of urine and uraemia following a combined hemigastrectomy and vagotomy, and a second died from an operation for closure of a duodenal fistula which developed after a difficult Billroth I gastrectomy with which vagotomy had also been combined. The overall mortality during the surgical treatment of these 215 patients has therefore been under 1%.

Commentary

The results of the investigations here recorded represent five years of study. During the first year little success was achieved beyond the development of a technique for complete vagus nerve section from below the diaphragm.

The percentage of failures among the early cases was high, but as the technique improved the proportion of incomplete vagotomies decreased, as did the proportion of failures. During the second and third years close follow-ups revealed the limitations of vagus resection as a therapeutic procedure in the treatment of duodenal ulcer, and some of the complications of vagotomy were recognized. Drainage operations were avoided at first, except when gross organic stenosis made it obligatory, until the effects of vagotomy alone had been studied. The observations made in this second period showed beyond question that complete vagotomy resulted in a marked fall in free acid, and that the low acid level was maintained in patients submitted to repeated secretion tests over a period of two years; but it also showed that in spite of a marked fall in free-acid level 25% of patients continued to complain of ulcer symptoms or suffered from recurrence after an initial period of well-being. Furthermore, it was noted that while 75% of vagotomized patients remained free from ulcer symptoms, certain side-effects of an unpleasant nature were apt to appear.

During the third and fourth years of study an analysis of good and bad results suggested that some of those who had been subjected to vagotomy were unsuitable subjects and that others presented too complicated a picture to be dealt with adequately by vagotomy alone, and combined operations were undertaken, such as vagotomy plus gastric resection or gastro-enterostomy.

The remaining period has confirmed that early uncomplicated cases of duodenal ulcer associated with high interdigestive secretion of free acid may be expected to obtain lasting benefit from vagotomy alone. For patients with a history of haemorrhage, perforation, scarring or deep crater formation—in other words, those most often presented to the surgeon—more radical operations are indicated. The results of these combined operations have been most gratifying, and the substitution of partial for high subtotal gastrectomy has done much to lower the post-operative morbidity and mortality of ulcer surgery.

Though resection plus vagotomy is the operation of choice at the moment, a prolonged follow-up of those patients who have had vagotomy plus gastro-enterostomy may prove that this is an adequate procedure with a minimal risk of stomal ulcer. Until this can be established beyond doubt, however, resection plus vagotomy must continue to be favoured. The scope of the resection is limited to removal of the ulcerated portion of the duodenum and enough of the pyloric half of the stomach to eliminate the secretory hormone element.

Summary

A series of 215 patients submitted to vagotomy over the last five years is reported. The results are satisfactory provided that the cases are skilfully selected and section of the nerves is complete. For large penetrating ulcers hemigastrectomy plus vagotomy has been tried, with, so far, promising results and avoidance of the "small-stomach syndrome" now becoming so common.

Despite our earlier fears, gastro-enterostomy plus vagotomy has continued to give excellent results in the small group in which it has been used.

The results of inadvertently incomplete vagotomy are variable and unsatisfactory, and only in the later part of our series did our technique become reliable in this respect.

BIBLIOGRAPHY

Allen, A. W. (1947). *Ann. R. Coll. Surg.*, **1**, 235.
Johnson, H. Daintree (1948a). *Postgrad. med. J.*, **24**, 193.
—— (1948b). *Proc. R. Soc. Med.*, **41**, 649.
—— (1949). "Vagotomy" in *Techniques in British Surgery*, edited by R. Maingot. Saunders, New York. (In press.)
Maingot, R. (1948). *Proc. R. Soc. Med.*, **41**, 645.
Orr, I. M. (1948). Ibid., **41**, 639.
—— and Johnson, H. D. (1947). *Lancet*, **2**, 84.
Rienhoff, W. F., jun. (1945). *Ann. Surg.*, **121**, 583.

