from enteric fever in his hospital, I find the name of one (Procter) who, for a year or two, had been previously in the service of the London Fever Hospital, sometimes engaged in the female enteric fever ward, and who yet escaped until, at a riper age, she contracted enteric fever at Homerton. The attacks among the nurses in the other wards will sufficiently show that there was abundance of susceptible material at Liverpool Road.

Dr. Collie finds some difficulty in allowing that the attacks of attendants at the London Fever Hospital are due to drain conditions—seeing special drain defects were only found contemporaneously with twelve cases out of a total of nineteen, leaving six for which no explanation had been given; and, in his last paper, he states: "That drain defects were not the cause of the Homerton cases is rendered probable by the absence of enteric fever among the general staff, and still more by the fact that, on every occasion upon which enteric fever arose, due inquiry was made into the condition of the drainage. . . . The drains were found to be right." It is clear, therefore, that there is no point of agreement between Dr. Collie and myself concerning the conditions under which enteric fever can arise from drains.

The Homerton Fever Hospital is built in pavilions of two stories, the main drains of which communicate with each other. Each pavilion is provided with a soil-pipe, in connection with the sluice-pan and water-closet from each ward; these are trapped by S-bends at the point of their communication with the soil-pipe, which then passes down below the earth's surface, where it is again trapped by another S-bend, holding four inches of trapping water. The soil-pipe then passes into a main drain common to all pavilions in the hospital. The soil-pipes, therefore, closed at both ends by traps, and would be a closed cavity but for a one-inch pipe which connects its interior with the open air. Dr. Collie has found that this one-inch pipe is sufficient to prevent the water in the traps becoming displaced when hot water is thrown into the soil-pipe; and he has assumed that, inasmuch as the air in the soil-pipe cannot be forced through the trap, that the *materies morbi* cannot escape from the soil-pipe into the ward. It is upon this point that I entirely differ from Dr. Collie; it is sufficiently obvious that, with but one small opening into this length of pipe, the exchange of the internal and external air can barely take place. The air in the soil-pipe must, therefore, become charged in the highest degree with the emanations from enteric excreta; and it is difficult to understand how the water in the upper trap can fail to become itself charged, and to give off the emanations Dr. Collie supposes it to retain.

In the London Fever Hospital, the wards are differently arranged; the soil-pipe is trapped at its upper end by the usual S-bend, as at Homerton, but the trap at its lower end (which is present in all the soil-pipes in the latter institution) is altogether absent in those of the former. Hence the passage of air from the main drain, common to all the wards of the hospital, to the trap at the upper end of the soil-pipe is uninterrupted by the intervention of the lower trap. As a consequence, the air in the soil-pipe is not confined, and does not therefore become so highly charged with poisonous matter as at Homerton; but, although the absence of the lower trap is beneficial, so far as the enteric wards themselves are concerned, a corresponding disadvantage is found in the other wards not being so thoroughly cut off from the main drain containing enteric matter. Hence it is not a matter of surprise that the upper trap in the enteric ward of the London Fever Hospital should become less poisonous than the corresponding trap at Homerton; and that the incidence of disease upon the attendants engaged in these wards should be less marked than at the latter institution. Moreover, the upper trap in the non-enteric wards at the London Fever Hospital must become to some extent poisoned, and the attendants in these wards from time to time be attacked with enteric fever—a result which could hardly happen at Homerton.

In conclusion, I would point out that the risk to attendants upon enteric fever patients will depend upon conditions which render the water in the upper trap of the soil-pipe more or less infectious; and that the ventilation in the soil-pipe at Homerton cannot be secured by one small opening. It is unnecessary here to enter into all the physical conditions which would tend to render the upper trap more poisonous at one time than at another, but I will confine myself to referring to the outbreaks (described in my previous paper) which occurred at the London Fever Hospital coincidentally with the obstruction of a drain. It will not, however, do to assume that the upper trap can never become a source of danger without such obstruction, even when some effort has been made to secure the ventilation of the soil-pipe and drain.

It is enough, at the present moment, to show that no ventilation worthy of the name exists in the Homerton drains; and, until this defect is remedied, I would submit that Dr. Collie has no grounds for eliminating so well-known a source of danger as a badly ventilated soil-pipe from being a possible cause of the disastrous results which attend the nursing of the enteric fever patients at the Homerton Fever Hospital.

