

It is clear, then, that the figures are not likely to be specially flattering to the treatment. It is, however, only fair to point out that since the opening of the new cholera ward in the Medical College Hospital there has been a vast improvement in the care and nursing of the patients, but, of course, this cannot account for anything but a small proportion of the increased recovery rate.

It is important to note that equally favourable results must not be expected in all types of the disease; for instance, in those epidemics where the great majority of the patients die in a few hours neither this nor any known line of treatment will save any large proportion of the patients. In such epidemics the treatment is likely to be unjustly condemned, or the medical man may be unduly discouraged by the poorness of the results obtained if he expects as great a reduction in the mortality as is obtained in a series of cases of average severity, such as is seen in the Medical College Hospital.

With regard to the details of the treatment, a complete account will be found in Major Rogers's book on Cholera, but one or two points may be noted. Early transfusion is the most important factor in the treatment. When the case is clearly one of cholera of any severity I think it is a mistake to wait for the blood pressure to fall and for the blood to become concentrated and highly charged with toxins. By prompt intravenous injection of hypertonic saline the toxins are kept from becoming concentrated, the circulation is maintained in the vital organs of the body, especially the heart and kidneys, and consequently serious damage to their tissues is considerably less likely to occur. Theoretically one might expect that the maintenance of the circulation would result in the absorption of a large amount of toxin from the bowel, but in practice it is found that any harm that may result from this is much more than counterbalanced by the other benefits resulting from transfusion. The rise of temperature following transfusion is probably due more to an equalisation of the body temperature by a restoration of the circulation, and to the restoration of the power of reaction to the toxins on the part of the body, than to the increased absorption of the toxins.

The administration of the permanganates has not yet been placed on a sound basis; pills and capsules are frequently unsatisfactory, and solutions are often resented by the patients. Washing out the stomach with a permanganate solution might be worth consideration in those cases where the patient would tolerate the procedure, and if it were found possible to retain a nasal tube *in situ* it might be practicable to eliminate a considerable amount of toxin by frequent lavage. The risk to the operator would have to be considered and guarded against.

Another possibility in the treatment of cholera to which certain American observers have called attention is the intravenous injection of alkalis to counteract the great diminution in the alkalinity of the blood that is known to occur. In some cases in which Major D. McCay kindly estimated the alkalinity of the blood for me the reduction was very great, but in these cases administration of alkalis by the vein was of little effect, probably because the treatment was too late.

The results stated above are by no means the best that are attainable, as some of the deaths were due to preventable causes such as errors and imperfections in the technique, but they are sufficiently good to show that the method is one of great value in saving life; while another advantage of the treatment that cannot be shown by figures is the remarkable relief of the suffering which is such a distressing feature of many cases of cholera.

I am indebted to Dr. Jitendra Nath. Ghosh, house physician, and to Dr. Sures Chandra Majumdar, assistant house physician of the cholera ward, for the notes on which the above figures are based.

LONDON (ROYAL FREE HOSPITAL) SCHOOL OF MEDICINE FOR WOMEN.—The annual dinner of the hospital and school will be held at the Trocadéro Restaurant, Piccadilly-circus, on Wednesday, Dec. 11th, at 7.15 P.M. Mr. Stanley Boyd will take the chair. Applications for dinner tickets, price 7s. 6d., should be sent to the honorary secretaries, Dr. Winifred Cullis, 8, Hunter-street, Brunswick-square, W.C., or Dr. Frederick Langmead, 53, Queen Anne-street, W., not later than Nov. 30th.

ERYTHRÆMIA.

WITH AN ACCOUNT OF SIX CASES.

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THE six cases here described have been seen at the London Hospital during the last six years. The name *erythræmia* has rightly superseded the terms "splenomegalic polycythæmia" and "chronic polycythæmia with cyanosis." Several cases have been reported in which the spleen was not enlarged, and a few cases have shown no cyanosis. But the word "erythræmia" might well replace the word "polycythæmia" wherever the important and characteristic feature is an increase of red cells; leukæmia is indeed a condition of polycythæmia. When erythræmia persists, and no adequate cause for it is found, the term *primary erythræmia* may be used. If the erythræmia is secondary to congenital heart disease, chronic pulmonary disease, or other conditions known to produce an increase of the red cells, it may be called *secondary erythræmia*. Many authorities have restricted the term erythræmia to the cases here called primary erythræmia, and have used the word *erythrocytosis* for the conditions here called secondary erythræmia.

The disease is probably due to a primary hyperplasia of the bone marrow, involving chiefly the erythroblastic tissues. It is thus analogous to myeloid leukæmia, in which the leucoblastic tissues are concerned. The exciting cause of the disease is unknown; like many another disease it has been ascribed to gastro-intestinal toxæmia. Cases 3 and 6 gave a history of exposure to fumes. For a full account of the pathology of erythræmia Dr. F. Parkes Weber's¹ critical review may be consulted.

Symptoms.—The symptoms usually appear in adults between the ages of 30 and 60, and rather more frequently in men than in women. Shortness of breath, blueness, giddiness, and general weakness are among the earliest and most constant complaints. In some patients the first symptoms are referable to the spleen and consist of abdominal pains, usually on the left side. Others complain of the presence of an abdominal tumour. It is interesting to find that the change in facial appearance may not have been noticed by the patient. Wasting and general weakness are frequent, but only severe when the other symptoms are also troublesome. The subjects of erythræmia are very liable to hæmorrhages. Epistaxis, bleeding from the gums, and hæmatemesis have often been remarked. Purpura occurred in two of the cases here described.

Headache occurs at some time during the course of most cases. It often becomes continuous and produces a feeling of pressure or fulness whenever there is an exacerbation of the general symptoms. Typical attacks of migraine are sometimes a feature. The giddiness of erythræmia comes on in attacks of brief duration; tinnitus is rare. Paræsthesiæ, such as tingling or numbness, may be felt in the arms and legs or over the whole body. Muscular spasms, twitches, and cramping pains may affect the extremities. Mental changes, such as nervousness, excitement, and loss of memory, sometimes appear. Graver cerebral symptoms suggest cerebral thrombosis or hæmorrhage—e.g., in Hutchison and Miller's² case. Temporary disturbances of vision are not infrequent.

It is unusual for cardio-vascular symptoms to predominate, but palpitation is common. Coldness of the extremities may be found, and a few patients have suffered severe neuralgic pains in them. Edema of the legs is sometimes present, especially late in the disease. Thrombosis of vessels in any part of the body may give rise to local symptoms. Shortness of breath almost invariably forms one of the patient's complaints, yet the objective distress is often slight. Vomiting occurs in many cases, and is associated with anorexia, pain after food, and constipation. Severe attacks of sweating are described.

Physical signs.—The face usually presents a striking florid appearance, with dilatation of the superficial venules. This full-blooded aspect is more characteristic than cyanosis. Cyanosis is, however, almost always present, being well seen

¹ F. P. Weber: *Quarterly Journal of Medicine*, 1908, vol. ii., p. 85.

² Hutchison and Miller: *THE LANCET*, 1906, vol. i., p. 744.

in the lips and ears. The whole face may be extremely cyanosed in severe cases and on exposure to cold. The congestion gradually fades towards the neck, and the trunk is rarely affected. The hands and forearms are congested, the colour ranging from red to bluish-red. The feet may be similarly involved. Clubbing of the fingers is sometimes found. The eyes are bloodshot, the retinal vessels congested. The tongue is bluish-red; the palate and pharynx are deeply injected. The above appearances are not diagnostic as some have implied; the erythræmia secondary to chronic cardiac or pulmonary disease can produce them all. Pigmentation of the skin is occasionally present. There is no enlargement of the lymphatic glands.

