

taken) fluctuations in vasomotor tone cause striking variations in the volume of blood flowing through the hands. These are not accompanied by any corresponding change in arterial pressure. After surgical sympathectomy the blood flow in the hands may increase fivefold, without any significant alteration in blood pressure (Barcroft and Walker, 1949; Duff, 1951). In some healthy subjects the prevailing level of sympathetic vasoconstrictor tone is unusually high, so that the volume of blood flowing through their hands tends to be low (Table I). But these individuals do not have higher blood pressures than others with less sympathetic tone.

These considerations support the conclusion of Pickering (1936) that increased vasomotor tone is not an important factor in the production of chronic hypertension. It is more likely that the increased peripheral resistance in hypertension is related to a functional abnormality of the vessels themselves rather than overactivity of the vasomotor nerves. Some direct evidence of this has recently been obtained. In patients with hypertension a tendency to increased adrenaline sensitivity was demonstrated in blood vessels of the hands (Duff, 1957). There is also some indirect evidence of abnormal vascular sensitivity to pressor hormones in the nailfold (Greisman, 1952) and bulbar conjunctiva (Lee and Holze, 1951) in hypertension.

The abnormality of vascular function in essential hypertension may, of course, be a result rather than a cause of the elevated blood pressure. Studies of vascular sensitivity in patients with early hypertension—that is, with hyperaemic hands and relatively slight increases in pressure—may be expected eventually to decide whether this phenomenon predisposes to hypertension or develops after hypertension has been established.

### Summary

The resting levels of blood flow in the hands of 36 healthy and 25 hypertensive subjects were measured by venous occlusion plethysmography under standard conditions.

In the healthy subjects the blood flow varied widely between different individuals, but averaged 10.5 ml. per 100 ml. hand volume per minute for the entire group.

In the hypertensive patients the level of hand blood flow tended to be inversely related to the height of the diastolic arterial pressure; in those with mild hypertension the flow was on average higher than in the healthy subjects, while in those with severe hypertension the hand flow was much below normal.

The results are interpreted as evidence that in hypertension a functional abnormality of the vessels themselves is probably more important than excessive activity of the vasomotor nerves.

I am grateful to Dr. Geoffrey Bourne and Dr. Graham Hayward for advice and encouragement, to Professor Sir James Paterson Ross for making available some of the apparatus, and to Professor Henry Barcroft for laboratory facilities. I am indebted to colleagues, patients, students, and friends who acted as subjects and helped in other ways, and to Mr. D. F. Kerridge for statistical advice.

### REFERENCES

- Abramson, D. I., and Fierst, S. M. (1942). *Amer. Heart J.*, **23**, 84.  
 Barcroft, H., and Edholm, O. G. (1943). *J. Physiol. (Lond.)*, **102**, 5.  
 — and Walker, A. J. (1949). *Lancet*, **1**, 1035.  
 Duff, R. S. (1951). *Clin. Sci.*, **10**, 529.  
 — (1952). *J. Physiol. (Lond.)*, **117**, 415.  
 — (1957). *Brit. Heart J.*, in press.  
 Greisman, S. E. (1952). *J. clin. Invest.*, **31**, 782.  
 Lee, R. E., and Holze, E. A. (1951). *Ibid.*, **30**, 539.  
 Mendlowitz, M. (1942). *Ibid.*, **21**, 539.  
 Neumann C., Cohn, A. E., and Burch, G. E. (1942). *Ibid.*, **21**, 651.  
 Pickering, G. W. (1936). *Clin. Sci.*, **2**, 209.  
 Stead, E. A., jun., and Kunkel, P. (1940). *J. clin. Invest.*, **19**, 25.  
 Stewart, H. J., Evans, W. F., and Haskell, H. S. (1946). *Amer. Heart J.*, **31**, 343.  
 Volhard, F., and Fahr, T. (1914). *Die Brightsche Nierenkrankheit*. Springer, Berlin.

## UNILATERAL SWEATING OF THE SUBMENTAL REGION AFTER EATING (CHORDA TYMPANI SYNDROME)

BY

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Various reports of sweating and flushing of the face after eating have been published, but these have almost entirely concerned cases of the auriculo-temporal, or Frey's, syndrome. It would appear, however, that only one case of unilateral sweating confined to the submental region after taking food has been recorded, and that was by Uprus, Gaylor, and Carmichael (1934). Their patient was a young woman of 22 who at the age of 5 had had enlarged cervical glands removed from the right side of her neck, and some two years later began to suffer from profuse sweating under the chin on the same side as a constant response to the stimulus of eating.