ON THE ENDEMIC CONTINUED FEVERS OF SUBTROPICAL LATITUDES.*

By WILLIAM G. DON, M.D.,

Surgeon-Major Army Medical Department.

THE title of my paper of course broadly indicates its scope; but, as that opens up a wide field of doubt and controversy, it is necessary to begin by explaining the special points upon which I wish to engage your attention.

The first question obviously is, What do I mean by the endemic continued fevers of subtropical latitudes? I am not about to essay the impossible task of attempting, in a short paper, any widely comprehensive survey or scientific classification of these fevers; only the more salient points can be touched upon. I intend to follow merely the arrangement and nomenclature of the Army Medical Blue Book; not that it is a strictly scientific classification probably, but wholly and solely because these returns afford us data nowhere else to be found.

The continued group of fevers in the Blue Book may be taken to include only:

1. Febricula (all forms);
2. Simple continued fever;
3. Enteric or typhoid fever.

True typhus we may exclude, from its fortunate rarity now-a-days; yellow fever, also, because it has a heading to itself; and likewise the exanthemata wholly; and the purely paroxysmal or malarial, although the latter often complicate and produce hybrid forms with the continued fevers. To a consideration of the above three forms I will limit myself, and endeavour to expound what seems to be their mutual relationships and etiological affinities.

The second question naturally is, What do I mean by subtropical? The term is more a geographical expression than anything else. It just means those belts of the earth's surface which, while tropical in summer, are more or less temperate in winter. Although, broadly speaking, they lie between the twentieth and fortieth parallels of latitude, north and south, they do not follow the rigid geographical lines, but more strictly the isothermal, or isotheral, which indicate the areas of like summer temperature. It is temperature that determines the true subtropics, whether of animal or vegetable life, or of disease; and especially is summer heat the chief factor in the genesis and evolution of the endemic continued fevers. Subtropical meteorology becomes, therefore, of great interest to epidemiologists; for, to broad general climatic influences, rather than to mere local unsanitary conditions, must we look, I think, for an explanation of much in the etiology of the endemic fevers. We are still comparatively ignorant as to how the imponderable forces of heat, light, and electricity, variations of atmospheric pressure, radiation, and evaporation, affect vital processes; but that they do so in a very marked way, I think there can be no doubt. The subject, however, is much too recondite for present discussion.

We have lately in this Society had interesting discussions on certain endemic fevers in India, but to-night I shall almost avoid that country, and elect to speak, by way of illustration, chiefly of Bermuda and Gibraltar, two of our stations with which I happen to have a personal acquaintance. Both of these places lie between 30° and 40° north. Bermuda is strictly insular; Gibraltar only partly so; the former is rainy all the year round, the latter only in winter and spring, and is very hot and parched in summer. The summer temperature of both ranges between 78° and 90° Fahr., but is more sustained, with less diurnal range, in Bermuda than Gibraltar. Both climates are trying, in summer, but very pleasant and healthy in winter. The physical and geological structure of the two places is most unlike. The soft and very porous coralline rock, with no elevation over 200 feet in Bermuda, is replaced in Gibraltar by a dense impervious limestone, towering up in a steep ridge 1,400 feet. No springs proper exist in either place, and good drinking-water is obtained by catching the rain on the roofs of houses or cemented slopes, and conducting it into built tanks in the ground.

The conservancy of the two places is not at all alike. Earth-closets and water-closets exist in the military and naval barracks in Bermuda; but the ordinary privy is usually a mere hole in the porous rock, which allows the fluid excreta to drain away, and retains the solid as a pasty mass. In Gibraltar, a complete system of main drainage exists; water is pumped up into reservoirs, with which the drains are flushed; while shafts, carried up the face of the rock above and beyond habitations, ventilate them. When this drainage-system was completed

* Synopsis of a paper read before the Epidemiological Society of London.

some years ago, it was hoped the notorious fevers of the "Rock" would disappear, but such expectation has not unfortunately been realised. I mention this fact not certainly to discredit such sanitary effort, but only to show that the endemic fevers are not mere products of supposed defective sanitation.

The population in Bermuda is chiefly scattered over the islands in homesteads; in Gibraltar, it is wholly massed into a crowded town at the western base; but the people neither do, nor are allowed to, live like pigs in either place; especially in Gibraltar are they under the strictest police, military, and sanitary supervision.

I have sketched these places just to show that, while widely different in many physical, sanitary, and social points, the indigenous fevers of both are, nevertheless, essentially the same.