Examination of the cardio-vascular system reveals slighter changes than might be expected. The arteries are slightly thickened, and later in the disease they may be hard and tortuous. The rate of the pulse is somewhat increased. The blood pressure is usually normal or moderately raised. A number of cases have been described by Geisböck and others in which the pressure was very high, but these are rare and do not form a suitable basis for classification. The renal condition may explain the high blood pressure in some cases. The left ventricle generally shows some degree of hypertrophy.

In the great majority of cases the spleen is enlarged. It is firm and not tender. The lower edge frequently extends to the level of the umbilicus, rarely lower. Perisplenitis may produce tenderness on palpation, and repeated attacks can alter the characters of the splenic tumour. The size of the spleen may vary greatly during the course of the disease. The liver is generally enlarged, in most cases to a moderate degree. Ascites is absent except as a terminal event.

The rate of respiration is raised, and varies from 20–30 per minute. The lungs show no abnormal signs. In a small proportion of cases the knee-jerks are absent, but no other abnormalities are found in the nervous system beyond the mental changes above mentioned. Albumin is generally found in the urine, sometimes in considerable or increasing amount.

The temperature was subnormal in each of the six cases here described, a sign which does not appear to have been recorded in previous cases.

The blood shows a great increase in the number of red cells, even to 13,000,000 per c.mm. The number usually ranges from 7,000,000 to 12,000,000 per c.mm., and may vary considerably from time to time in the same individual. The corpuscles are normal in appearance. The presence of normoblasts has been reported by Osler.³ The hæmoglobin is seldom increased in proportion to the number of erythrocytes, hence the colour index is low. A fair degree of leucocytosis (10,000–30,000 per c.mm.) is the rule, and the polymorphonuclears are relatively increased. Viscosity is raised in proportion to the number of cells; coagulability varies in different cases. The total volume of blood is increased; it may measure two or three times the normal. The total oxygen-capacity of the blood is also greatly augmented. (See Cases 3, 4, and 5.)

Diagnosis.—The diagnosis is made from the presence of an excess of red cells in the blood and the absence of other recognised causes for it. Erythræmia, cyanosis, and enlarged spleen are the three main features of the disease. It is said that venous stasis in thrombosis of the portal and splenic veins can produce both erythræmia and splenomegaly; such cases would be difficult to diagnose from primary erythræmia during life. The presence of albuminuria has led to a diagnosis of chronic nephritis. The cerebral and mental symptoms may suggest neurasthenia or even cerebral tumour.

It should be remembered that the normal number of red cells in a healthy adult male is 6,000,000 per c.mm., rather than 5,000,000, as generally stated. The erythræmia secondary to cardiac or pulmonary disease may be as extreme as that of primary erythræmia. A case of congenital heart disease recently in this hospital had 12,500,000 red cells per c.mm. A case of chronic bronchitis and emphysema had 8,500,000 per c.mm., and the spleen was readily palpable.

Prognosis.—Patients affected with primary erythræmia may continue in fair comfort for several years after the disease has become manifest. But the symptoms tend to recur with greater severity, and cure is unknown. Death may occur with symptoms and signs of heart failure, and an

exacerbation of the cyanosis. In a few cases cerebral hæmorrhage or thrombosis has been the cause of death. The condition of the kidneys may, perhaps, contribute to a fatal termination.

Treatment.—As most cases are treated in bed for a time, the beneficial effects of rest should not be ignored when the effect of other remedies is considered. Venesection provides the most certain means of relieving symptoms; in some cases the relief has seemed more than temporary. Dr. Robert Hutchison advises the removal of 30–40 ounces of blood at a time, and this should be repeated as necessary during the course of the disease. Relief may thus be obtained in cases where the blood pressure is not raised. The application of X rays to the bones over long periods has been followed by improvement in some cases. Splenectomy is dangerous. The inhalation of oxygen did not benefit the cases described below.

CASE 1.—The patient, a cook, aged 47, was admitted to the London Hospital on May 13th, 1911, under the care of Dr. Wilfred Hadley, on account of pain in the abdomen.

History.—For 15 months the patient had lost weight and strength. During this time he had been subject to colds and had experienced occasional attacks of giddiness. For five months he had also suffered from attacks of breathlessness, especially at night, so that he felt compelled to rise and stand at the window to get breath. During this time he had a dry cough. Three months before admission a gripping pain in the abdomen came on suddenly while he was at work. Since that time abdominal pain had been present during the greater part of each day. It occurred either as a sharp epigastric pain immediately after food, or, at times, quite independent of food. The pain often radiated to the left side and it might be produced by lying upon that side. The appetite had been good throughout. For three months the legs and thighs had been swollen after the day's work. For the same time he had experienced frequency of micturition, hourly during the day, two or three times during the night. He had slept badly for some time. The patient remained at work until a week before admission, when he ceased owing to the severity of abdominal pain.

Previous health.—For several years he had suffered, especially in the ankles, from what he called "rheumatic gout." The last attack was 15 months before admission, and the patient noticed the onset of the weakness and wasting soon after it. Apart from this joint trouble and occasional headaches and "bilious attacks," the previous health had been good. Until a few months before admission he had taken 12 pints of porter a day and spirits occasionally. He was accustomed to smoke 5 ounces of tobacco a week. There was no history of syphilis or gonorrhœa. He had never been abroad. The family history showed nothing important.

On admission.—The skin was dark and of a brown colour, especially over the abdomen. The nipples were deeply pigmented. There was no pigmentation of the buccal mucous membrane. The face, and to a less extent the rest of the body, had a congested appearance, with some degree of cyanosis. Yet the "full-blooded" appearance was not so distinctive that it at once allowed a diagnosis of erythræmia. The body was wasted and slight œdema of the ankles was present. The teeth were dirty and carious. The axillary and inguinal glands were just palpable.

The abdomen was prominent, especially in the lower half. The lower edge of the liver almost reached the umbilical plane; the anterior surface of the liver was smooth and the edge sharp. The whole of the left side of the abdomen was tender on palpation. The spleen was enlarged, hard, and tender. It extended downwards one inch below the costal margin in the nipple line, but almost to the anterior superior iliac spine in the left flank. Dulness to percussion was obtained over a corresponding area; the right flank was resonant. The apex beat of the heart was in the fifth intercostal space one inch external to the nipple line and 4½ in. external to the mid-line. The impulse was not forcible, and the area of cardiac dulness was increased only to the left. The heart sounds were normal and no murmurs were heard. The pulse was regular; the radial artery felt thick. Pulsation was noticeable in the carotid and brachial arteries. The systolic brachial blood pressure was 130 mm. Hg, measured by the Riva-Rocci method, as in all these cases. On examination of the lungs, tenderness was elicited by percussion on the left side. The breath sounds were faint at both bases and also in the left axilla, where a pleural rub was heard. There were no other adventitious sounds. No abnormal signs were found on examination of the nervous system except that the knee-jerks were obtained with difficulty. The urine was acid and of specific gravity 1015. Albumin was present; sugar was absent. A test meal given on May 20th showed free HCl, 0.09 per cent.; total acidity, 51.

The blood was examined on May 18th and showed: Erythrocytes, 10,900,000 per c.mm.; hæmoglobin, 130 per cent.; colour index, 0.6; leucocytes, 27,400 per c.mm. **Differential count:** Polynuclear neutrophils, 85 per cent.; polynuclear eosinophils, 4.5 per cent.; small lymphocytes, 6 per cent.; large lymphocytes, 3.5 per cent.; large hyaline cells, 1.5 per cent. The Wassermann reaction in the blood was negative.

