—whether treated by a short course of quinine or by atebtrin—if a relapse does not occur within two months of the primary attack the prognosis is extremely good. In benign tertian malaria this is not the case; nevertheless, over 57 per cent. of those who relapse after a primary attack do so within two months of treatment.

5. Though atebtrin has reduced the liability to relapse in European malaria cases by about 20 per cent., it cannot be said to have fulfilled the somewhat exaggerated claims made for it, but as the precursor of more effective synthetic preparations it is a definite milestone on the road towards the complete eradication of the malaria parasite.

I have to thank the State medical and health officer, Perak, Federated Malay States, for permission to publish this paper, and the patients who, by their intelligent co-operation, have made it possible to follow up the results of treatment.

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TREATMENT OF MALARIA WITH ATEBRIN

BY

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TRINIDAD

The following short account of fifty cases of malaria treated with atebtrin requires little explanation. A considerably larger number of cases were treated with atebtrin and plasmoquine co., but this report deals only with those in which blood films showed parasites before the commencement of treatment. Every case recorded was kept under such observation as is hardly practicable outside institutions; some patients were required to attend thrice daily at the dispensary, and all possible precautions were

taken to ensure that the prescribed courses were carried out punctually and thoroughly. Quinine was administered only in febrile cases, the atebtrin treatment being instituted as soon as acute symptoms had subsided. With the exception of yellow pigmentation, which was marked in only one case, any complications arising as the result of treatment were, I am convinced, due to the use of plasmoquine co., and were never of great severity: grave symptoms were noted in two cases (not included in this series, because repeated examinations of the blood failed to discover any parasites), and were attributed to the fact that the patients were not properly nourished whilst taking the treatment.

The mention of "quinine clinic" (Q.C.) refers to the six weeks' treatment which was carried out before the

Case	Age	Sex	Race	Symptoms	Blood	Treatment	Remarks
1	35	M	E.	Malaise. "Rheumatism"	M. T.	15 At./15 P.C.	Acute colic for two hours in middle of course: felt 100 per cent. well at conclusion of treatment. (Colic possibly not due to treatment.)
2	40	M	E.	Frequent attacks of fever, resistant to plasmoquine and all forms of quinine. Ill-health threatening his continued employment	M. T.	15 At./15 P.C. 7 At./7 P.C.	"Cured" after full course in January, 1933. Later half course precautionary. No recurrence of fever.
3	35	M	E.	T. 103° F. Ague. Frequent attacks	B. T.	Q. to allay fever. 15 At. 7 At./7 P.C. in second week	Felt "cheap" at conclusion of treatment; blood negative. Later half course precautionary. No recurrence since January.
4	20	M	N.	T. 1.4° F. P. 140. (Q.C. 1931 and 1932)	B. T.	Q. to allay fever. 5 P.C./15 At.	Rapid pulse persisted for eight days after conclusion of treatment.
5	25	M	N.	T. 104.6° F. Ill. (Q.C. 1931 and 1932)	M. T.	Q. gr. 60 in two days. 15 P.C./15 At.	Rapid recovery. No recurrence.
6	30	M	N.	T. 105° F. Prostrated	Mixed (B. and M.)	Q. gr. 80 in two and a half days. 15 P.C./15 At.	Returned to work in seven days.
7	20	M	E.	T. 103° F. P. 128. Otherwise strong	M. T.	Q. gr. 8 four-hourly for two days. 15 P.C./15 At.	Developed yellow pigmentation. No malaise.
9	25	M	N.	T. 103° F. (Q.C. October, 1932)	M. T.	Q. gr. 20 stat. 15 P.C./15 At.	Off duty for one day only.
11	16	M	N.	Recurring fever. Palpable spleen	B. T.	5 At. half tab. m. et n.	
13	17	M	E.I.	T. 103° F. Weak. (Q.C. April and August, 1932)	M. T. 19/8/33 29/8/33	(1) 10 P.C./10 At. (2) 15 P.C./15 At.	Failed to complete course, so that from August 29th another course was administered. On September 4th blood film showed no parasites. Probably a relapse; possibly reinfection.
13A	17	M	E.I.	Mild fever. Not off duty	M. T. 26/9/33	(3) 15 P.C./15 At.	
17	31	M	E.I.	Chronic malaria. T. 104° F.	M. T.	Q. gr. 20. 15 At./15 P.C.	Blood negative after seven of each tablet.
19	19	M	E.I.	Chronic malaria. Weak	M. T.	12 At./12 P.C. 15 At./15 P.C.	Patient failed to complete full course, so that another course was administered.
22	25	M	E.I.	Chronic malaria. No fever. (Q.C. 1931)	B. T.	2 P.C./15 At.	Blood negative after 2 P.C./7 At.
25	30	M	N.	Four attendances Q.C. 1931 and 1932	M. T.	15 P.C./15 At.	No fever since April, 1933.
30	23	M	E.	T. 103° F. Vomiting	M. T. (crescents)	Inj. Q. gr. 7½. 15 At./15 P.C.	Colicky pains persisted for several days.
32	14	F	E.I.	Recurring fever. Palpable spleen	B. T.	5 At. half tab. m. et n.	Mild fever on second day of treatment.
36	20	M	E.I.	Chronic malaria	B. T.	15 At.	Returned with "fever" two months later. No parasites. Responded to sod. salicyl. and Q.
38	29	M	N.	Frequent attacks of fever	M. T.	Q. 15 At./15 P.C.	No attack from January–November, 1933.
39	40	F	N.	Ill. Pains all over. (Q. and P.C. 1931 and 1932)	M. T.	Q. 15 At./15 P.C.	Gained 12 lb. in following six weeks.
42	5	F	N.	Frequently recurring fever	B. T. 9/10/33 M. T. 20/11/33	Q. 13 At. 14 At./13 P.C.	This patient's blood showed B. T. on October 9th, but treatment was not commenced until November 14th, when M. T. rings were seen. On November 24th a further combined course was administered, the patient taking 27 tab. atebtrin in fourteen days without any toxic symptoms.
45	38	M	N.	Frequent attacks. (Three courses Q.C. 1931 and 1932)	B. T.	Q. 2 P.C./15 At.	
48	16	M	E.I.	Fever resistant to Q. gr. 10 o.d. for two weeks. Palpable spleen	M. T. (crescents)	16 At./16 P.C.	Blood showing parasites at commencement of treatment, despite two weeks' Q. Fever stopped after 3 At./3 P.C.
50	12	F	N.	Mild fever	Quartan	17 At./14 P.C. in seven days	No complications.