An almost identical case is now presented and discussed.

### Case Report

The patient, a young healthy girl aged 12½ years, was referred to me by Dr. Warner Smith on October 13, 1954, on account of profuse sweating of the right submental region after eating.

She had been admitted to the Lister Hospital on January 5, 1944, when she was nearly 2 years old, for the removal of tonsils and adenoids. Readmitted on February 23, 1944, on account of enlarged tuberculous glands of the right side of the neck, she underwent an operation for the removal of the glands on March 10, the right submandibular salivary gland being removed at the same time. The wound broke down, but during the next ten weeks it slowly healed.

She kept well until 1952, when she was readmitted on account of enlargement of the liver. There was no jaundice, but cervical glands were palpable on both sides. Various investigations were carried out, but as the findings were within normal limits the patient was detained in hospital for only eight days.

Towards the end of 1952—that is, when she was 10 years old—it was noticed that at mealtimes the chin on the right side became red, and beads of perspiration formed on it, which a little later would drop unless dabbed by a handkerchief. This phenomenon occurred at every meal, and though some types of food seemed to bring it on more quickly than others, it occurred with any kind of food. There was no pain.

On examination the girl seemed perfectly healthy and of normal size for her age of 12½ years. There were two scars on the right side of the neck; one 3 in. (7.5 cm.) long, extending from below the mastoid process to within 1 in. (2.5 cm.) of the midline, and the other, very short, 1 in. (2.5 cm.) inferior (Fig. 1). There was no loss of cutaneous sensation over the affected area.

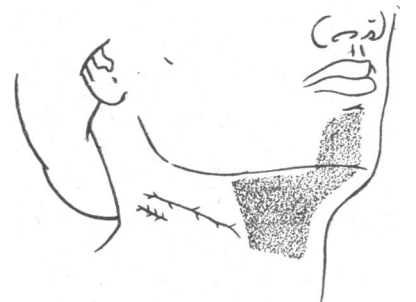


FIG. 1.—Diagram showing extent of abnormal sweating (shaded area) and site of scars.

She was given two biscuits and an apple to eat, and within one or two minutes of her finishing these the skin over the right submental area, ending exactly at the midline, began to get red followed by profuse sweating. If nothing further was eaten, the erythema gradually faded and sweating ceased. Figs. 2 and 3, taken before and after eating, show the scars, site, and extent of the reaction.

#### Investigations

The patient was admitted for further observation and tests in November and December, 1954, and again in October, 1955. These tests consisted of: (1) reaction to various substances chewed and/or swallowed; (2) reaction after taking tincture of belladonna; (3) reaction after sympathetic block; and (4) reaction after lingual nerve block.

**Reaction to Food or Other Substances.**—After eating a normal meal flushing of the affected area was observed in 10 to 15 minutes, and sweat exuded from under the chin on the right side about three minutes later. An apple would bring on the reaction in three to five minutes on most occasions. Sucking a lemon produced erythema in three minutes, followed rapidly by sweating. This continued for a further five minutes, and then ten minutes after beginning to suck the lemon the erythema began to fade and sweating ceased. A similar reaction occurred on sucking cotton-wool soaked in 0.5% acetic acid. Drinking a small quantity of tea without food produced no erythematous reaction. Reaction to sucking a lemon half an hour after taking 30 min. (1.8 ml.) of tincture of belladonna showed little or no difference—erythema and sweating appeared in three

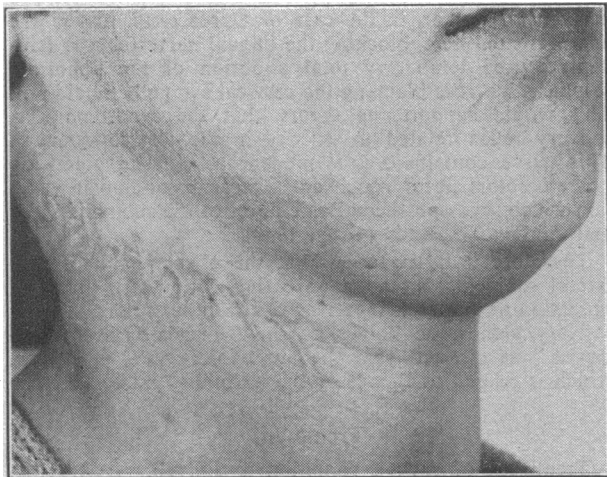


FIG. 2.—Photograph taken before eating.