Course.—The temperature, which was 101.5° F. on admission, fell to 98° on the following day. Except for several temporary rises to 99° or 101°, it then remained subnormal until death. The rate of the pulse was 90–100 per minute. The general condition did not improve. The abdomen became more tympanitic and the pain more severe, though it varied from day to day. The feeling of breathlessness continued; the respirations averaged 30 per minute. Headache was constant and often severe. The daily amount of urine averaged 50 oz.; in contained albumin, eventually a considerable amount. On July 7th signs of ascites were detected; 50 oz. of fluid were withdrawn, the deposit from which contained blood and epithelial cells. Ascites persisted from this time until he died. Further blood counts are given below.

At the beginning of July the general condition had become rather worse and the right leg showed considerable œdema. The patient began to complain of pain and difficulty on micturition. On local examination the tip of the glans penis was found to be gangrenous, and

³ Osler: THE LANCET, 1908, vol. i., p. 143.

showed a line of demarcation one-third of an inch from the meatus. The necrotic portion gradually separated, leaving a scar. During July the patient also suffered greatly from the pain in the left side of the abdomen. The headache became intense, and the cough troubled him greatly. On August 4th, 1911, he died. The results of the necropsy will be published later.

Effects of treatment.—May 18th, 1911: Erythrocytes, 10,900,000. May 22nd-27th: Liq. arsenicalis, m iii. t.d.s. May 29th: Erythrocytes, 9,400,000. May 29th-June 6th: Oxygen, 30 min. bis die. June 6th: Erythrocytes, 10,600,000. June 10th: Venesection, 20 oz. June 14th: Liq. arsenicalis, m iii. t.d.s. June 19th: Erythrocytes, 9,112,500. June 20th: Liq. arsenicalis, m 5 t.d.s. June 26th: Liq. arsenicalis, m 7 t.d.s. June 28th: Erythrocytes, 7,000,000. June 30th: Venesection, 20 oz. July 4th: Erythrocytes, 8,610,000.

1. **Venesection.**—After the venesection (20 oz.) on June 10th the patient felt better, and his breathing seemed easier for a few days. After the venesection (20 oz.) on June 30th the improvement was slight and even more temporary.

2. **Oxygen.**—Hill's⁴ oxygen mask, a light concave plate of celluloid with silk sides loosely enveloping the face, was used. Oxygen was given for 30 minutes morning and evening during one week. The cyanosis diminished almost as soon as the mask was applied, the colour becoming much brighter. The cyanosis returned two or three minutes after removal of the mask. The patient experienced no relief from the oxygen inhalation. During the last two or three days of the week of oxygen treatment he felt short of breath and a sense of pressure across the chest, with slight nausea. These symptoms were said to be worse about half an hour after each inhalation had been stopped.

3. **Arsenic.**—The administration of arsenic, as that of oxygen, seemed to have no influence on the downward progress of the disease. Though the two blood counts recorded during the course of arsenic (June 14th-August 4th, death) were lower than the previous counts, yet the patient's symptoms and general appearance became steadily worse during the same time.

Summary (Case 1).—Under observation three months. Florid appearance with cyanosis. Brown pigmentation of the skin. Spleen irregularly enlarged. Heart enlarged to the left. Arteries thickened. Blood pressure 130 mm. Hg. Erythrocytes 10,900,000 per c.mm. Albuminuria. Gangrene of tip of penis. Terminal ascites. Death 18 months from onset of symptoms.

CASE 2.—The patient, a wharf labourer, aged 26, was admitted to the London Hospital on July 12th, 1911, under the care of Dr. Wilfred Hadley, on account of pain in the abdomen.

History.—For four or five months he had felt pain in the abdomen on lifting. During that time he had suffered from anorexia, constipation, and slight pain after food; there had been no vomiting. For three weeks he had been unable to work owing to the severity of the abdominal pain, which affected especially the left side. He had lost about a stone in weight, and had become much weaker during the few weeks before admission. He had sometimes noticed "sparks in the sight," even sufficient to interfere temporarily with vision. There had been no headache, no palpitation, and no shortness of breath. The patient said that his face had always been red; he had not noticed any change in his appearance.

Previous health.—Four and a half years before admission he had a single hæmatemesis with melæna, following one of the drinking bouts in which he frequently indulged at that time. For two or three years his teeth had been giving him trouble especially by causing "abscesses" on both sides of the upper and lower jaws. Ten months before admission six carious stumps and several other carious teeth were extracted, leaving only four teeth in the mouth. Artificial dentures had since been provided. Apart from the single hæmatemesis and the dental caries his health had always been good. There was no history of venereal disease. The family history revealed nothing of importance.

On admission.—The face was of a deep red colour and showed dilated venules on the cheeks. The lips were bluish-red. The conjunctivæ and the mucous membrane of the mouth and pharynx were deep red. The forearms were congested. The superficial lymphatic glands were not enlarged. The weight was 8 st. 3 lb. The spleen was easily felt extending downwards a little below the umbilical plane. It was hard and not tender. The liver was enlarged to percussion and almost reached the umbilical plane. The edge was not readily felt on account of slight abdominal rigidity. There was impairment of the percussion note in the fourth right intercostal space in the nipple line. There were no signs of ascites. The apex beat of the heart was in the fifth intercostal space in the nipple line. The area of cardiac dullness extended to the nipple line on the left, a finger's breadth to the right of the sternum on the right, and to the third rib above. The heart sounds were normal, except that the second sound at the base was duplicated, though it was not louder than usual. No murmurs were heard. The pulse was regular and of frequency 96. The artery was just palpable and not tortuous. The blood pressure was 135 mm. Hg. The respirations were 26 per minute. No abnormal physical signs were found in the lungs or nervous system. The urine contained albumin.

The blood report on July 15th showed: Erythrocytes, 12,200,000 per c.mm.; hæmoglobin, 130 + per cent.; colour index, 0.6 (approximately); leucocytes, 10,440 per c.mm. Differential count (200 cells): Polynuclear neutrophils, 73 per cent.; polynuclear eosinophils, 2.5 per cent.; small lymphocytes, 17 per cent.; large lymphocytes, 4.5 per cent.; large hyaline cells, 2.5 per cent.; coarsely granular basophils, 0.5 per cent. Rouleaux formation normal. The results of further blood counts are given below.

Course.—The temperature remained subnormal (96.4°-98.4° F.) except on five occasions when it reached 99°. The pulse-rate varied between 70 and 110 per minute. The respirations averaged 24 per minute. There was never any objective shortness of breath. The florid appearance did not vary to any great extent. It was, perhaps, more evident in the latter half of August than on admission. The daily amount of urine averaged 40 oz. The amount of albumin deposited after boiling was about 1/20th (i.e., 1/20th of the volume of urine boiled). A few casts and pus cells were present.

The appetite notably improved, and the patient felt better "in himself" than on admission. Occasional headaches were complained of during August. The pain in the side improved for a time, but on August 9th he had a sharp attack of pain in the left hypochondrium, with tenderness on light palpation in this region. Some general abdominal pain was also present. The condition was considered to be perisplenitis. Further attacks, less severe, occurred especially when the patient was allowed to get out of bed. Before his discharge these recurring attacks of pain had ceased, and he could walk with impunity. On discharge, Sept. 25th, 1911, the erythrocytes numbered 11,250,000, the blood pressure was 115-120 mm. Hg, and the florid appearance was much the same as on admission.