This observation and contrast equally applies to Malta, Hong Kong, Mauritius, the Cape, and many parts of India.

I firmly believe the endemic continued fevers of all subtropical countries are essentially alike and allied; they vary chiefly according to the amount of malaria mixed up with them, whereby they assume a less or more remittent, relapsing, or other anomalous type.

Let me review very shortly the three fevers already named, comprised in the continued group of the Blue Book.

1. *Febricula*.—It has a variety of names, of which may be mentioned: *a*. Ephemeral fever (from its shortness); *b*. Ardent fever (especially in India, from its sharpness); *c*. Broken-bone (in Bermuda, the West Indies, and the Southern States, from the frequent severity of the neuralgic symptoms). Whatever the name, the essential feature of febricula is, that it only lasts so many days or hours, and is neither fatal nor complicated. It is the seasoning or climatorial fever, which very few Europeans escape during early residence in the tropics. It has been ascribed to almost anything or everything of the nature of an exciting cause. My opinion is that, if we only knew its true pathology, we would have a clue to the pathology and etiology of the more dangerous and complicated endemic forms.

In the West India areas, the broken-bone variety (not to be confounded with dengue) occasionally prevails epidemically, as a prelude to yellow fever outbursts. This is shown in Bermuda as follows. The continued group of fevers there (of which febricula would form 80 or 90 per cent.) gave, in a series of years, the figures 55.3 in an annual ratio of 1,000 of mean strength; but in 1863, preceding the yellow fever epidemic of 1864, the ratio rose to 153.6. The prevalence of febricula, therefore, in Bermuda is always viewed with apprehension, as indicating one of those pandemic waves of epidemic influence so well described by Inspector-General Lawson.

2. *Simple Continued Fever*.—When febrile symptoms do not subside, but go on and on for several weeks, but without specific complication, the disease is called simple continued fever. Some maintain the term "simple" is not only a misnomer, but a paradox. For, say they, we do not believe in any continued or prolonged fever without a lesion somewhere; and therefore the term simple, meaning uncomplicated, is inapplicable. I will not argue this point, but remark that, which is the experience of hundreds of others, cases of continued fever constantly occur in the subtropics which have not only no constant specific complication, but no lesion that can be detected of any kind whatever. There is no malaria in Bermuda, and cases of continued fever pure and simple can be well studied there. But in Gibraltar and Malta, where malaria exists, peculiar anomalous hybrid forms of continued fever are found, which have had a variety of names. Marston calls them gastric remittent. Such fevers are most intractable, and often followed by persistent neuroses, which are a source of much inefficiency and invaliding from our Mediterranean garrisons.

3. *Enteric or Typhoid Fever*.—This form is specially interesting to epidemiologists, because of the controversy which has centred and still rages around it. Surgeon-General Ewart lately ably introduced a discussion here on this fever as it appears in India, and we also know the very able and exhaustive reports of Surgeon-General C. A. Gordon on this disease within the Madras command. I know of no disease which has been more strongly dogmatised upon; a few years ago it was perfect heresy to question, however deferentially, the views of the eminent exponents of the fever in England. Now, however, doubts are pretty freely expressed on its generally recognised causation, especially by army medical officers whose experience of it extends to all parts of the world. Buckle, in his *History of Civilisation*, says that, as unquestioned authority means stagnation and deadness, so honest doubt becomes the parent of progress and reform; let us therefore welcome honest doubt on any subject. Let us first come to some understanding as to what we severally mean by the term enteric fever; otherwise, if we begin by mutual misapprehension, we may end in a battle over mere words and names. Let us agree to a mere anatomical or pathological definition, committing to no theory of causation, specific or otherwise;

that enteric is a continued fever presenting certain signs and symptoms, of which the chief and essential one is: infiltration, inflammation, and ulceration of the solitary or aggregate glands of Peyer in the intestine. The fever of which the above is the characteristic complication has of late years figured largely in military statistics as a source of much mortality in all our intertropical stations.

But only a few years ago it scarcely figured at all in these statistics. Are we therefore to conclude that it has become endemic in all our stations from east to west only during the last quarter of a century? The medical history of these stations warrants no such conclusion. Enteric fever is now the chief cause of death in these stations. But did no soldiers die from fever in these places before the term enteric came into use? Of course they did, with a higher death-rate than now, only they died under fever called continued merely or remittent.

