possible, which it is not, that each group receive an equal amount of infection. Then if the same amount of infection were to equally infect the children in both groups, it would follow that infection must be the principal determining cause of the disease. Again, if the same amount of infection which infected the children of infectious cases did not infect the children of non-infectious cases, it is clear that this difference in susceptibility would be due to some factor other than transmitted qualities common to both, and other than the amount of infection which we postulated as common to both. There is no alternative but that the greater susceptibility in the children of infectious tuberculous patients would be due to a variation in their general health, as representing a lowered resistance to infection. It is also obvious that this variation in general health in the children is in relationship to the presence or absence of infectious qualities in the parents. That is to say, susceptibility to tuberculous infection is dependent in an equal degree upon the amount of infection and the general health of the infected person, and that in the case of children the general health is lowered as a direct result of the presence of infectiousness, as distinct from the amount of infection, in the parents. Heredity has no place in this equation.

Is this theorem compatible with clinical facts and experience? It has been shown that in two groups of children, whose heredity is the same, there is a larger proportion of tuberculosis among the children of infectious parents than among the children of non-infectious parents. At first sight this might appear to indicate that exposure to infection in this case was the sole determining factor. That is not so, for before we could prove it the factor of general health would require to be common to both groups. It would be essential that the children of both classes of parents should be of the same physique, the same development, should have the same amount of nourishment, and should be in similar circumstances of home life. Such conditions, however, immediately render any comparison impossible. The infectious parent is generally in a more advanced stage of the disease, which has begun to affect the smallest circumstances of his life. He is less fit for work, his employment is intermittent, and his wages are less. The female with advanced disease is less able to look after her house and children. She is often laid up, meals are less regular, and the selection and preparation of food is indifferent. All these immediate factors tell on the children. They are poorly nourished and ill covered, so that windows are kept closed for warmth. This alone will lower their resistance to tuberculosis and to any other infectious disease, and render them more susceptible than the children of parents in a non-infectious stage of the disease—the heredity of both groups of children being equal, and the amount of infection being equal.

CONCLUSIONS.

1. There is more tuberculosis among the children of consumptives than among the children of healthy parents.
2. This may be due to their exposure to infection, to their lowered general health, or to their heredity.
3. There is more tuberculosis among the children of infectious consumptives than among the children of non-infectious consumptives.
4. This must be due to exposure to infection plus lowered general health, inseparable from it as the result of the stage of the disease in the parents.
5. Therefore it is not heredity which determines whether the children of consumptives will develop the disease, but the existence of certain immediate factors which are under our control.

It is not necessary to argue the case further, but it is possible to imagine a last stand being made for the influence of heredity on the following lines: "Granted an equal exposure to infection and an equal lowering of general health, would the children of healthy parents develop the same amount of tuberculosis as the children of consumptives?" If they did, it would prove that heredity had no influence whatsoever. If they did not, it would indicate that the absence of a tuberculous heredity protected them from infection (incidentally simplifying the tuberculosis problem to an extent no one has dreamt of), and that the presence of a tuberculous heredity was the determining cause in the development of tuberculosis among the children of consumptives, which has been proved to be impossible.

Owing to the rapidly increasing number of tuberculosis dispensaries in this country, the data on which these deductions are based may be tested on an unprecedented scale. If they be corroborated, it means that the influence of heredity is disproved once and for all. Of greater import, it will imply that if our present activity against tuberculosis be augmented we may look with confidence to the total eradication of this disease. On the other hand, should it be proved, as has too long been taken for granted, that soil and seed are independent factors, then, even by a direct attack on the seed (by diminishing the sources of the tubercle bacillus), it would be more difficult to completely exterminate the malady so long as the soil remained (as represented by inherited qualities). This is not so. The children of infectious tuberculous patients and of non-infectious tuberculous patients are all the children of consumptives. The difference in their susceptibility to infection is the direct result of the stage of the disease in their parents. What has been termed for a century "soil" is really the result of the pathogenic action of the "seed." Soil and seed are not independent factors, for they are one and the same. If, then, by the co-ordinated Edinburgh system, the disease is controlled at every point, the resistance of the population exposed to infection will also be raised. The truth is this—that the seed creates the soil.

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A NOTE ON RAT-BITE FEVER, WITH REPORT AND TEMPERATURE CHART OF A RECENT CASE.