On July 6th, 1912, he came to hospital by request in order that he might be examined again. Since his discharge in September, 1911, he had not missed an hour's work. He had recently felt slight gnawing pains in the epigastrium about an hour after meals and had been inclined to constipation. A few days before, he had suffered from a slight "bilious attack" which terminated in vomiting. On several occasions he had felt giddy and had experienced a numb sensation all over the body. There had been no return of the pain in the left side.

On examination he presented an appearance very similar to that on his discharge in September, 1911. The face was red; there was scarcely a trace of cyanosis except in the colour of the lips. The pulse was 82 and regular, the artery just palpable. The blood pressure was 125 mm. Hg. The red cells numbered 10,487,000 per c.mm. The apex beat of the heart was in the fifth intercostal space within the nipple line. The area of cardiac dullness was not enlarged. The pulmonary second sound was duplicated, the aortic second accentuated. There were no murmurs. The spleen could only be felt when the patient took a deep inspiration. It was very hard and not tender. The liver was much enlarged, the lower edge being felt in the umbilical plane. It was firm but not hard. There was no ascites. Both kidneys were palpable; the left appeared to be enlarged. The knee-jerks were readily obtained. The urine was acid and albuminous. The amount of albumin deposited after boiling was one-third. A few granular casts were seen in the centrifuged deposit from the urine.

On Oct. 23rd, 1912, he was sent to hospital by his private doctor. Ten days before, and during the five days before admission, he had experienced severe general abdominal pain of a cutting character and accompanied by vomiting. On admission his general appearance was the same as before. His face was red, but not more cyanosed than on previous admissions. He complained of severe abdominal pain, but did not appear to be dangerously ill. The pulse was 80 and regular; the respirations were 28 per minute. The heart showed the same signs as before. Symptoms of heart failure, such as oedema and dyspnoea, were absent. The abdomen was prominent and there was dullness in the flanks. The spleen was not palpable. The liver extended four fingers' breadth below the right costal margin. A few hours later 6 oz. of blood were passed per rectum. The abdominal pain became worse and was accompanied by nausea. During the night it was found that the pulse had become scarcely perceptible at the wrist. The rate of the heart on auscultation was upwards of 150 per minute. There were no symptoms of heart failure. He quickly became unconscious and died 15 minutes later, ten hours after admission. The results of the necropsy will be published later.

Effects of treatment.—July 15th, 1911: Erythrocytes, 12,200,000 per c.mm. July 17th: Venesection, 20 oz. July 19th: Erythrocytes, 12,400,000 per c.mm. July 22nd-29th: Oxygen, 30 min. bis die. July 31st: Erythrocytes, 10,500,000 per c.mm. August 9th: Erythrocytes, 9,900,000 per c.mm. Sept. 11th: Erythrocytes, 11,250,000 per c.mm.

1. **Venesection.**—For two or three days after venesection (20 oz.) on July 17th the patient felt relieved and said that he was able to rest better. No change was shown in the blood count of July 19th (q.v.).

2. **Oxygen.**—Oxygen was inhaled through a Hill's mask for half an hour morning and evening during one week (July 22nd-29th).

(a) **Immediate effect.**—Almost as soon as the oxygen mask was applied the respirations became very deep. The rate of respiration was 24 per minute before and throughout the administration. The rate of the pulse was reduced during the inhalation—e.g., in three experiments 108 became 98, 108 became 100, 88 became 84. The colour of the patient always became a much brighter red after two or three minutes of oxygen. He experienced no subjective sensations during the inhalation. In one experiment the blood pressure was taken before and after 30 minutes of oxygen. It was 115 mm. Hg and remained unaltered.

(b) **Remote effect.**—It will be seen by a reference to the above summary that the number of erythrocytes fell by about 2,000,000 during the week of oxygen inhalation. But it cannot be assumed that this was an effect of the oxygen. A further fall took place in the ten days which followed. The patient did not seem or feel any better in his general condition. The only change noticed by him was an improvement in his appetite, especially for his dinner, which followed the morning inhalation.

Summary (Case 2).—Under observation one year. Florid appearance with cyanosis. Spleen greatly enlarged, later not palpable. Blood pressure 115-135 mm. Hg. Erythrocytes 12,200,000 per c.mm. Severe albuminuria, increasing in amount. Attacks of perisplenitis. Death 1½ years after onset of symptoms.

CASE 3.—The patient, a man aged 57, first came under the care of Dr. Theodore Thompson at the out-patient department of the London Hospital on March 4th, 1908. He complained of pain in the abdomen and of giddiness.

History.—The patient had been engaged for 18 years in a capacity that caused him to come frequently in contact with gas and fumes. He left in 1904, when many workmen were discharged, and had since done other kinds of work. No symptoms appeared while the patient was employed at his former work. Several months later (1905) he began to suffer from attacks of giddiness, which lasted two or three minutes and recurred two or three times a day. There were intervals of a week's freedom from these attacks. Headache began about the same time; it was continuous in character and vertical or occipital in position. He then noticed that he was becoming "blue." This was noticed first at the margins of the ears and later in the rest of the face.

In 1907 he began to experience occasional pains in the left side of the abdomen, and suspected that he had a lump there. On Dec. 31st, 1907,

⁴ L. Hill: Brit. Med. Jour., 1912, vol. i., p. 71.

two months before coming to the hospital, he was compelled to give up work owing to severe abdominal pain. This was general and had no relation to food. The attacks of giddiness had also become more troublesome and occurred while he was at work on the scaffolding. On inquiry the patient stated that for the last few years he had been somewhat short of breath on exertion.

Previous health.—In 1870 he contracted syphilis and was treated for six months. Four years later appeared a gumma of manubrium sterni, the scar of which is still present. For 30 years the patient had passed a catheter every fortnight on account of a stricture at the external orifice of the urethra. Constipation had always been troublesome. He had never been abroad. He had rarely taken more than two pints of beer a day and never spirits. The family history revealed nothing important.

On examination (March, 1908).—He presented an appearance of extreme "red-purple" cyanosis. The spleen was felt extending two inches below the left costal margin. The heart was not enlarged to percussion, there was no thickening of the vessels, and the blood pressure was 130 mm. Hg. The urine contained a trace of albumin. Examination of the blood showed the number of erythrocytes to be 12,000,000 per c.mm.

Course.—In April, 1908, the patient was admitted to the hospital because the face and abdomen were swollen and the abdominal pain was severe. Venesection was performed several times and a month's course of mercury and iodides was given. He returned to the out-patient department where a course of oxygen inhalations was tried.

In July, 1908, Dr. A. E. Boycott kindly made special observations and found that the total amount of blood in this patient was two and a half times, and the total oxygen-capacity was three times the normal. (Haldane and Lorrain Smith's method.) The red cells numbered 12,000,000 per c.mm. at this time; in September, 1908, 12,500,000.

From September, 1908, to May, 1909, X rays were applied to the tibia, sternum, and spleen, for ten minutes each every few days. The general condition improved during this time, but in December, 1908, he was readmitted to hospital for two months because of pain in the left side and trembling of the hands and feet. Two blood counts showed 7,600,000 and 8,000,000 erythrocytes per c.mm. The spleen was the same size as before.