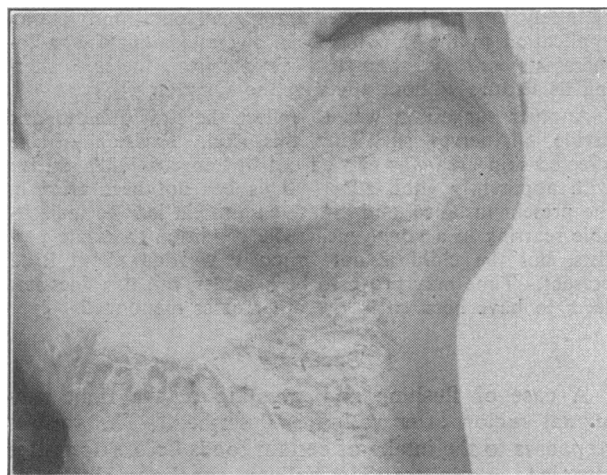


FIG. 3.—Photograph taken after eating, showing site and extent of reaction.

minutes. After 60 min. (3.6 ml.) of the tincture, however, a lemon produced erythema but not sweating. Local applications of antiperspirant lotions or ointments did not prevent the reaction.

**Sympathetic Block.**—A stellate ganglion block was carried out on the right side, using 0.5% lignocaine hydrochloride, and Horner's syndrome was produced. However, it had no effect in stopping the flushing and sweating after ingestion of foods as above.

**Lingual Nerve Block.**—Right lingual nerve block was carried out, and this did succeed in stopping the reaction. Even sucking a lemon produced no erythema or sweating.

#### Present Condition

When last seen (January 16, 1956) the patient stated that the disability was just the same, but it did not seem to be worrying her unduly. Eating an apple brought on the reaction as before.

#### The Literature

Unilateral sweating of part of the face or neck may occur following trauma or suppurative involving the parotid gland or after cervical sympathectomy; it may even be connected with disturbance of the central nervous system—for example, in cephalitis (Vamos, 1938) and epilepsy. An interesting example of the latter condition was described by Maggiolo *et al.* (1954). Their patient was an epileptic who suffered from sweating of the left cheek one to one and a half minutes after eating. There was no previous history of an operation on the neck or face, nor any sign of cranial injury. Treatment for the epilepsy by sedation with phenobarbitone, etc., did not affect the reflex unilateral sweating.

Wilson (1936), in an interesting article on facial sweating, describes and discusses four cases, two of which manifested unilateral sweating after eating. One was a case of syringomyelia, and sweating involved the left side of the face; the other followed right superior cervical ganglionectomy, when sweating occurred on the right side of the face during eating. (In this latter case section of the sensory root of the right trigeminal nerve, and also removal of an extracranial portion of the right glosso-pharyngeal nerve, had been carried out several years previously.) In both these cases sweating occurred after any stimulus to salivation.

However, over the past hundred years, beginning with Baillarger (1853), most of the numerous reports in the literature on unilateral sweating of the face on eating have been concerned with lesions of the parotid gland; and, because the area of hyperhidrosis corresponds more or less to the cutaneous distribution of the auriculo-temporal nerve, these have come to be known as manifestations of the auriculo-temporal syndrome. There is no need to describe this syndrome in detail, as it is now well known.

Langenskiöld (1946) describes two cases of the auriculo-temporal syndrome, one of which, interestingly enough, also presented features similar to the case reported by Uprus *et al.* (1934), and the one recorded here. The patient was a farmer aged 33 who came under his care in 1924 on account of gustatory local hyperhidrosis, having been operated on when 16 years of age for bilateral tuberculous cervical lymphadenitis. About two years later he began to get trouble after eating; this caused perspiration over the right cheek, which remained intensive over a small area underneath the chin on the right side. This affected area under the chin was treated with success by excision of the portion of the skin from which the sweat appeared. When examined 21 years later the patient stated that he had been much improved by the operation, but that the skin in front of the ear and along the right mandible still perspired to a certain degree, as did the left cheek occasionally, after eating something acid.

