receiving iron, and neither receiving folic acid. This finding is superficially at variance with that of Chanarin *et al.* (1965), who found a greater fall of serum folate in late pregnancy among unsupplemented compared with iron-supplemented patients. However, this difference was not continued into the postpartum period in their cases, and this was the time at which the serum folate level was measured in the present series. Like Chanarin *et al.* (1965), we have found a higher incidence of megaloblastic anaemia, though different criteria were employed, in the unsupplemented group 1, compared with the iron-supplemented group 2 patients (Table III). The numbers of cases, however, are small.

Summary

Antenatal patients have been randomly allocated to five prophylactic treatment groups at their first clinic visit. Thereafter their haemoglobin level was estimated at each visit, and they were removed from the trial if anaemia developed. In 350 consecutive patients the 2–4 day postpartum fasting serum folate level was measured. It was found that these levels were similar in the non-supplemented group 1 and the iron-supplemented group 2, but significantly raised in the iron plus 100 μg. of folic-acid-supplemented group 3. In the groups receiving iron plus 300 μg. (group 4) or 450 μg. (group 5) a day of folic acid the postpartum serum folates were further significantly raised ($P<0.001$). The levels in these groups are compared with those in patients not in the trial, with patients with overt megaloblastic anaemia, and with a group of non-pregnant normal adults.

The median postpartum serum folate levels in groups 1, 2, and 3 were lower than in the normal non-pregnant adults, the level in group 4 receiving 300 μg. a day was identical, at 5 mμg./ml., with that of the normal adults, while the level in group 5 was supranormal. In group 4 84% of the patients had postpartum serum folate levels above 2.5 mμg./ml., and no cases of megaloblastic anaemia were found in group 4 or 5 before or after delivery.

It is concluded that the minimal oral requirements of folic acid in late pregnancy are close to 300 μg. a day.

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Diaphragmatic Paralysis after Herpes Zoster

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Motor complications after herpes zoster are not uncommon, the first association of muscular paralysis and zoster being reported by Sir William Broadbent (1866). Since that time there have been many reports of muscular paralyses following herpes—of the hand, abdominal muscles, face (Ramsey Hunt, 1907), calf, quadriceps, foot, and even bladder, and many other sites. A comprehensive review of the literature on motor involvement has been made by Taterka and O'Sullivan (1943).

The association between diaphragmatic paralysis and zoster was first reported by Halpern and Covner (1949). The case presented below showed not only weakness of the right arm but also diaphragmatic involvement following herpes zoster of C 5 and 6 on the right side. Recognition of this latter relationship became important when the patient developed carcinoma of the bronchus in the right lung some months later.

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Case Report

A man aged 54 first developed symptoms of rheumatoid arthritis in 1942, but was reasonably well until 1958, when his wrists, proximal interphalangeal joints, and left shoulder became stiff and painful. At that time he was given chloroquine and aspirin, with some relief. During the next five years he had various forms of treatment, including gold, steroids, A.C.T.H., and phenylbutazone.

In May 1963, whilst an inpatient with an attack of acute bronchitis, he developed a typical zoster eruption affecting C 5 and 6 on the right side. Pain and itching were the main symptoms, but he complained of weakness in the right arm and hand one week later, and dyspnoea after a further fortnight.

On examination he was thin, with no enlarged glands or clubbing. There was evidence of rheumatoid arthritis in the hands, wrists, elbows, knees, and feet. Many of these joints were deformed and some were warm and painful. The cardiovascular system and abdomen showed no clinical abnormality. There were no abnormal findings concerning his chest. The neck had a full and painless range of movement. The cranial nerves were normal. Scarred herpetic lesions were present over the right trapezius and outer border of the upper arm and forearm, with sensory loss to pinprick over an area compatible with the distribution of C 5 and 6. The biceps and supinator reflexes were absent on the right side. The lower limbs were normal.

Investigations.—Haemoglobin 100% (14.8 g./100 ml.); W.B.C. normal; E.S.R. 15 mm. in first hour (Wintrobe). Serum proteins: total 5.8 g./100 ml. (albumin 3.1 g., globulin 2.7 g.).