THE USE OF PROCAINE PENICILLIN WITH ALUMINIUM MONOSTEARATE IN ADULTS

BY

E. J. WAYNE, M.D., F.R.C.P.
Professor of Pharmacology and Therapeutics, University of Sheffield

J. COLQUHOUN, M.B., Ch.B.
Senior Bacteriologist, Sheffield Royal Infirmary and Hospital

AND

JOYCE BURKE, M.B., B.S., D.C.H., D.R.C.O.G.
Junior Registrar, Sheffield Royal Infirmary

Of the many attempts which have been made to prolong the action of penicillin the most successful up to the present time have involved the use of the insoluble salt formed by combining penicillin G and procaine. By the use of this salt in fine suspension in arachis oil it has been claimed that bacteriostatic levels of penicillin in the blood can be maintained for 24 hours. While there is no doubt that in many cases this claim is justified, we have found in common with other observers (Emery, Stewart, and Stone, 1949) that the titre in the blood at 24 hours is very variable and often falls below the usually accepted minimum bacteriostatic level.

The retarding effect of aluminium stearate on the absorption of procaine penicillin has been pointed out by Buckwalter and Dickison (1948). The aluminium ester, which is a water-repellent, seems to produce a unimolecular envelope over the crystals and to delay their absorption. Observations on this preparation have been reported by Thomas, Lyons, Romansky, Rein, and Kitchen (1948), who found that a single injection of procaine penicillin in arachis oil with 2% (w/v) aluminium stearate maintained effective blood concentrations over a longer period than similar preparations without aluminium stearate. Robinson, Hirsh, Milloff, and Dowling (1948), using a similar preparation, found that the majority of cases had assayable blood levels after 24 hours and that one-third had assayable levels after 48 hours.

In this country Young, Andrews, and Montgomery (1949) have estimated the penicillin blood level after injection of procaine penicillin in oil with aluminium stearate. Estimations were made in 65 cases at 24-hour intervals

after a single injection of 300,000 units and in four cases at four-hour intervals. The effect of aluminium stearate in delaying absorption was confirmed. Eight patients received a single injection of 2,000,000 units of this preparation of procaine penicillin. This large dosage was tolerated well, and the indication is that very high blood levels can be obtained without incurring toxic effects from the large amount of procaine which must necessarily be administered at the same time. The prolongation of the effect of procaine penicillin by aluminium stearate has also been studied in children by Emery, Rose, Stewart, and Wayne (1949), who confirmed the advantage of the preparation over simple procaine penicillin suspensions in arachis oil.

The importance of particle size in prolonging the effect of procaine penicillin has been emphasized by Welch, Hirsh, Taggart, and Smith (1947). Thomas *et al.* (1948) likewise found that with preparations containing aluminium stearate the greatest prolongation was obtained where 95% of the particles were under 5 μ in diameter. On the other hand, Young *et al.* (1949) used preparations with a particle size of 5–20 μ with satisfactory results, and state that adequate blood levels were obtained with coarse particles of 60 μ, although such preparations tended to clog needles.

We have studied the penicillin blood levels in adults after standard doses of 300,000 units and 600,000 units of procaine penicillin in arachis oil with 2% aluminium stearate. Our estimations were carried out at relatively frequent intervals during the first 24 hours, and the blood levels were compared with those obtained after 600,000 units of penicillin in aqueous solution. We have also investigated the penicillin blood levels after daily injections of 600,000 units of the oily preparations, and in these observations preparations containing three different sizes of particle have been used.

Method and Results

Serum penicillin levels were estimated by dilutions in phenol-red–glucose–serum medium (May, Voureka, and Fleming, 1947) which were inoculated with *Streptococcus pyogenes* and compared with similarly inoculated dilutions of standard penicillin in the same medium. Injections were given to ward patients and to volunteers. Except in Cases 4, 9, 11, and 12 (see Tables I and II), to which attention will be drawn, we had no reason to think that the condition from which the patient was suffering would affect the blood levels reached.