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THIS disease seems so rare in this country, so far as reported cases go, that I think the case described hereafter may be of some interest.

Rat-bite fever, or sokòdu or sokòshio, is a disease, according to Castellani and Chalmers (*Tropical Medicine*), which has been known in Japan, and also in China, for a considerable time and many cases are cited by them, but, so far as I have been able to find, the only cases in this country were three reported by Dr. T. J. Horder¹ (1909-10) and a case in a girl of 3 (1895) by Dr. George S. Middleton (Glasgow).² In America several cases have been noted.³

In the *Epitome of Current Medical Literature* (BRITISH MEDICAL JOURNAL, August 24th, 1912), a case is quoted by Cesare Frugoni, published originally in the *Berl. klin. Woch.*, February 5th, 1912, which he claims to be the first case occurring in Europe diagnosed clinically and carefully observed. There appear, however, to have been at least two others, one in France and one in Spain.³

Diagnosis.

Castellani and Chalmers give the following points:

1. Occurrence of a rat bite.
2. Incubation period of from one to twenty-one days.
3. Periodic form of fever.
4. Negative results of bacteriological culture. (Since then a special parasite, protozoon associated with the neosporidia, has been alleged as the cause. Certain blood changes also noted.)⁴
5. Spontaneous recovery after prolonged duration of disease.

Symptoms.

Three types are described (Miyake):

- (a) Febrile with a marked eruption.
- (b) Afebrile with nervous symptoms.
- (c) Abortive.

The feverish state is accompanied by an eruption of purplish spots. The wound heals during incubation—fever begins abruptly. The site of the bite becomes red and swollen, dropsy may appear, local gangrene is found in some cases. Onset with chilliness, headache, marked weakness, fever, and eruption of dusky-coloured purple spots. Pain may be felt in the abdomen, and diarrhoea may occur. The pulse is rapid and weak, and a feeling of precordial pain and palpitation is complained of. Breathing short; delirium may be present. The disease runs a prolonged course, and recurrences are common at varying intervals.

In one case quoted by Hora⁵ there were ten relapses a year for a period of seventeen years.

Case.

J. C., aged 51, a gentleman of stout build, accustomed to outdoor sport, was out with his dog on July 8th, 1911. The dog seized a rat and shook it, but did not quite kill it. J. C. went "to finish it off" and caught hold of the hind legs of the animal, intending to strike its head on the toe of his boot. The rat at this moment turned round and bit the middle finger of his right hand, immediately over the joint between the first and second phalanges on the dorsum. The bite bled a little; the patient sucked the wound well and bathed it, but thought little more of it and it healed up. He noted at the time that the rat seemed to be unhealthy—"mangy." About July 17th or 18th the finger became somewhat red and swollen over the joint, but as the patient was subject to attacks of articular rheumatism, he put the swelling and redness down to this, and did not then associate the condition with the bite. On July 21st (thirteenth day after the bite) he noticed in the centre of the swollen area a bluish coloration, and on the 22nd this had become almost black.

I saw him first on this date. The finger was much swollen (brawny induration), red and tender, extending from the knuckle to the distal end of the second phalanx, the chief point being on the dorsum and over the joint between the first and second phalanges. Here there was a bluish-black spot about the size of a sixpence, the margins of which showed slight vesiculation and the centre appeared to be ulcerating. I was then told of the bite, and looked upon

Fig. 1.—Temperature during early fever, twenty-eighth to forty-fourth day (August 5th to August 22nd). Character of temperature lasting four and a half weeks.

the condition as due to some septic infection. It was treated by application of pure carbolic acid, followed by fomentations of lysol lotion.

For the next few days there was little change in appearance but there was a gradual spread of the discoloration and increase in the ulceration. There was no distinct fluctuation to be made out, but the blackish part felt boggy and soft; the cubital and axillary glands were not affected. The temperature was normal and subnormal. On July 27th he was seen by Mr. E. C. Bevers (Oxford) in consultation, and it was decided that the part should be thoroughly opened. This was done under gas, an incision being made on either side of the middle phalanx of the finger down to the bone, and a gauze drain passed through from one end to the other. Absolutely no pus was found, but the tissues were gangrenous and the bone of the middle phalanx was found bared and roughened. The gangrenous process had spread further in the depth than the blackened surface of the skin indicated, and we concluded that if no improvement followed in twenty-four hours the finger should be amputated at the metacarpo-phalangeal joint. Treatment with antiseptic bath and fomentations was continuously applied. Purplish spots showed on the forearm and the under side of the upper arm.