Langenskiöld, before discussing the mechanism and pathogenesis of the auriculo-temporal syndrome, says that the term is not fully correct, as the hyperhidrosis in some

cases comprises also regions of the skin innervated by the cervical plexus. Summing up the various theories on causation, he is inclined to support the suggestion of List and Peet (1938) that it is a humoral reflex closely connected with the functions of the salivary glands. By "humoral" he explains "that there is an increased irritability in the autonomic synapses in a limited skin area near the big salivary glands after an injury in the parotid region, or on the sympathetic. When the patient is eating, acetylcholine is constituted in the salivary glands in connexion with their function, and this substance diffuses in the surrounding tissue enough to cause sweat secretion and hyperaemia in the supersensitive area."

Various other theories on the cause of the auriculo-temporal syndrome may be summed up here. Wilson (1936), with reference to his cases mentioned above, concludes that the sweat glands of the human face have a double nerve supply—the sympathetic secretory fibres and an accessory set of fibres. He states that both these sets of fibres are cholinergic and believes the cause of the sweating to be due to a reflex. He also suggests that an abnormally reactive condition of the sweat glands may follow degeneration of sympathetic secretory nerves. Fulton (1949), however, points out, as have other physiologists, that there is no anatomical evidence of a double innervation of sweat glands.

Ford and Woodhall (1938) suggest that when the auriculo-temporal nerve is injured various groups of nerve fibres contained in it may be severed and in the process of regeneration may become misdirected along pathways other than those they originally pursued, so that they form connexions with the sweat glands and blood vessels of the skin. Thus nervous impulses passing over the parotid fibres, as when eating, may cause paroxysmal sweating and vasodilatation in the distribution of the auriculo-temporal nerve.

Payne (1940), in an article entitled "Pneumococcal Parotitis and Antecedent Auriculo-temporal Syndrome," regards the syndrome as a reflex from taste stimuli from the posterior third of the tongue.

Goatcher (1954), after describing a case of typical auriculo-temporal syndrome following excision of a portion of parotid gland for parotitis, sums up the various views held concerning its causation and then finally states: "It becomes apparent that the mechanism of the auriculo-temporal syndrome is not fully explained."

Bell, Davidson, and Scarborough (1953) state: "Although the fibres to the sweat glands are in fact post-ganglionic sympathetic fibres, they act in most animals, including man, by releasing acetylcholine"; or, as Fulton (1949) puts it, "sudomotor sympathetic fibres, in contrast to vasomotor and pilomotor fibres, are cholinergic."

Incidentally, it should be noted that gustatory reflex sweating may occur physiologically as when eating spicy foods, but it is ordinarily confined to the face, the upper lip, and tip of the nose (List and Peet, 1938).

### Discussion

Unilateral submental sweating on eating as observed by Uprus *et al.* and by Langenskiöld and in the present case would seem to be analogous to the auriculo-temporal syndrome but due to damage to the submandibular salivary gland as distinct from the parotid gland. (In Langenskiöld's case there was probably damage to both the parotid and the submandibular salivary glands on the right side, as the scar on that side extended from just below the lobe of the ear and sweating was not confined to the submental region.)

Uprus *et al.* carried out numerous tests on their patient, one of which was the effect of atropine. They found that after the administration of the drug (2 mg. subcutaneously) flushing but not sweating occurred on eating an apple. (It has been shown that a corresponding test in the present case produced similar results.) They point out that the effect of atropine pharmacologically on the salivary glands is to render stimulation of the chorda tympani ineffective in causing secretion without impairing its vasodilator activity,

for the chorda tympani is known to have true vasodilator fibres as well as secretory fibres. They also state that in all cases with such abnormal flushing and sweating injury has occurred to or in the vicinity of nerves which are known to contain true vasodilator and secretory fibres, and unknown to occur within the neighbourhood of a nerve which does not contain vasodilator fibres. Whilst they have no evidence to connect the fibres of the chorda tympani with the vessels and sweat glands of the abnormal area they consider that the period of latency between the original trauma and the onset of symptoms is consistent with an unusual regenerative phenomenon having occurred. They conclude that it is an abnormal reflex and that it has been identified with that of the salivary reflex, and that the abnormal effect is related to activity in the chorda tympani.