Ten patients were given 300,000 units of the preparation, and the serum penicillin levels were estimated at frequent intervals for the first 24 hours and then 12-hourly for the next two days. The results are given in Table I. Two

TABLE I.—*Serum Penicillin Levels (u./ml.) Following the Injection of 300,000 Units of Procaine Penicillin with 2% Aluminium Stearate*

Case No.	Hours After Injection									
	1	2	3	6	12	24	36	48	60	72
1	—	—	0·5	0·25	0·125	0·125	0·06	<0·06	<0·06	<0·06
2	0·125	0·25	0·25	0·125	0·125	0·125	<0·06	<0·06	—	—
3	0·125	0·25	0·25	0·25	0·125	0·125	0·125	—	—	—
4	0·06	1·0	4·0	1·0	0·5	0·25	0·06	0·06	—	—
5	0·25	0·25	0·125	0·125	0·125	0·125	0·06	0·06	0·06	0·06
6	0·5	0·5	0·25	0·25	0·125	0·125	0·125	0·06	0·06	0·06
7	0·125	0·06	0·125	0·06	0·06	0·06	0·03	<0·03	<0·03	<0·03
8	0·5	0·25	0·125	0·06	0·125	0·06	0·06	0·03	0·03	<0·03
9	0·5	1·0	2·0	1·0	1·0	0·5	0·25	0·06	<0·03	<0·03
10	0·03	0·03	0·03	0·03	0·03	0·03	0·03	0·03	<0·03	<0·03

cases (Nos. 4 and 9) showed very high levels, which we attribute to impaired renal excretion, since Case 4 had congestive heart failure and Case 9 suffered from type II nephritis. These two cases have been excluded from the average figures, which are given in the composite graph, but they are of interest in showing the high levels reached when excretion is impaired. It will be noticed that we have taken as our minimum bacteriostatic level a concentration of penicillin of 0.06 u./ml., whereas many American observers accept a level of 0.03 u./ml. In making general statements about "bacteriostatic levels" the actual level accepted by a group of observers must clearly be taken into account.

Apart from Case 10, adequate serum levels were maintained for 24 hours, but it was realized that higher dosage might give consistently higher levels. A further 33 patients received a single injection of 600,000 units. The serum levels obtained are given in Table II. In Cases 11 and 12

TABLE II.—*Serum Penicillin Levels (u./ml.) Following the Injection of 600,000 Units of Procaine Penicillin with 2% Aluminium Stearate*

Case No.	Hours After Injection									
	1	2	3	6	12	24	36	48	60	72
11	8	8	16	8	2	1	0·25	0·125	0·125	0·125
12	16	1	1	0·25	0·5	0·25	0·25	0·125	0·125	0·125
13	—	—	—	—	—	—	0·5	0·125	0·06	0·03
14	0·25	0·25	0·5	0·125	0·25	0·125	—	—	0·06	0·03
15	0·5	0·5	0·25	0·125	0·25	0·125	—	—	0·06	0·03
16	0·25	0·5	0·5	0·5	0·5	0·125	—	—	—	—
17	0·25	0·5	0·25	0·25	0·25	0·25	0·25	0·125	0·125	<0·03
18	0·125	0·25	0·125	0·125	0·125	0·06	0·03	0·03	0·125	0·06
19	0·125	0·5	0·25	0·06	0·06	0·06	0·03	0·03	0·03	0·03
20	0·5	1	2	0·5	0·5	0·5	0·25	0·25	<0·03	<0·03
21	0·03	0·03	0·06	0·03	0·125	0·06	0·06	0·03	<0·03	<0·03
22	1	1	1	1	0·5	0·25	0·125	0·125	<0·03	<0·03
23	0·5	0·5	0·5	1	0·5	0·125	0·25	0·125	0·03	<0·03
24	0·5	0·25	0·25	0·25	0·5	0·25	0·125	0·125	0·03	0·03
25	2	2	4	0·25	0·25	1	1	0·5	0·125	0·06
26	0·25	0·5	1	1	1	1	1	1	1	1
27	0·5	0·5	0·5	0·25	0·5	0·125	0·5	—	0·06	—
28	0·5	0·5	0·5	0·5	0·5	0·25	0·25	—	—	—
29	0·5	1	0·5	0·25	0·25	0·25	0·25	0·125	—	0·03
30	0·5	1	0·5	0·5	0·5	0·125	0·125	0·06	—	0·03
31	0·5	0·5	0·5	0·5	0·5	1	0·25	0·25	0·25	0·25
32	0·5	0·5	0·5	0·5	0·5	0·5	0·5	0·25	0·25	0·125
33	1	1	1	0·5	1	0·5	0·25	0·25	0·125	—
34	1	0·5	0·5	1	—	0·25	—	0·03	—	0·03
35	1	1	1	2	—	0·25	—	0·125	—	0·06
36	0·5	1	0·5	1	—	0·06	—	0·03	—	0·03
37	1	—	0·5	2	—	0·125	—	0·03	—	0·03
38	—	1	1	—	0·5	0·5	0·25	0·25	0·125	0·125
39	—	0·25	0·25	0·25	0·25	0·125	0·125	0·25	0·125	0·125
40	—	0·25	0·25	0·25	0·25	0·25	0·25	0·25	0·125	0·03
41	1	0·5	1	2	0·25	0·25	0·06	0·06	0·06	0·06
42	1	1	1	0·5	0·5	0·25	0·06	0·06	0·06	0·06
43	0·5	0·5	0·5	0·5	0·5	0·25	0·06	0·06	0·06	0·06