The conclusion is therefore irresistible, that the chief change in the fatal type of intertropical continued fever is only one of name. Such change may indeed indicate an advance in pathological knowledge, but it is quite another matter how far it necessitates or involves an entire change in an etiological view.

I need not recite the pathognomonic symptoms of enteric fever; suffice it to say, that in Gibraltar these symptoms are usually as well marked as in London. In Bermuda, however, I do not think I ever saw the so-called characteristic rash; nor were the stools light or ochry, but generally dark and bilious. Some may say these were not true enteric cases; but if not, what were they? For the fatal cases showed the essential bowel-lesion, even passing to perforation.

I have rapidly glanced at these three forms of continued fever constituting the Blue Book group. Let me now further glance at some points in which they seem to be mutually allied, and mixed up both in their etiology and their epidemiology.

The first broad fact is that their early symptoms are usually so much alike that it is primarily often impossible to distinguish them, and to determine what form will ultimately supervene. Often have I seen cases admitted under febricula, changed to simple continued, and finally to enteric fever, just as the phenomena slowly developed.

The second is, that the three forms occur simultaneously, concurrently, and mixed up at the same time, in the same place, or regiment, or community. From the same barrack-room, on the same day, comrades present themselves, one suffering from febricula, another from simple uncomplicated fever, and a third from the enteric form.

The third important fact is, that all three forms have the same seasonal period of prevalence, and that period corresponds to the months of highest average temperature, and the maximum of solar elevation and power. June to October is the period in north-latitudes, and a corresponding reverse period in the southern hemisphere.

When such allied forms of disease as these fevers present such points in common as place, circumstance, and season of occurrence, may we not reasonably conclude that the causation of each is also common to all? If the exciting causes are distinct, how are they to be differentiated? If the subjection of a body of men to influences, apparently identical, results in the evolution of three different forms of fever, some explanation must be forthcoming.

I have often found medical officers who at once conceded that the exciting causation of the short febricula and the longer simple continued was probably identical, but that they considered in enteric there was a *plus something more*. Whether this something more was always specific, or might be evolved *de novo* from pythogenic sources; whether, in truth, it was wholly outside the patient at all, was the difficulty.

From what I have seen and read, I cannot help thinking that the broad factors of all climatorial fevers are, if not identical, entirely similar; that mere local insanitation, however much it may aggravate the type, is not the original or essential exciting cause.

I may be asked, if the general causation is so utterly vague and indefinite, how are the different types and varieties of climatorial indigenous fevers to be accounted for? I have tried to do this by looking narrowly into internal or predisposing causes in the individuals affected, as well as trying to search out external or exciting causes.

The individualising of the patient in such cases I consider to be of much importance. In Bermuda, I endeavoured to carry this out, and noticed, as a rule, that while everyone, of whatever constitutional type, seemed liable to febricula, or simple continued fever, the subjects of enteric fever were almost entirely those presenting some of the physical evidences of a strumous or tubercular tendency. The hard drinkers also were singularly free from enteric fever, probably because such men are generally of a robust, vascular, arthritic type.

If such generalisations are of any value or significance, can it be that like endemic causes acting on individuals of different constitutional types will give rise to different forms of climatorial fever?

The individualising of the subjects of these endemic fevers naturally

leads to the question of predisposing causes, of which I will mention three : 1. Constitutional, hereditary or acquired (which I have already touched upon) ; 2. Age ; 3. Want of acclimatisation.

Youth and immaturity very strongly predispose to all forms of endemic tropical fever ; even in this country, enteric fever is chiefly a disease of early manhood. But, as far as military statistics are concerned, age and acclimatisation are not to be separated as predisposing causes. This arises from the fact that the young soldier is necessarily a recent arrival, and a recent arrival is nearly always a young soldier.

I am indebted to Deputy Surgeon-General Tydd for the following statistics for British troops in Bengal, for 1878, with regard to enteric fever. In that year there were 166 deaths from enteric fever, which were reported from nearly every division, and indeed from almost every station, in the Presidency. This was nearly three times in excess of the average of previous years ; and note the following : about 75 per cent. of the deaths took place in the second and third quarters of the year (summer and autumn) ; nearly 50 per cent. were among men during their first year in the country ; and 60 per cent. were those under twenty-four years of age.