In April, 1909, examination showed no signs of cardiac hypertrophy. The area of cardiac dullness, the first heart sound at the apex, and the aortic second sound were all normal. The spleen seemed somewhat smaller. A blood examination showed: Erythrocytes, 12,000,000 per c.mm.; hæmoglobin, 140 per cent.; colour index, 0.5; leucocytes, 11,800 per c.mm. Differential count: Polynuclear neutrophils, 94.5 per cent.; polynuclear eosinophils, 0.5 per cent.; small lymphocytes, 3.0 per cent.; large lymphocytes, 1.0 per cent.; large hyaline cells, 1.0 per cent.

In May, 1910, he was again admitted to the hospital. Some erythema and purpuric spots had appeared in the skin on several occasions. At one time the right foot became cold and the patient complained of a "woolly" feeling in it. He had previously mentioned tingling sensations in the left arm, hand, and fingers. The erythrocytes then numbered 9,500,000 per c.mm., and the hæmoglobin was approximately 130 per cent. The spleen was enlarged as before; it was hard and not tender. The liver was not palpable. The heart showed no abnormal signs. The pulse-rate varied from 70 to 100 per minute. The radial arteries were not thicker than those usually felt in a man of 59. The temperature was subnormal (97° F.). The average rate of respiration was 24 per minute. The urine was at that time free from albumin. The weight was 8 st. 7 lb.

In February, 1911, and in May, 1911, the erythrocytes numbered 10,500,000 per c.mm. and the hæmoglobin was 130 per cent. During the intervening period purpura recurred.

In October, 1911, the spleen had become larger and could easily be seen moving on respiration. It extended downwards exactly to the umbilical plane and inwards to three inches from the mid-line. The edge of the liver was just palpable, but it was not hard. The radial artery had become moderately thickened and tortuous. The apex beat of the heart was still in the nipple line in the fifth space. It had not the forcible character of a hypertrophied heart. The blood pressure taken on four occasions was 118–128 mm. Hg. The general appearance of the patient was the same as before. He had done no work since he first came under observation, but had no serious disabilities so long as he abstained from work.

In March, 1912, there was some œdema of the left leg which rapidly subsided by rest.

In June, 1912, the erythrocytes numbered 7,300,000 per c.mm., the hæmoglobin was 120 per cent., and the colour index 0.7. The bluish-red congested appearance of the face and hands continued the same. The skin of the rest of the body was not in the least flushed and there was no œdema. The fingers were not clubbed. The condition of the spleen, liver, heart, and vessels was the same as in October, 1911. The blood pressure measured 120 mm. Hg. The urine contained a trace of albumin but no casts. An X ray examination showed nothing abnormal in the chest, unless slight enlargement of the heart to the left. The weight was 9 st. 7 lb.

Effects of treatment.—(1) *Venesection.*—In April, 1908, he was venesected several times with temporary relief. The general condition remained unaltered.

(2) *Oxygen.*—(a) *Immediate effect.*—Pure oxygen was administered through an ordinary nitrous oxide inhaler. The colour seemed a little brighter during the administration. There were no subjective sensations. The respiration did not change either in rate or character. The rate of the pulse was reduced by several beats per minute. On two occasions the blood pressure was taken before and after 30 minutes' oxygen. In one case it was 120 mm., in the other 128 mm. Hg before the inhalation; in both cases it remained unaltered.

(b) *Remote effect.*—In June, 1908, Professor Leonard Hill instituted a three months' course of pure oxygen inhalations. Oxygen was administered directly from a cylinder through a mask with inlet and outlet valves, as fitted to the Siemens-Gorman diving helmet. It was given for one and a quarter hours on five days a week during six weeks, and then three times a week during the rest of the three months. Repeated estimations of erythrocytes were made. Professor Hill was satisfied that there was no effect on the general condition or on the number of erythrocytes. The patient experienced no subjective sensations from the treatment.

(3) *X rays.*—From September, 1908, to May, 1909, a period of nine months, X rays were applied to the tibia, sternum, and spleen for

ten minutes each, daily for three weeks, later once or twice weekly. The spleen became somewhat smaller. The general condition certainly improved, although he was readmitted during this time on account of perisplenitis. Before X ray treatment was begun the erythrocytes numbered 12,500,000 per c.mm. Although after three months the numbers had fallen to 7,600,000 and 8,000,000 per c.mm., yet at the end of the nine months' course the erythrocytes had again reached 12,000,000 per c.mm.

Summary (Case 3).—Under observation four years. History of continued exposure to gas. Extremely florid and cyanosed. Spleen enlarged. Arteries became thickened. Blood pressure 120 mm. Hg. Erythrocytes 12,000,000 per c.mm. Albuminuria. General condition remains good.

CASE 4.—The patient, a man aged 38, was admitted to the London Hospital on Dec. 27th, 1907, under the care of Dr. Robert Hutchison. He complained of pains in the chest and legs, and of shortness of breath.

History.—In January, 1907, he began to suffer from cramping pains in the legs. On Jan. 22nd he was seen in the out-patient department. The face was congested. The urine contained a trace of albumin. The spleen was not palpable. The patient ceased to attend after two weeks because the pains had disappeared. In October, 1907, they returned, and he began to suffer from shortness of breath and slight pain in the chest. Vomiting occurred on several occasions immediately after meals. He did not complain of "blueness," or of palpitation.

Previous health.—For many years the patient had been subject to bleeding from the gums, and had often found blood on the pillow on waking. Until a year before admission he had been otherwise quite well. He was a Pole, and had lived in England for 11 years. He rarely took beer or spirits and did not smoke. There was no history of syphilis.

On admission.—There was redness, with slight cyanosis, of the face, lips, mucous membranes, and of the fingers and toes. There was no objective dyspnoea. The fingers were not clubbed. The teeth and gums were very dirty. The weight was 9 st. 9 lb. The apex beat of the heart was in the fifth space in the mid-clavicular line. The area of cardiac dullness was not enlarged. The second sound at the aortic area was loud, but the other heart sounds were normal, and no murmurs were heard. The blood pressure was 124 mm. Hg. The abdomen was slightly prominent. The spleen was easily palpable, but not greatly enlarged; the edge was firm and not tender. The lower edge of the liver extended one inch below the right costal margin. The lungs showed no abnormal physical signs. The knee-jerks were obtained with difficulty. The retinal veins were seen to be greatly distended.

A blood examination showed: Erythrocytes, 10,500,000 per c.mm.; hæmoglobin, 180 per cent.; leucocytes, 15,300 per c.mm. Differential count (800 leucocytes): Polynuclear neutrophils, 81.25 per cent.; small lymphocytes, 12.5 per cent.; large lymphocytes, 2.5 per cent.; eosinophils, 3.75 per cent. Coagulation time (Wright's tubes): 6–8 minutes. Viscosity: 16 times that of water.

Special investigations kindly made by Dr. A. E. Boycott⁵ showed: Total oxygen capacity: Feb. 1st, 1908, 1620 c.c.; Feb. 15th, 1480 c.c.; Normal, about 500 c.c. Total blood volume: Feb. 1st, 4970 c.c.; Feb. 15th, 4765 c.c.; normal, about 3000 c.c.

During the month's stay in hospital the temperature was subnormal (97°–98°), the pulse-rate averaged 76, the respirations 22 per minute. The daily amount of urine was about 60 ounces. A trace of albumin was present.

Course.—The slight general improvement which occurred in hospital was maintained throughout 1908. In April, 1909, he began to experience difficulty and pain in micturition. The pains in the legs returned. General weakness, and especially weakness of the legs, increased, so that he could scarcely stand. The "blueness" seemed to him to be worse; the feet and legs often felt very cold. At times objects seemed blurred before his eyes.