the levels were so much higher than in the rest that they have been excluded from the composite curve. In Case 11 renal deficiency was present, but we could find no reason for the very high serum level at one hour in Case 12, which was a case of gout. From Table II and the composite curve it will be seen that serum levels at or above 0.06 u./ml. are present in every case at 24 hours and at or above 0.03 u./ml. at 48 hours. At 72 hours, out of 29 cases in which estimations were made, 24 had serum levels at or above 0.03 u./ml. The composite curve shows that the average level is above 0.06 u./ml. at 72 hours. For comparison, three patients were given 600,000 units of crystalline penicillin G in water; the composite curve is shown in the Chart.

We next investigated the serum levels attained with daily doses of 600,000 units of procaine penicillin and aluminium stearate for four days. For this purpose we used three preparations from different manufacturers, A, B, and C. Over 95% of the particles in preparation B were much below 5 μ in diameter and there were no large particles. This is the preparation which has been used in the investigations described above. Preparation A contained some rather large crystals, but the great majority were much below 5 μ in size. In preparation C the crystals were also

rather large—approximately 5–20 μ. The results are set out in Table III. With preparations A and B remarkably constant serum levels were achieved, so that the composite curve is practically level. With preparation C the levels reached were not so constant. Although the total number of cases studied is small, we think this result is not due to chance and that small particle size is desirable. After the fourth day no further injections were given, but detectable quantities of penicillin were present in the blood 72 hours later in those cases in which estimations were made.

TABLE III.—*Serum Penicillin Levels (u./ml.) After Daily Injections of 600,000 Units of Procaine Penicillin with 2% Aluminium Stearate for Four Days Using Preparations with Three Different Sizes of Particle*

Preparation	Case No.	Hours After Injection					
		24 (Day 1)	24 (Day 2)	24 (Day 3)	24 (Day 4)	48 (Day 5)	72 (Day 6)
A	44	0·5	0·5	0·5	0·5	—	—
,,	45	0·5	0·5	0·5	0·5	—	—
,,	46	0·125	0·125	0·125	0·125	—	—
,,	47	0·25	0·5	0·5	0·5	—	—
,,	48	0·125	0·25	0·25	0·25	—	—
B	49	0·5	0·5	0·5	0·5	0·25	0·5
,,	50	0·25	0·25	0·25	0·25	0·125	0·03
,,	51	0·25	0·06	0·25	0·25	0·125	0·06
,,	52	0·25	0·25	0·25	0·25	0·25	0·125
,,	53	0·25	0·25	0·5	—	0·125	0·125
C	54	0·25	0·25	0·125	0·06	0·06	0·06
,,	55	0·125	0·5	0·25	0·125	0·06	0·06
,,	56	0·25	0·06	0·06	0·03	0·03	—
,,	57	0·25	0·25	0·25	0·06	0·03	0·03
,,	58	0·25	0·25	0·125	0·06	0·03	0·03