In the case presented above it is of particular interest to observe that the right submaxillary gland was removed and that the wound did not heal by first intention. It is possible that some portion of the gland remains, and in any case the surrounding area must have suffered trauma at the time of the original operation.

From perusal of the literature and after consultation with others it seems there is as yet no completely satisfactory explanation of the phenomenon, but the theories regarding the cause of the auriculo-temporal syndrome could be applied to these cases of unilateral submental sweating, except that a different nerve is involved—namely, the chorda tympani and not the auriculo-temporal.

In the three cases of submental sweating which have been described there was a long interval between the original operation and the onset of symptoms. This supports the theory that some abnormal regeneration of fibres had occurred. Further, in the case of Uprus *et al.* and in the one presented here, blocking the lingual nerve (chorda tympani) caused temporary total abolition of the abnormal response, whereas blocking the cervical sympathetic did not. This would support the theory that the syndrome is a salivary reflex related to activity in the chorda tympani. This nerve contains a few preganglionic parasympathetic (secretomotor) fibres which enter the submandibular ganglion which sends post-ganglionic fibres to the submandibular and sublingual glands (Gray, 1949).

Therefore it is suggested that the phenomenon of unilateral submental sweating on eating, following a previous operation on the neck involving one or other submandibular salivary glands, be known as the "chorda tympani syndrome" as distinct from the auriculo-temporal syndrome, which is related to lesions of the parotid gland.

### Treatment

Treatment of such a condition is difficult. Destruction of the lingual nerve would lead to undesirable side-effects. Belladonna also has side-effects and cannot be taken indefinitely but might be used on special occasions. X-ray application to the skin has been suggested, but the radiotherapists consulted thought this might harm the skin, altering its texture without affecting the symptoms.

Another suggestion was to reflect the skin affected and divide all nerves supplying this skin. Excision of the affected skin area was carried out in Langenskiöld's patient with apparently good effect. This has not been tried in the present instance, and in any case might lead to undesirable scarring in a young girl. The condition therefore persists, but the child is not seriously worried about it at present. Time may prove to be a healer, but this does not seem to have been so in the other cases mentioned.

### Summary

A case of flushing and sweating of the right submental region after eating is described. The various responses to the intake of certain foods before and after atropine administration, stellate ganglion block, or lingual nerve block were observed.

The history of one identical case, and another somewhat similar case recorded previously by other authors, are summarized, and theories of causation are discussed particularly in relation to the analogous auriculo-temporal syndrome.

The aetiology is somewhat uncertain, but the phenomenon would seem to be due to a reflex definitely related to the chorda tympani and abnormal regeneration of nerve fibres. It is suggested that the symptom-complex be termed "the chorda tympani syndrome."

I am indebted to Dr. E. A. Carmichael for his advice and for the photographs, which were taken at the National Hospital, Queen Square; to the librarian of the Royal Society of Medicine; to Mr. D. S. Hawke, my registrar; and to the sisters, house-surgeons, and colleagues at the Lister Hospital, who have helped with various tests, or have given suggestions regarding aetiology and treatment of the syndrome described in this paper.

## REFERENCES

- Baillarger, M. (1853). *Gaz. méd. Paris*, 18, 194.  
 Bell, G. H., Davidson, J. N., and Scarborough, H. (1953). *Textbook of Physiology and Biochemistry*, 2nd ed., p. 765. Edinburgh.  
 Ford, F. R., and Woodhall, B. (1938). *Arch. Surg. (Chicago)*, 36, 480.  
 Fulton, J. F. (1949). *Physiology of the Nervous System*, 3rd ed., p. 224. New York.  
 Goatcher, P. D. (1954). *British Medical Journal*, 1, 1233.  
*Gray's Anatomy*, 30th ed., 1949, p. 1086. London.  
 Langenskiöld, A. (1946). *Acta chir. scand.*, 93, 294.  
 List, C. F., and Peet, M. M. (1938). *Arch. Neurol. Psychiat.* (Chicago), 40, 443.  
 Maggiolo, J., Rawak, F., and Mussio-Fourmier, J. C. (1954). *Bull. Soc. méd. Hôp. Paris*, 70, 950.  
 Payne, R. T. (1940). *Lancet*, 1, 634.  
 Uprus, V., Gaylor, J. B., and Carmichael, E. A. (1934). *Brain*, 57, 443.  
 Vámos, L. (1938). *Derm. Wschr.*, 107, 1147.  
 Wilson, W. C. (1936). *Clin. Sci.*, 2, 273.