In May, 1909, he was readmitted to hospital on account of these symptoms. The cyanosis was much as before; there was general fulness of the veins, especially of those of the legs. The physical signs in the heart, lungs, and abdomen were the same as in December, 1907. The blood pressure was 120 mm. Hg. The knee-jerks were not obtained. The urine contained albumin, 1/10th. There was a considerable amount of deposit which contained pus cells and a few red cells; no casts were seen. A blood examination showed: Erythrocytes, 10,712,000 per c.mm.; hæmoglobin, 130 per cent. (approx.); colour index, 0.6. During the stay in hospital the temperature, pulse-rate, respiration-rate, and amount of urine were much the same as at the first admission. The patient was venesected to two pints on May 21st, and to 24 ounces on May 27th. His symptoms were greatly relieved, and he returned to work on June 9th, 1909.

In May, 1910, he came to hospital "to have some more blood drawn off," and was readmitted. Weakness of the legs and general weakness were the chief complaints. He also complained of frontal headaches. He still suffered from shortness of breath on exertion. Thirst was excessive, and there was nocturnal frequency, but no longer any pain on micturition. On examination the face was cyanosed, and the extremities congested as before. The body was well nourished and weighed 9 st. 3 lb. The temperature was 97°–98°. The teeth were dirty, and the gums tended to bleed. The lymphatic glands were not enlarged. The heart showed the same physical signs as before; the aortic second sound was accentuated. The blood pressure was 122 mm. Hg. The pulse was regular and of frequency 72; the radial artery was thick and tortuous. The spleen was larger and harder than on previous admissions. It extended downwards three fingers' breadth below the left costal margin, and was moveable laterally. The lower edge of the liver was firm and extended two fingers' breadth below the right costal margin. There was no ascites. The knee-jerks were not obtained. The urine still contained albumin. The erythrocytes numbered 10,400,000 per c.mm. A venesection to 30 ounces was performed; the spleen could barely be felt after the venesection. He was greatly relieved and left the hospital two days later.

In August, 1912, he was requested to come to the hospital for further examination. He stated that he had not missed a day's work since his discharge from hospital in May, 1910. He felt certain that his face was

⁵ A. E. Boycott: These results have been quoted by F. Parkes Weber, loc. cit., p. 97.

not nearly so red as at that time, nor were his lips and ears so blue. There had been slight giddiness at times and occasional blurring before the eyes. He had not suffered from shortness of breath, headache, palpitation, or abdominal pain. The frequency of micturition, present since he first came under observation, was two-hourly during the day and two or three times during the night.

On examination his face was red, his lips were bluish-red, and his ears slightly blue. The mucous membrane of the mouth was injected and the eyes were bloodshot. The retinal vessels were numerous, but the appearance of the fundus was not striking. The hands were congested and bluish; there was no clubbing of the fingers. The superficial veins of the arms were numerous and prominent. The veins of the leg were rather prominent but not varicose. The toes were somewhat congested. The skin of the trunk was free from congestion except near the upper end of the sternum. There was no pigmentation of the skin and no oedema. The superficial lymphatic glands were not enlarged. The pulse was regular; the radial arteries were moderately thickened and very tortuous. The blood pressure was 130 mm. Hg. No abnormal physical signs were found in the heart beyond an accentuation of the aortic second sound. The apex beat could not be felt. Radiographic examination of the heart, however, showed slight enlargement of the heart to the left. The lungs were healthy. On examining the abdomen a slight prominence was seen in the splenic region. The spleen was enlarged and very hard. It extended four fingers' breadth below the left costal margin. The liver was firm but not so hard as the spleen. Its lower edge was felt two fingers' breadth below the right costal margin. There was no ascites. The pupils were equal and reacted briskly to light. The knee-jerks could not be obtained. The blood contained 9,975,000 erythrocytes per c.mm. The Wassermann reaction was negative in the serum. The urine was acid and contained one-third albumin. It was cloudy, and pus cells were very abundant in the centrifuged deposit. No casts were seen, nor any red cells. Large numbers of long-chained streptococci were present, but no tubercle bacilli could be discovered.

Effects of treatment.—*Venesection.* The venesections (40 oz. and 24 oz.) in May, 1909, gave relief to the patient's symptoms. In May, 1910, he applied "to have some more blood drawn off" and was relieved by the removal of 30 oz. The spleen, which extended three fingers' breadth below the costal margin before the venesection, could barely be felt after it.

Summary (Case 4).—Under observation 5½ years. Face congested and slightly cyanosed. Spleen became palpable under observation. Arteries thick and tortuous. Blood pressure 124–130 mm. Hg. Erythrocytes 10,500,000 per c.mm. Severe albuminuria, increasing. Knee-jerks not obtained. Size of spleen much reduced by venesection. General condition remains good.

CASE 5.—The patient, an engine-driver, aged 40, was admitted to the London Hospital on June 27th, 1906, under the care of Dr. Robert Hutchison. He complained of shortness of breath, palpitation, headache, and general weakness.

History.—For a few months he had experienced slight attacks of giddiness while at work, and had noticed that his face had become rather blue. These slight symptoms were ignored until three months before admission, when he also began to suffer from shortness of breath, left frontal headache, and palpitation. He perspired more freely than usual. Loss of appetite and general weakness developed so that he became unable to work. There had been no pain in the chest or abdomen and no cough. Walking had been painful for a few days on account of soreness of the right calf. When attention was drawn to the clubbing of the fingers, the patient stated that he had noticed it developing in the last six or seven weeks.

Previous health.—He had enjoyed good health until a few months before admission. He was married and had four children. He had been a total abstainer for 20 years. There was no history of syphilis. The family history revealed nothing important.

On admission.—The face was extremely florid and cyanosed. The lips and tongue were cyanosed, the other mucous membranes congested. The hands and feet were congested and blue; the fingers and toes were clubbed. The right leg showed dilated veins and a few red and tender raised areas. There was scarring with pigmentation above both ankles. These changes were attributed to the varicose veins. Oedema was absent. His weight was 9 st. 10 lb. There was no oral sepsis and the teeth were sound. The pulse was regular and of moderate volume; the radial artery was thickened and slightly tortuous. Visible episternal pulsation and impairment of the percussion note on the right side of the upper end of the sternum led to a suspicion of aneurysm. The apex beat of the heart was in the fifth left intercostal space just external to the nipple line. The area of cardiac dullness was slightly enlarged to the left. The heart sounds were normal. No murmurs were heard. No abnormal physical signs were found in the lungs. The spleen was not felt, nor was it enlarged to percussion. The liver was not enlarged. The pupils were equal and reacted to light. The knee-jerks were present. The patient seemed rather garrulous and showed slight confusion of ideas. The urine contained no albumin and no sugar. The radiograph revealed slight dilatation of the aorta, but no localised aneurysm.

A blood examination showed: Erythrocytes, 10,520,000 per c.mm.; hæmoglobin, 110 per cent.; leucocytes, 10,000 per c.mm. Differential count: Polymorphonuclears, 75 per cent.; lymphocytes, 22 per cent.; eosinophils, 1 per cent.; hyaline cells, 2 per cent.

Course.—Except for three temporary rises to 99° or 100° F. the temperature remained subnormal during his stay of seven weeks in hospital. The pulse-rate averaged 84, the respiration-rate 24 per minute. A venesection to 76 oz. was performed on August 3rd; the patient experienced considerable relief from it. A sample of this blood was citrated and sent to Dr. F. Parkes Weber, who kindly made a special examination. His report was as follows:—

"1. After standing in a well-corked bottle during the night the plasma layer formed only 3 mm. out of the total column of 120 mm. 2. Specific gravity of the citrated blood, 1068. 3. Hæmoglobin (Haldane's method), 130 per cent. 4. Red cells, 11,750,000 per c.mm. 5. The viscosity coefficient, using a viscosity tube of bore 1 mm., was

about 13 times that of water at the room temperature (68° F.). (Normal human citrated blood is about five or six times that of water)."