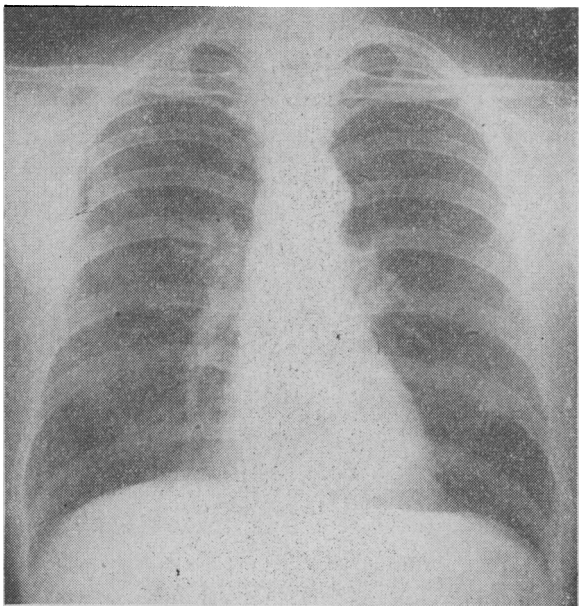

FIG. 1.—Radiograph taken on 12 February 1963.

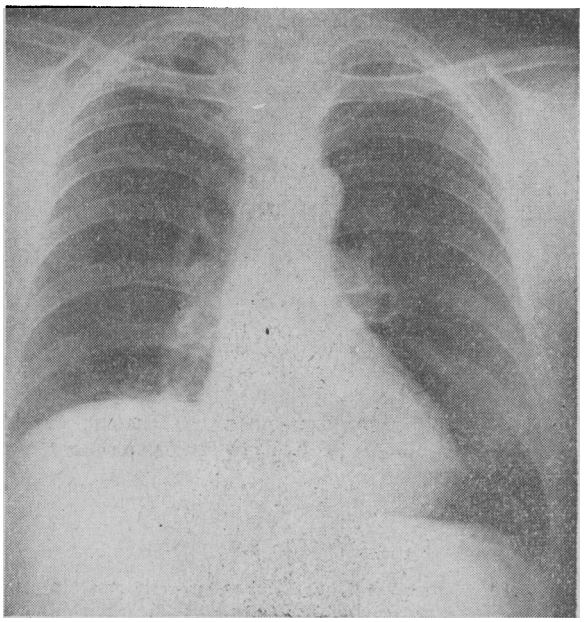

FIG. 2.—Radiograph taken on 13 July 1963.

Blood urea 36 mg./100 ml. Serum uric acid 5.3 mg./100 ml. E.C.G. within normal limits. Rheumatoid latex fixation test positive. *X*-ray examination showed marked rheumatoid changes of hands and feet and osteoporosis and posterior osteoarthritis at all levels between C 2 and C 5. The report on a chest *x*-ray film taken on 12 February 1963 (Fig. 1) stated: "The lung fields show no abnormality. No cervical rib is seen." A further chest *x*-ray film taken on 13 July 1963 (Fig. 2) was reported on as follows: "The right diaphragm is now a full posterior interspace higher than in the *x*-ray film taken on 12 February."

No local causes for a phrenic-nerve lesion could be found, whether pressure from glands or skeletal deformities. Evidence for a rheumatoid or carcinomatous neuropathy was lacking. There was no evidence of arteritis.

The cutaneous lesion in the C 5 and 6 area and the diaphragmatic paralysis were thought to be due to herpes zoster affecting the C 5 and 6 cutaneous distribution and also the phrenic nerve or its roots.

Comment

Only six cases of diaphragmatic paralysis due to herpes zoster have been reported (Halpern and Covner, 1949; Cervia, 1953; Parker and Ramos, 1962; Beard, 1963; Spiers, 1963; Donald, 1964). Half of these had no symptoms referable to the respiratory system. The above patient did, however, complain of dyspnoea, and this has continued. The right diaphragm remained completely paralysed. This became of diagnostic significance when he was observed, four months later, to have developed a circular opacity in the upper zone of his right lung. Tomography revealed a solitary nodule, and bronchoscopy was negative. A provisional diagnosis of carcinoma of the lung was made.

Thoracotomy was undertaken (Mr. W. G. Williams) and a poorly differentiated squamous carcinoma was found in the posterior segment of the right upper lobe. Right upper lobectomy was successfully performed. At operation no local involvement of the mediastinum or phrenic nerve was found. At that time extradural metastases as the cause of the herpes were excluded on length of history, and also on clinical and radiological grounds.

In this case the importance of the herpes as the cause of the diaphragmatic paralysis is apparent. An erroneous diagnosis of mediastinal-gland or phrenic-nerve involvement was therefore avoided.

This case is presented in order to bring to mind the possibility of motor involvement following herpes zoster and perhaps to account for some unexplained paralyses of the diaphragm (Couch, 1953).

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