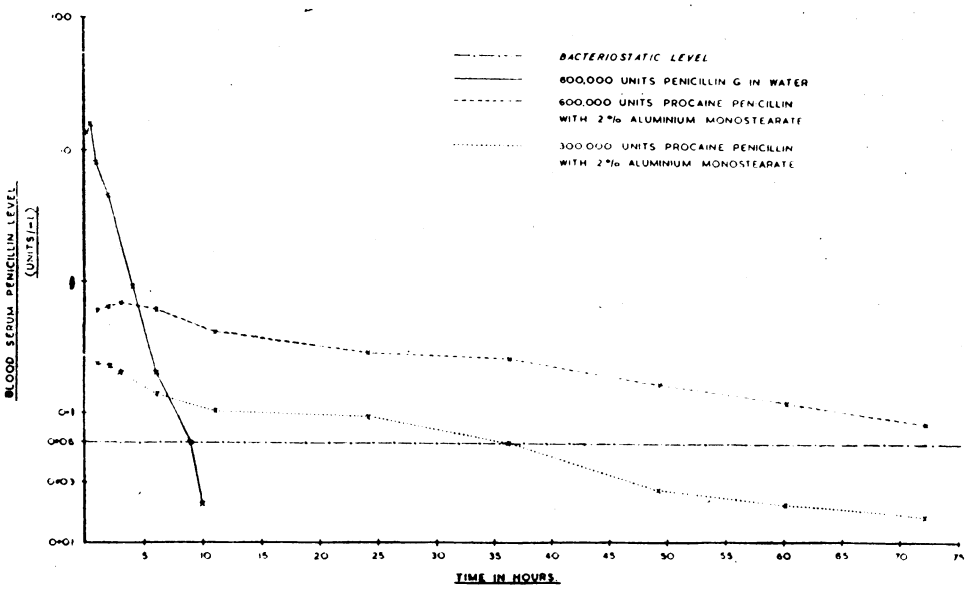

Chart showing the average serum levels of penicillin reached after single doses of 300,000 units (8 cases) and 600,000 units (31 cases) of procaine penicillin with 2% aluminium stearate. The average levels after a single dose of 600,000 units of penicillin G in water are shown for comparison. The concentration of penicillin is plotted on a logarithmic scale.

Serum penicillin levels were also estimated in one patient after 600,000 units of procaine penicillin with aluminium stearate both before and during the administration of caronamide in doses sufficient to give effective blood levels. The results are shown in Table IV. During caronamide administration significantly higher blood levels were achieved 36, 48, 72, and 96 hours after the penicillin had been given.

TABLE IV.—*Serum Penicillin Levels After Two Injections of 600,000 Units of Penicillin with Aluminium Stearate, One Before and One During the Administration of Caronamide. The Caronamide was Given in 4-g. Doses Four-hourly by Mouth for 96 Hours Starting 24 Hours Before the Second Injection*

Hours After Injection	Serum Penicillin Levels (u./ml.)		Serum Caronamide Levels (mg./100 ml.)
	Before Caronamide Administration	During Caronamide Administration	
12	0·25	0·25	38
24	0·125	0·125	46
36	0·125	0·25	44
48	0·125	0·25	56
72	0·06	0·25	60
96	0·03	0·125	9

Discussion

When penicillin was first introduced it was assumed that the best clinical results would be obtained by maintaining a level of penicillin in the blood which was always above the minimum bacteriostatic level for the organism causing the disease. Consequently, continuous intravenous and, later, intramuscular drips were used. It then became abundantly clear that equally good clinical results could be obtained by the intermittent intramuscular injection of penicillin every three hours during the day and night. With the necessity for conserving the limited supplies of penicillin then available, this method was undoubtedly justified, but later, when it was possible to use much higher doses, it became the custom in general practice to give no more than two injections in each 24 hours. Indeed, it would rarely have been possible to treat patients in their own homes by any other system of dosage.