ABBREVIATIONS.—At. = Atebrin gr. 1½.
T. = Temperature.
P. = Pulse.

E. = European.
N. = Negro.
E.I. = East Indian.

Q. = Quinine.
M. T. = Malignant tertian.
B. T. = Benign tertian.

P. C. = Plasmoquine co. (gr. ½ Q. gr. ij).
Q. C. = Quinine clinic, six weeks' course, with varying doses of P.C.

introduction of the five-day course of atebtrin; patients were usually given twelve tablets of plasmoquine co. during the first week, and two tablets during each of the remaining weeks, the usual quantity of quinine administered daily being twenty grains. Results of this treatment were not to be compared with those obtained from the atebtrin course, as may be gathered from the number of Q.C. references on my list. In my experience the size of a palpable spleen has diminished at about the same rate, whether the malaria has been treated with quinine or by atebtrin. Quinine in large doses (grains xx stat.) brought about relief of symptoms far quicker than did atebtrin in orthodox doses.

The only occasion on which I have injected atebtrin was in the case of an ill-nourished East Indian girl, aged 3, with convulsions. The prognosis seemed hopeless, and I was surprised that she recovered, as my mortality with such cases treated by quinine injections is very high. Case 13 was apparently one of relapse; a careful examination of the surroundings of this patient's dwelling place failed to discover any source of infection.

Each of these patients appeared, and believed himself, to be cured as the result of this treatment; observation over several more months will be necessary to establish the actuality of such "cure." No follow-up treatment has been carried out, except to administer cod-liver oil to a small percentage of these cases: all patients were requested to return immediately to the dispensary in the event of recurrence of fever.