## SIMPLE CLINICAL TEST FOR THE DIAGNOSIS OF EARLY PREGNANCY

BY

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In 1953 Matthew and Hobson published their observations on the effects of intramuscular injections of progesterone and oestrogen ("disecron") as a means of diagnosing pregnancy. Although this test was associated with a high degree of accuracy and was more reliable than the Hogben test in the early weeks of pregnancy, it involved the disadvantages of two consecutive daily injections. To overcome this element of discomfort and inconvenience to the patient a further series of cases has been accumulated to show the effects of the administration of oral progesterone and oestrogen in circumstances similar to the earlier trial.

### Present Series

As a dosage reasonably comparable with the injected preparation, a total amount of 100 mg. of ethisterone and 0.5 mg. of ethinyloestradiol has been given over two consecutive days. This entailed the administration of five tablets ("orasecron") each containing 10 mg. of ethisterone and 0.05 mg. of ethinyloestradiol on each of the two days. The tablets were taken singly at three-hourly intervals and in this way caused no real upset, although a few patients complained of mild nausea. In all, 94 patients have so far been subjected to this test. The interval from the last menstrual period did not exceed 16 weeks (112 days) in any instance; in fact, cases have not been included in which the diagnosis of pregnancy would be reasonably certain as a result of pelvic examination.

Patients have been derived mainly from the sterility clinic, and the average age of the total series was 27.6 years.

The cases have been divided into two groups according to whether uterine bleeding was associated with the administration of the test dosage of combined progesterone and oestrogen or not.

Time Menstrual Period Overdue

Days Menstrual Period Overdue	No. of Cases	
	Group 1	Group 2
1 to 7 .. .. .	9	10
8 ,, 14 .. .. .	28	13
15 ,, 21 .. .. .	18	4
22 ,, 28 .. .. .	3	1
29 ,, 84 .. .. .	4	4
Total .. .. .	62	32

Group 1 consists of 62 patients (average age 27.7 years) in whom follow-up examination established the ultimate diagnosis of pregnancy (see Table). In this group there were *no instances* of uterine bleeding associated with the administration of progesterone and oestrogen in the dosage prescribed. It should be noted from the Table that in 37 patients (60%) the calculated interval between the first day of the missed period and the administration of the tablets was within 14 days, the period of pregnancy during which the Hogben biological test is not regarded as being reliable (Matthew and Hobson, 1953).

Group 2 consists of 32 patients (average age 27.5 years) in whom follow-up examination excluded the presence of pregnancy (see Table). Although cases of short-term secondary amenorrhoea in the absence of pregnancy are less often encountered, and thus the total number included in this group is smaller than in group 1, it would seem that the two series are comparable, especially in the timing of the test (see Table). In *every patient* in this group uterine bleeding occurred within a reasonable time from the taking of the progesterone/oestrogen tablets. The time interval before bleeding occurred varied up to a maximum of 14 days. Six patients began bleeding on the second day of the test, four on day 1 after completion of the course of tablets, one on day 2, six on day 3, three on day 4, one on day 5, two on day 6, and two on day 7. Thus in 78% of the cases bleeding occurred within a week of the test. Of the remainder, one patient had bleeding on day 8, one each on days 9, 10, 11, and 14, and two on day 12.

### Summary

A further step has been taken in investigating withdrawal bleeding following the administration of progesterone and oestrogen in women of child-bearing age complaining of short-term amenorrhoea. Parenteral administration used in the previous trial has now been succeeded by oral administration and the results observed in a series of 94 cases. When amenorrhoea was due to pregnancy no withdrawal bleeding occurred and no untoward effects upon the pregnancy were noted. In cases of non-pregnancy amenorrhoea withdrawal bleeding occurred within a varying period of time up to a maximum of 14 days. Thus the oral administration of combined progesterone and oestrogen in the dosage prescribed would appear to constitute a reliable clinical method of diagnosing early pregnancy.

Generous supplies of orasecron were kindly made available by British Schering Ltd. for use in this trial.

## REFERENCE

- Matthew, G. D., and Hobson, B. M. (1953). *J. Obstet. Gynaec. Brit. Emp.*, 60, 363.