After his discharge on August 14th, 1906, the patient returned to work. He remained fairly well until May, 1907, when he began to lose strength and to experience pains all over his body, shortness of breath, and palpitation. Headache became severe, especially after exertion. The attacks of giddiness came on during his work, and almost caused him to fall. He sweated profusely at times.

In June, 1907, he was readmitted to hospital on account of the return of symptoms. He had the same florid and cyanosed appearance as before. The skin of the trunk showed some general brown pigmentation. Slight oedema of the ankles was present. There was visible pulsation of the carotid arteries and in the episternal notch. The blood pressure was 120 mm. Hg. The apex beat of the heart was in the fifth space in the nipple line; the impulse was powerful. The first sound at the apex was accompanied by a systolic murmur which disappeared a few days later. At times a systolic murmur was heard in the third left intercostal space. There was a want of elasticity in the chest. On auscultation, expiration was found to be slightly prolonged. On this occasion the spleen was palpable on deep inspiration. The liver was not enlarged and there was no ascites. The urine on admission contained a trace of albumin, which disappeared within a few days. The weight, temperature, pulse, and respiration were the same as on the previous admission. Ophthalmoscopic examination showed nothing striking; the vessels were slightly distended. A blood examination showed: Erythrocytes, 12,000,000 per c.mm.; hæmoglobin, 140 per cent.; specific gravity, 1062. No abnormal cells were seen. The patient was discharged on August 1st, 1907, feeling better for the rest of his bed.

In December, 1907, he was readmitted. He had been unable to work for a month owing to general weakness and shortness of breath. He had sustained two severe attacks of epistaxis in the week before admission. He missed the warmth of his position as engine driver, for he had been transferred to work in a filter bed. On one occasion when he was cold and wet he became "almost black." Shortly afterwards he was compelled to become a casual labourer. Headaches and attacks of giddiness had been infrequent but severe. On examination the general appearance was as before. The spleen could not be felt on this occasion. There was a systolic murmur at the apex of the heart and in the tricuspid area, but the area of cardiac dullness was not enlarged. The erythrocytes numbered 12,000,000 per c.mm. on admission and also on discharge. A course of arsenic was given for one month; an initial dose of 4 minims of liquor arsenicalis was gradually increased to 12 minims three times a day. During this time the patient remained in bed. His mental condition was slow and he was so nervous that the prick of a needle upset him. His weight was 10 st. 9 lb. The cyanosis diminished and the symptoms greatly improved before his discharge on Jan. 19th, 1908. In February Dr. Boycott⁶ kindly made special observations and found that the oxygen capacity of his blood was 3375 c.c., and that the total blood volume was 10½ litres (normal about 500 c.c. and 3 litres respectively).

In April, 1908, he was readmitted for venesection. His previous symptoms had increased, and for a fortnight he had suffered from vomiting three or four times a day independent of food. On examination the spleen could not be felt. The erythrocytes numbered 12,100,000 per c.mm. The coagulation time was 2½ minutes. On April 29th, after the above estimation, venesection was performed. Two pints of blood had been withdrawn from the arm when the patient became restless and the extremities cold. He rapidly recovered when the venesection was stopped. A week later the erythrocytes numbered 11,300,000 per c.mm. The rate of pulse and respiration in the week following the venesection did not differ from that in the week preceding it. The patient felt much better.

In June, 1908, venesection (40 oz.) again gave relief to his symptoms. On that occasion the spleen was palpable, and there was some oedema of the feet. On examination in April, 1910, the spleen could not be felt.

In October, 1910, the patient had a severe attack of vomiting which lasted for 24 hours, and was accompanied by a throbbing headache. The attack terminated in a profuse hæmatemesis followed by melæna. He felt so weak and cold during the next three weeks that he applied for readmission and was taken into the hospital on Nov. 4th, 1910. He said that he had been fairly well since 1908 until four months before admission. Since then the shortness of breath had returned, and vomiting had occurred almost daily, often preceded by cold sweats. He had also suffered from pain in the back, shivering attacks, tinnitus, and giddiness. On examination he seemed more cyanosed than on previous admissions. The spleen was not palpable. A systolic murmur accompanied the first sound at the apex and over the lower end of the sternum. A purpuric rash was present on both legs. The weight was 9 st. 7 lb. The urine contained no albumin. The erythrocytes numbered 12,000,000 per c.mm. and the coagulation time was 3½ minutes. Venesection was performed to the amount of 2 pints, and on the following day the red cells numbered 11,300,000 per c.mm. The temperature was 97° before the venesection and 98°–99° during the week following. On Nov. 14th, 1910, he was discharged feeling much relieved.

On Jan. 4th, 1911, he died at home with signs of heart failure. For a few days before death his face was of a deep purple colour, the feet were oedematous, and there was considerable ascites. Mental changes were prominent—muttering delirium and incoherent raving, but no violence. To Mr. Allan Hair, of Hounslow, I am indebted for these particulars of the final illness.

Effects of treatment.—1. *Venesection.*—August 3rd, 1906: Venesection (76 oz.). April 29th, 1908: Erythrocytes, 12,100,000 per c.mm. Venesection (40 oz.). May 6th: Erythrocytes, 11,300,000 per c.mm. June: Venesection (40 oz.). Nov. 7th, 1910: Erythrocytes, 12,000,000 per c.mm. Venesection (40 oz.). Nov. 8th: Erythrocytes, 11,300,000 per c.mm. On each occasion relief followed the blood-letting. It was noticed that the temperature, which was subnormal, was always at a slightly higher level during the week after the venesection—e.g., 97°–98° became 98°, 97° became 98°. No change occurred in the rate of pulse or respiration.

2. *Arsenic.*—In December, 1907, a course of arsenic was given for

⁶ Boycott: loc. cit.

one month. The initial dose of liq. arsenicæ, m 4 t.i.d., was gradually increased to m 12 t.i.d. During this time the patient remained in bed. The cyanosis diminished and the symptoms improved.

Summary (Case 5).—Under observation four and a half years. Face florid and cyanosed. Pigmentation of the skin. Clubbing of fingers. Spleen at times enlarged, at others not palpable. Arteries thickened. Dilated aorta (radiograph). Blood pressure, 120 mm. Hg. Erythrocytes 10,520,000 per c.mm. Epistaxis, hæmatemesis, purpura. Profuse sweating. Mental changes. Death, five years after onset of symptoms, with heart failure.

CASE 6.—The patient, a man, aged 58, was admitted to the London Hospital on Oct. 18th, 1912, under the care of Dr. Francis Warner. He complained of pain and swelling in one toe, but this was a trifling perionychia and it was for the investigation of his blood condition that he was admitted by Dr. Cecil Wall.

History.—Ten or twelve years ago he began to suffer from severe pain beneath the sternum, commencing about an hour after food and lasting one or two hours. Very shortly afterwards he noticed that his nose and cheeks were becoming "red." This was ascribed to the indigestion. Within a year or two the whole face had become as "red" as it was on admission. The patient thought that the indigestion and the redness were due to exposure to the fumes from a paint factory. He had worked in an adjoining yard during two and a half years, and whenever the wind blew in his direction the smoke and fumes from the boiling paint were almost unbearable. It caused him and his fellow workmen to cough and spit. He did not know that any of his mates had become "red" as he had done; they all complained bitterly of the fumes.