The ages of the patients ranged from under 3 years to over 40, the majority being between 20 and 30 years old. Thirty-seven were males and thirteen females. Europeans numbered six, negroes twenty-nine, and East Indians fifteen. Benign tertian malaria was present in twenty-four cases, malignant tertian in twenty-four, mixed benign and malignant in one, and quartan in one. The course of treatment included: (1) haustus mag. sulph. $\bar{c}$ sod. bic.; (2) quinine with potassium bromide in cases with acute symptoms; (3) fifteen tablets of atebtrin (one t.d.s.) in cases of benign tertian; and (4) fifteen tablets of atebtrin and fifteen of plasmoquine co. (of each, one t.d.s.) in cases of malignant tertian and quartan. At the conclusion of the treatment all bloods were negative, except in Case 42, which had been treated for benign tertian and was found to be a case of malignant tertian (rings) when examined after treatment with atebtrin only. There was only one return case.

CONCLUSIONS

1. That the atebtrin, and atebtrin combined with plasmoquine co., treatment of malaria (in Trinidad) is superior to its predecessors.
2. That atebtrin is an effective preparation which can safely be handed out to patients of moderate intelligence.
3. That the dosage of plasmoquine co. mentioned in this paper is sufficient, and that the advice of the manufacturers—that the administration of plasmoquine be carried out under medical supervision—is of very great importance.

These notes were presented at a meeting of the Southern Division of the Trinidad and Tobago Branch of the British Medical Association, and I am grateful to members for their advice and kindly criticisms, which are responsible for the form of the present report. I am also indebted to the staff of the Apex Oilfields Company for their assistance in securing regular treatment.

The annual report of the Registrar of Births and Deaths, Federated Malay States, draws attention to the fact that throughout 1932 no deaths were recorded from small-pox, cholera, or plague. Eleven deaths were, however, caused by meningococcal meningitis as against six in 1931, and there were forty-six deaths from diphtheria as compared with twenty-nine. It is possible, the report adds, that more exact diagnosis is the explanation of the increased numbers recorded.

THE "RECOVERY PRINCIPLE" IN GAS-OXYGEN ANAESTHESIA

A "CLOSED" SYSTEM

BY

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The principle of "gas recovery" as applied to gas-oxygen anaesthesia is a development about which a good deal is being heard at present. Several publications have appeared in journals and other literature under various titles which, however, all deal with the same idea—namely, the use of means whereby general anaesthesia may be maintained by the constant re-use of a limited amount of anaesthetic gas. It may be helpful to define the principle more exactly.

By "recovery principle"—the term to be used throughout—is meant the continuous rebreathing of a relatively small fixed volume of anaesthetic gas which is constantly maintained in a respirable and life-supporting condition. This definition implies a completely "closed" system, consisting of the apparatus and the respiratory organs of the patient with whom the apparatus is connected: it also implies the removal by suitable means of the gaseous waste products of the patient, and the supply to him of an adequate amount of oxygen to sustain life. This idea of recovery of anaesthetic gas is not new, protection by patent having been sought by German and American experimenters from 1926 onwards. Others, in all probability, have had the idea in mind before that, as the chemical basis of the principle has been known for a considerable time. Within the last two or three years British anaesthetists have exhibited an increasing interest in this matter, and have produced experimental machines of remarkable capabilities, but, so far, the possibilities of this method of anaesthesia do not appear to have been sufficiently realized in practice to justify the permanent adoption of the principle by anaesthetists. That the recovery principle has come to stay there can be little doubt, but it has to be developed along lines different from those generally adopted in existing machines.

On looking into the various inventions in this particular field one is struck with the almost complete identity of thought exhibited by the several inventors (including the writer in his earlier experiments). This problem has, in all cases, been approached from an analytical standpoint, which reasons and visualizes the several functions of the necessary apparatus as occurring in a unidirectional cycle, the rhythm of which is governed by the act of respiration. It is therefore found that all recovery machines, described or in use, are constructed according to this point of view, and are therefore very similar in their working and general design. From experience the writer is able to state that this point of view, and the method of construction based upon it, while it works reasonably well, is not the most efficient one, and consequently enough cannot be made of the recovery principle to justify its complete acceptance with confidence. Practical experience with four machines constructed on this scheme of breathing in a circle showed the inherent defects of the method, and it ultimately became apparent that the respiratory circle with its double tubes and directional valves was quite unnecessary. Much better results were later obtained from machines worked by simple to-and-fro breathing through a single tube, since by this arrangement the breath has to pass through the absorbing chamber on *inspiration* as well as on *expiration*. The same, of course, applies to the ether chamber when it is in use. This simple but important change, by thus increasing efficiency, led to greatly improved construction,