The condition next day showed a still further encroachment of gangrene towards the knuckle. The finger was amputated at the joint and the wound packed with gauze and left open for free drainage. Next day the hand and forearm were placed in a continuous bath—mercury biniodide 1 in 4,000—for twenty-four hours, and afterwards warm boric acid solution. This treatment was kept up for seven or eight days. The wound remained clean and healthy and began granulating. The process continued in

a quite normal manner, and the wound was completely healed on the sixteenth day after operation. At no time was any pus to be detected.

The temperature remained normal and subnormal until the eighth day after operation. About this time (August 5th, twenty-eighth day after the bite) the patient complained of intense headache, chilliness, nausea, and feeling of general ill-being. He was sleepless, the face flushed, conjunctiva injected, and the temperature and pulse were raised (see charts). The wound appeared quite healthy, but on the forearm were two dusky, purplish spots, irregular in shape, slightly raised, about the size of a sixpence. On the inner side of the upper arm were several other spots of the same character, six or eight in all. The skin between the spots was not discoloured, nor were there any surface inflamed lymphatic channels such as one sees in acute septic conditions of the hand. The lymphatic glands at the elbow and in the axilla were not palpable nor tender to touch. The patient complained of joint pains in the other arm, and on this also a few spots appeared, similar in character and distribution, but not so bright in colour; there was swelling, pain, and larger dusky spots on both ankles also, but this I attributed at the time to articular rheumatism, to which the patient was subject. He also complained of pains in the abdomen. The temperature and pulse gradually rose until August 9th (fifth day), when it reached 102°. On the following morning it fell to 98° with perspirations during the fall; the temperature rose again that night to 100°. During the height of the early attacks sensibility was dulled, with a tendency to mental wandering—"night-

Fig. 2.—Showing the character of the temperature during the later period of fever (from September 15th to October 3rd), and lasting for ten and a half weeks.

mare." The evening temperature for the next four nights reached about 100°, falling a degree or more in the mornings. This was followed by a fall to normal and subnormal for thirty-six hours, then an increasing evening rise for five days, when it ultimately reached 101.8°.

During this higher range the patient's symptoms were again much the same as described during the attack beginning on August 5th. The rash, which had been duller in appearance, again showed up brightly. The range and character of the temperature remained much the same for four and a half weeks, periods of moderate fever rising daily for a few days to an acme of about 102° evening, then falling quickly two or three degrees by next morning. After this, for the next ten and a half weeks, the periodic character of the fever was marked. Onset fairly rapid (two or three days), then highest point; somewhat more rapid fall, then a period of normal and subnormal temperature for about four days.

During the fifteen weeks there were fifteen feverish attacks, all characterized by the same general symptoms. The longest period between the acme of attacks was eleven days, the shortest (the last), which proved to be an abortive attack, was five days. The intermediary attacks showed eight, seven, and six days' intervals.

The patient himself realized the regularity with which his illness and discomfort came, and quite dreaded the Friday, Saturday, and Sunday, and looked forward to the other days of the week.

The disease apparently, in this case, ceased suddenly with an abortive attack about the fifteenth week. The temperature was recorded for a month longer and was normal or subnormal.

During the illness the pulse-rate fluctuated with the

temperature, and towards the end of the illness the heart showed distinct signs of weakness, the first sound becoming faint and signs of dilatation being present. The patient became much thinner and lost over 14 lb. in weight. The bowels throughout were constipated; there was no enlargement of liver or spleen. Urine showed no albumen but often deposit of urates. No late rash was noted.

Convalescence was very slow and he suffered much from headache. He was not able to get about much for six months after the bite, but up to the present time no distinctive manifestations have occurred, though he still occasionally complains of giddiness and headache.

Treatment by various drugs—*aspirin*, *phenacetin*, *quinine*, *sodium salicylate*, *sodium sulpho-carbolate*, etc.—did not seem to influence the course of the disease. The two first named were useful when headache was severe. Later on tonics containing *strychnine* proved useful and the condition of the heart began to improve.