By this method clinically satisfactory results can be obtained in many minor disorders, such as those ordinarily treated in a casualty department, and we can ourselves vouch for the adequacy of six-hourly injections of 120,000 units of penicillin in water in the treatment of pneumococcal pneumonia. Similar clinical results have been reported by other observers (Wheatley, 1947, 1949; Barclay, 1949; Tompsett, Timpanelli, Goldstein, and McDermott, 1949). It should be remembered that it was originally assumed that the best results would be obtained by maintaining a bacteriostatic level of penicillin in the blood. It has been argued that an interval without penicillin in the blood may allow dormant organisms to undergo active multiplication; for it is only at this time, as Chain and Duthie (1945) have shown, that they are susceptible to the drug. It has also been argued that the very high levels obtained after a large single dose of penicillin in aqueous solution will enable penicillin to pass into relatively avascular tissue by diffusion. The bacteriostatic action of penicillin may indeed apparently persist some time after it can no longer be detected in the blood. The evidence in favour of the discontinuous use of penicillin has been reviewed by Marshall (1948).

Eagle and Musselman (1948) and Eagle (1948), on the other hand, have brought forward evidence which suggests

that the maximum bactericidal effect of penicillin is achieved by comparatively low blood penicillin levels of the order of 0.1 u./ml., and that there is no advantage in attempting to reach higher concentrations except in the case of relatively insensitive organisms. Indeed, there may be an actual disadvantage, since with some bacteria high concentrations reduce the bactericidal effect. It cannot be said that it is yet known with certainty whether discontinuous or continuous methods of administration are preferable. Tompsett *et al.* (1949) compared the effect of 300,000 units of aqueous penicillin given twice daily with that of a single injection of 300,000 units of procaine penicillin. Both systems of treatment gave satisfactory results in pneumococcal pneumonia.

It should be pointed out, however, that almost all the clinically satisfactory results reported have been achieved with methods which give a relatively stable blood concentration, and that, so far, there is no similar mass of clinical evidence in favour of discontinuous administration. Maintenance of a steady blood penicillin level is easy to achieve by a single daily dose of the preparation we have been investigating, and if a single estimation of the blood penicillin level is made it may be assumed that this will be constant from day to day. It is possible to impose a daily peak on this steady level by adding soluble penicillin to the injection if the theoretical arguments in favour of this procedure are felt to be impressive enough.

There is evidence that in the treatment of infections with sensitive organisms penicillin in oil with aluminium stearate is clinically effective (Boger and Flippin, 1949). Mahoney (1949) states that three injections of 600,000 units give as satisfactory results in the treatment of syphilis as the standard three- or four-hourly injections. There is no reason to doubt the efficacy of the preparation in any infection provided the sensitivity of the organism is estimated and the penicillin blood level is occasionally checked. The advantages of using this preparation of penicillin are the increased comfort of the patient, who need be subjected to but one painless injection a day at the most. There is also a great saving of time of the medical and nursing staff. The aluminium stearate tends to prevent sedimentation and make the preparation more fluid.

The advocates of discontinuous therapy with aqueous penicillin advise at least two injections in 24 hours, and oral administration of penicillin involves frequent dosage with not very palatable preparations. Our limited experience with procaine penicillin in oil in adults agrees with that of Emery, Stewart, and Stone (1949) in children. They found very variable blood levels. Emery, Rose, Stewart, and Wayne (1949), however, were able to maintain bacteriostatic levels in children when procaine penicillin in oil with aluminium stearate was used, and our results in adults are again in agreement.

We have used procaine penicillin with aluminium stearate in the treatment of several cases of urinary-tract infections with good results, also in a few other infections. It would be necessary, however, to treat a large number of comparable cases by this method and by standard three-hourly injections in order to make a statistically acceptable comparison.

We have seen no reactions in any patient, and the injections are almost painless. It seems probable that the preparation will become a standard form of penicillin administration except in cases in which resistant organisms are concerned.

