurses and midwives in this country (population = 22,000,000). It has to be mentioned that only a small proportion of the qualified medical personnel is working in rural provinces. With two medical schools existing we have about 200 physicians graduating each year, hardly enough to keep up with the rapid rate of population increase. Special attention is now being focused on preventive services among which sanitation drives and health education are considered as the most important plan for nation-wide rural health development of Thailand.

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VERTEBRAL VENOUS PLEXUS AS A POSSIBLE ROUTE CAUSING AMOEBIC ABSCESSES IN OTHER ORGANS FROM AMOEBIC COLITIS (in English)

S. Sangvichien. University of Medical Sciences, Bangkok, Thailand. (9th Pacific Science Congress).

There is at present discrepancy of opinions about the routes of passage of amoeba from amoebic colitis in causing abscesses in various organs such as liver, lung and brain. The author studied the question by injecting x-ray opaque material into the veins of cadavers, by measuring the intraperitoneal pressure in patients subjecting to pneumoperitoneal treatment for pulmonary tuberculosis in various positions. These positions were lying down, lying down with straining, sitting on a chair, sitting on a chair with straining, squatting, squatting with straining. He found that the squatting position which is the position commonly adopted by the Thai people during defaecation causes the highest intraperitoneal pressure. Average among 11 patients 64.72 mm. of mercury, lowest 41 and highest 94. Cadaver with less than 40 mm. of pressure by injecting air into the peritoneal cavity failed to allow material injecting through branch of the portal system to reach the liver while injection without pressure the material flow easily into the organ. From this finding the author believed that there must be another route of passage than the portal system for the blood to return to the heart when there is increased pressure in the peritoneal cavity. This likely route is the vertebral venous plexus. At present he has not yet succeeded in filling the vertebral venous plexus by injecting x-ray opaque material into the branch of portal system in cadaver with increased pressure in the peritoneal cavity, but he had reasons to support this hypothesis by having a case of carcinoma of pancreas verified at. postmortem. The tumour caused obstruction in the portal system. When x-ray opaque material was injected into the spleen by the method of splenoportography it was found that the material which failed to enter the liver filled the veins of the vertebral venous plexus. The other was shown by patient with Tetralogy of Fallot getting relief of respiratory distress by squatting down, which would raise the pressure in the peritoneal cavity and cause blood to flow back into the lungs by way of vertebral venous plexus. From this finding he concluded that the patient with amoebic colitis straining at stool because of tenesmus, can cause increased pressure in the peritoneal cavity which may dislodge the parasites into the vertebral venous plexus and can make the disease appear in distant organs such as the lung and brain. These organs have free communication with the vertebral venous plexus as already shown by Batson (1940).

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INDUCTION OF REVERSAL OF THE HEART BEAT IN CHICK EMBRYOS BY INJECTION OF NOVOCAIN INTO THE VEIN (in English)

S. Sangvichien. University of Medical Sciences, Bangkok, Thailand. (9th Pacific Science Congress).

By increasing carbon dioxide to modify the metabolic activity of the embryo the author (Sangvichien 1952) succeeded in induction of reversed heart beat in the chick embryos. In order to demonstrate that the sino-atrial part could be suppressed directly to allow the parts of the cardiac tube which lie more cephalic and previously formed to resume dominancy, 1 % novocain tinted with methylene blue was injected into the circulation of chick embryo of 42 to 48 hours of incubation. The heart stopped beating suddenly when the solution reached the chamber of the organ. About 1 minute later it resumed beating, but contraction started in other regions other than the sino-atrial portion. The result confirmed that of the previous experiment and the work of Patten & Kramer (1933) that the sinus venosus is not the first part of the heart to pulsate. As each new part of the heart is formed it exhibits a higher intrinsic rate of contraction than the parts of the cardiac tube previously formed. If the sinus portion could be suppressed the part of the heart which is cephalically located would resume beating and the wave of contraction spread in a reverse direction.

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