Unfortunately, at the time the finger was amputated the diagnosis of the disease had not been made and a thorough blood examination and culture were not instituted. Later on the patient refused to allow this examination.

For some time the diagnosis was difficult. When Mr. E. C. Bevers had seen the case we concluded that the rat bite was undoubtedly the cause of the condition, and he was kind enough to look up the subject and found Dr. T. J. Horder's article. From the description of those cases and from the after-history of this case the condition became evident.

A short time before the patient was bitten he had been using a virus for the extermination of rats, but whether this could in any way be associated with the disease I cannot say.

A very complete article on this disease is published in the *International Clinics*, Series XXI, vol. iv.

Since writing the above I find a case of rat-bite fever was described at a meeting of the Royal Academy of Medicine in Ireland on December 15th, 1911, by Dr. O'Carroll.⁶

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A RULING HABIT STRONG IN DEATH.

BY

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THE case here reported presents, I think, many points of interest.

X. Y., aged 63, the senior partner of a firm of engineers largely interested in Government and other contracts, with works in South London, an old school friend of mine, had for some years been failing in health. Five years ago he had rheumatic fever with heart affection, and I saw him with his medical attendant, Dr. Matthews, of New Cross Road. This illness was followed by Bright's disease, but under Dr. Matthews's care he got about again much as usual. Three years ago he had a large carbuncle, which laid him up for two

about 10 p.m., and was laughing and joking with his wife and son. About 11.30 he was seized with a very violent attack of breathlessness, and got out of bed. His wife found him lying on the floor. With the help of her son he was got on to the bed; it was observed that his left side was useless. He asked for the asthma medicine and various things, and talked sensibly, though his voice was somewhat peculiar. Dr. Richardson, of Boscombe, who had been sent for, gave full instructions, but made a serious prognosis.

The patient talked incessantly until daylight, when his speech became more and more unintelligible, his neck began to swell, and he grew more unconscious. At 10 a.m. on July 8th he appeared quite unconscious, but he went through the motion of taking out his eyeglasses, putting them on, taking his fountain pen from his pocket, and then writing a letter on the bedclothes. During this morning he tried at times to throw off the bedclothes to get out of bed to pass water; and his wife thought, when she took his hand and asked him to kiss her, that he pressed her hand and pursed up his lips.

months. He got about his work again, but the albuminuria continued. He could not be induced to take proper care, but exposed himself in all weathers and took long cycling rides with his son. He kept on his work as usual until May, 1912, though his disabilities increased. He then became dangerously ill, the symptoms being those of heart and kidney disease accompanied by cardiac asthma. Dr. Matthews impressed on him the necessity of giving up his work, but he was unwilling to do so, and asked me to see him. I visited him on June 9th. He was then improving as to the acute symptoms, but was clearly unfit for work owing to advanced heart and kidney disease and arterial degeneration. I pressed him to resign himself to the inevitable, and, with Dr. Matthews's consent, undertook to arrange a consultation.

He improved somewhat, however, under treatment, and insisted on trying a few weeks' change at Boscombe; but on July 7th I heard from his wife that he had not benefited by the change, and had made up his mind to return home on July 8th. On July 7th he was pretty well and cheerful; he went up to bed

I saw him late on the evening of July 8th. He was lying on his back in bed quite unconscious. His face and neck were swollen, his eyes half closed, and the eyeballs prominent. Breathing was somewhat stertorous, quick and irregular, the mouth partly open, and the tongue swollen and dry. The pulse was full and hard, he was quite comatose, and apparently in a hopeless condition. On the morning of July 9th he was quiet and seemed quite unconscious; he was breathing heavily and unable to swallow, but at 10 a.m. he again began to go through his habitual procedure when about to write. His wife was inspired with the idea to see if he could write, and got a writing pad with some paper, put his fountain pen in his fingers, and guided his hand to the right place. He began to write a long and evidently business letter, crossing his t's, and when he thought he had got to the bottom of the first sheet of paper, he turned it over with his little finger (a habit of his) and went on writing on the second sheet.

He continued quite unconscious all day, and on the morning of July 10th made no motion or attempt to write, and continued

if you could - but it would be as how what you would want for a letter of it

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