Summary

Procaine penicillin in arachis oil with 2% aluminium stearate has been given in single doses of 300,000 units to 10 individuals and in single doses of 600,000 units to 33 individuals. The blood-serum penicillin levels have been estimated at frequent intervals. With the lower dose, bacteriostatic levels (above 0.06 u./ml.) were maintained for 24 hours in all but one case. With the higher dose, bacteriostatic levels were maintained for 24 hours in every case, and the average level remained above 0.06 u./ml. for 72 hours.

Daily doses of 600,000 units for four days were administered to 15 patients, using preparations with three different sizes of particle. Remarkably constant bacteriostatic levels were maintained while the injections were being given, especially with preparations containing many particles of small size. Detectable quantities of penicillin were present in the serum three days after administration had ceased.

One patient received caronamide before and after a single dose of 600,000 units of procaine penicillin with 2% aluminium stearate. Significantly higher levels were reached than when caronamide was not administered.

The arguments in favour of discontinuous administration of large doses of penicillin are reviewed, and it is concluded that the balance of evidence is in favour of a maintained steady blood penicillin level such as is attained by the daily administration of 600,000 units of procaine penicillin with 2% aluminium stearate.

We should like to thank Dr. H. Brody for permission to include in our series observations on some of his cases. The penicillin preparation used in most of the investigations was kindly supplied by Imperial Chemical (Pharmaceuticals), Ltd., Manchester.

REFERENCES

Barclay, G. A. (1949). *British Medical Journal*, **1**, 175.
Boger, W. P., and Flippin, H. F. (1949). *J. Amer. med. Ass.*, **139**, 1131.
Buckwalter, F. H., and Dickison, H. L. (1949). Quoted by Thomas *et al.* (1948).
Chain, E., and Duthie, E. S. (1945). *Lancet*, **1**, 652.
Eagle, H. (1948). *Ann. intern. Med.*, **28**, 260.
—— and Musselman, A. D. (1948). *J. exp. Med.*, **88**, 99.
Emery, J. L., Rose, L. M., Stewart, S. M., and Wayne, E. J. (1949). *British Medical Journal*, **1**, 1110.
—— Stewart, S. M., and Stone, D. G. H. (1949). Ibid., **1**, 845.
Mahoney, J. F. (1949). *Practitioner*, **162**, 358.
Marshall, E. K., jun. (1948). *Bull. Johns Hopk. Hosp.*, **82**, 403.
May, J. R., Voureka, A. E., and Fleming, A. (1947). *British Medical Journal*, **1**, 627.
Robinson, J. A., Hirsh, H. L., Milloff, B., and Dowling, H. F. (1948). *J. Lab. clin. Med.*, **33**, 1232.
Thomas, E. W., Lyons, R. H., Romansky, M. J., Rein, C. R., and Kitchen, D. K. (1948). *J. Amer. med. Ass.*, **137**, 1517.
Tompsett, R., Timpanelli, A., Goldstein, O., and McDermott, W. (1949). Ibid., **139**, 555.
Welch, H., Hirsh, H. L., Taggart, S. R., and Smith, G. M. (1947). Presented at the Meeting of Syphilis Study Section, September 24. Washington, D.C.
Wheatley, D. P. (1947). *British Medical Journal*, **1**, 530.
—— (1949). *Practitioner*, **162**, 508.
Young, M. Y., Andrews, G. W. S., and Montgomery, D. M. (1949). *Lancet*, **1**, 863.

The results of an investigation to establish norms for heights and weights of infants and pre-school children has recently been published by the Department of Health of the Melbourne City Council. It is the standard practice at the health centres in the city to record and chart the weight of each child who attends, and the investigation was planned to provide information about average heights and weights in the years 1926, 1936, and 1946. The results are presented in a set of tables with accompanying graphs. The main features are: (1) The difference in the average height of males and females seems to be so great that separate norms are required. (2) There has been a considerable rise in the average height and weight of infants and pre-school children in the city of Melbourne between 1936 and 1946. Such evidence as was available suggested that there had been a smaller increase between 1926 and 1936. (3) The average weight of infants in the city of Melbourne is apparently about the same as that shown by the most recently available data from New Zealand. (4) The average weight of infants is considerably higher than that which is shown as normal on the printed graphs used at the infant-welfare centres in the State of Victoria.