The pain after food was troublesome on and off for several years, and at one time he was compelled to take to his bed for a month. For the last few years it had been less troublesome. There had never been vomiting, hæmatemesis, or melæna. For many years the gums had been prone to bleed, and after extraction of a tooth a year ago he bled for two days. There had been no other hæmorrhages.

For the last four years his chief complaint had been sudden attacks of giddiness lasting about five minutes and occurring, at some periods several times a day, at others once a week. In the attacks he felt "tipsy" and had to seize hold of some support. He had experienced for years occasional attacks of tinnitus, a buzzing noise in both ears, lasting about 20 minutes. These occurred quite apart from the attacks of giddiness. He had become less able to do his work in recent years on account of general weakness, though he had not wasted. When hard at work he sometimes felt faint and began to tremble, but this would pass off in a few minutes. There had been no shortness of breath or palpitation, and no headache. Slight nocturnal frequency had been present for some years.

Previous health.—At the age of 16 he contracted small-pox, at 18 syphilis. He had rarely taken beer or spirits. There was nothing noteworthy in the family history.

On admission.—The whole face and exposed part of the neck were deep bluish-red and showed telangiectases. The lips were bluish-red; the tongue was red and the palate injected. The left eye was blood-shot, but the retina showed little congestion. The right eye had been destroyed by an accident in 1888. The hands and feet were not congested and the fingers were not clubbed. The skin of the trunk and limbs was not congested and there was no pigmentation or œdema. A slight degree of perionychia was found on the third right toe, but seemed to be quite independent of his blood condition. The superficial lymphatic glands were not enlarged. Two teeth were carious and the gums were dirty. The temperature was subnormal (97°-98°4' F.). The weight was 10 st. 2 lb.

The pulse was regular and of frequency 86. The radial artery was thick and tortuous. The blood pressure measured 170 mm. Hg. The apex beat of the heart was in the fifth space, five inches from the mid-line. The area of cardiac dullness was slightly increased to the left. The second sound in the aortic and pulmonary areas was accentuated, otherwise the heart sounds were normal and there were no murmurs. The respirations numbered 22 per minute. The lungs showed no abnormal signs. Nothing abnormal was seen in the chest on radiographic examination. The spleen was hard and easily felt; it extended one inch below the left costal margin. The liver was felt one inch below the right costal margin. There was no ascites. The knee-jerks were readily obtained, and no abnormal signs were discovered in the nervous system. The urine contained a trace of albumin; a microscopic examination of the deposit showed urates only.

The blood report on Oct. 21st, 1912, showed: Erythrocytes, 10,600,000 per c.mm.; hæmoglobin, 130+ per cent.; leucocytes, 11,000 per c.mm. *Differential count:* Polynuclear neutrophils, 80·2 per cent.; polynuclear eosinophils, 2·2 per cent.; small lymphocytes, 8 per cent.; large lymphocytes, 6·8 per cent.; large hyaline cells, 1·8 per cent.; coarsely granular basophilic cells, 1 per cent. Two *megakaryoblasts* were seen while counting 500 leucocytes. The Wassermann reaction in the serum was negative.

Summary (Case 6).—Under observation one week. History of exposure to fumes. Face deep bluish-red. Spleen enlarged. Arteries thickened. Blood pressure 170 mm. Hg. Erythrocytes 10,600,000 per c.mm. Slight albuminuria. General condition good, after 10-12 years' symptoms.

My thanks are due to Dr. Hadley, Dr. Hutchison, Dr. Thompson, and Dr. Warner for kind permission to publish the cases under their care. Case 3 was shown by Dr. Theodore Thompson, and Cases 4 and 5 were shown by Dr. Charles Miller, at the Clinical Section of the Royal Society of Medicine on Nov. 13th, 1908. Dr. P. N. Panton and Dr. H. L. Tidy, clinical pathologist and assistant clinical pathologist to the hospital, carried out the blood examinations, and have given me help in many ways. I desire to acknowledge my great indebtedness to Dr. Robert Hutchison for his valued advice and for the use of his private notes.

THE VARIETIES AND TREATMENT OF LATERAL CURVATURE OF THE SPINE.¹

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LATERAL curvature of the spine may be classified according to its pathological causes or according to its anatomical varieties.

Classification according to Pathological Causes.

Under the first method of classification the varieties to be recognised are—

1. *Congenital.*—There is usually some congenital malformation of the vertebræ, such as wedge-shaped vertebræ or a half vertebra. These most often occur at the lumbo-sacral junction or in the upper dorsal region. When the latter region is affected there is often also a malformation of the ribs, one or more being bifurcated. In congenital scoliosis the primary curve is sharp and is present at birth; later secondary curves arise as soon as the upright position is assumed.

2. *Rickety.*—Some of the very worst curves are due to rickets. They arise early in life, before the child has walked, and owing to mechanical factors they tend to increase for years after the active processes of the disease have ceased. The usual sites for rickety curves are to the left in the dorso-lumbar region, and to the right in the upper dorsal region.

3. *Secondary.*—Secondary curves may be due to:—

(a) Tilting of the pelvis from shortness of one leg. This produces a long curve extending throughout the lumbar and dorsal regions toward the side of the short leg. An apparent anomaly is here shown in that this curve raises the shoulder on the side of the short leg.

(b) Tilting of the pelvis from fixed adduction of one hip-joint. This produces a long curve away from the side of the adducted hip.

(c) Torticollis. Contraction of the left sterno-mastoid causes a cervical curve convex to the right, and a compensatory dorsal curve convex to the left—that is to say, the dorsal curve is toward the contracted muscle.

(d) Fibrosis of the lung or adherent and thickened pleura produces a dorsal curve convex toward the sound side, usually accompanied by evident rotation of the vertebræ. In other forms of secondary curves rotation of the vertebræ is, as a rule, slight. The curve secondary to lung trouble presents another peculiarity, from which the condition of the lung may sometimes be guessed before auscultation and percussion have been carried out. In an ordinary case of right dorsal curve with evident rotation and consequent prominence of the right ribs posteriorly, there is a corresponding prominence of the left ribs anteriorly; if the curve is due to disease of the lung or pleura this prominence of the left ribs may be absent, so that the whole left side of the thorax is smaller than the right.

(e) Spinal caries may produce a lateral curve in two ways.

1. Asymmetrical spasm of muscles may produce a lateral tilt of the spine during the active stages of the disease. Such a lateral deviation is an important evidence of active disease. 2. Asymmetrical destruction of bone may leave vertebræ that are wedge-shaped, and so give rise to secondary lateral curves just as do the congenital malformations of the vertebræ. Such lateral curves are most likely to arise when the disease has occurred in the lower lumbar region or at the dorso-cervical junction.

4. *Paralytic.*—This is most commonly due to anterior poliomyelitis, but lateral curvature is also an incident in many other forms of paralysis. Poliomyelitis may produce a lateral curve in three ways. (1) Paralysis of one erector spinæ, partial or complete, produces a long curve convex toward the paralysed side; (2) paralysis of one psoas may produce a rather sharp convexity in the dorso-lumbar region toward the sound psoas; (3) fixed abduction or adduction at one hip-joint as a result of the paralysis may produce a secondary curve.

5. *Adolescent or static.*—This class includes the greater proportion of cases of lateral curvature, including all those

¹ Founded on a lecture delivered in the Post-Graduate course at St. Bartholomew's Hospital.