The process of natural selection, or weeding out of the subjects most susceptible to endemic causes of disease, is, therefore, a very rapid one ; and, whatever may be the true etiology of enteric fever in these Indian stations, it is certainly not to be disassociated from the very marked proclivity which constitutional type, age, and want of acclimatisation (or weeding out) exercises among a body of men.

I will conclude by a short special reference to intertropical enteric fever, as seen in the army.

I assume we are agreed that we may call any case of continued fever, in which the specific bowel-lesion is recognised, enteric, without reference to an assumed cause. Starting from such an hypothesis, I cannot help thinking that the said enteric lesion is to be found in several forms of a closely allied fever ; and that, although anatomically specific as a lesion, it does not necessarily spring from only one specific cause.

Enteric fever is usually seen in this country in an epidemic form—that is, it tends to propagate itself through the media of air, food, or water ; and I doubt not that it may occur and spread in an identically similar way in tropical countries. But we can at once subscribe to the doctrines of such eminent exponents of the disease as Budd and Murchison, and at the same time not shut our eyes to the fact that the theories of these great men cannot and do not, always and wholly, explain the phenomena of sporadic enteric fever in such places as Bermuda, Gibraltar, or an Indian cantonment.

Surgeon-General Gordon has shown that fever, with enteric lesion, occurs in India, which cannot reasonably be accounted for either on an assumption of direct propagation, or a filth origin *de novo*. Propagationists say that it is not the theory that is at fault, but the observer, who does not bring sufficient science or skill to bear on the investigation. If the disease arise only from specific germs, then we must assume an almost certain ubiquity and indestructibility for such germs. If the disease always have a filth-origin, how do we account for its appearance, say, in the virgin wilds of Zululand ? I maintain that in hot climates the theories of propagation, or of pythogenesis, applied to enteric fever, often seem utterly at fault.

I could give many instances of this which have come under my own observation. Over and over again, in Bermuda and Gibraltar, I have seen isolated cases of enteric fever, both in barracks and private houses, which a filth-theory alone could not possibly explain. For, if such cases arose from soil or water pollution, how came it that scores of other people, living under identically the same conditions, were not similarly affected ? Or, if soil and water contamination be the cause of the disease, why should it be so only in summer and autumn ? Such sources of the disease are equally present, and ought to be quite as active, during the mild winter and spring in subtropical localities.

If a cesspit system and a porous absorbent rock be at the bottom of the mischief in Bermuda, as has been often asserted, then we must find some other explanation in Gibraltar, where there is impervious limestone, and elaborate main drainage conservancy. And so, by a process of logical involution, the etiology of endemic sporadic enteric fever in the tropics becomes a matter of exceeding difficulty and perplexity. We are bound to look at causation from every point of view ; but this becomes difficult when preconceived opinions are apt to beset us on every side.

Appropos of this remark, I conclude by quoting from a paper on Pandemic Influences, by Inspector-General Lawson, in which he says : "The advance of knowledge has been much impeded by the disposition, so strong among medical writers and observers, to regard disease as they individually see it, and refer its prevalence and character to circumstances affecting obviously the population within their immediate sphere ; which, had their observations been extended to other countries,

a similar prevalence of disease might have been found under local circumstances very different from those thought so essential to its occurrence among themselves."

A CONTRIBUTION TO THE ETIOLOGY OF TYPHOID FEVER.

By J. MCNEILL, M.B., Homerton Fever Hospital.

AT the present time, when eminent men differ much in their opinion regarding the etiology of typhoid fever, it might be of importance were I to give the history of sixteen cases which I attended in the Island of Colonsay in 1876. The Island of Colonsay lies off the west of Argyllshire. It is separated from the neighbouring islands of Mull, Jura, and Islay, by belts of the Atlantic, twelve to eight miles broad. Small eminences and intervening hollows, scarcely deserving the name of hills and valleys, make the surface of the island very irregular. The soil of the valleys is peat, clay, sand, and gravel, pure and in combination. The valleys are generally cultivated. The hills are mostly made up of hard whin rock, covered with a thin layer of peaty soil, giving growth to a fine crop of heather. The population in 1871 was 456. The people are distributed all over the surface of the island, so that at any place there are not more than a dozen families, within several hundred yards of each other. With the exception of a few fishermen, the people are all given to agriculture. They generally build their houses in the valleys, or a little way up the hills. They never meet in large numbers, except at kirk, at a wedding, or a funeral. Typhoid fever broke out in six houses. Three had the disease in the first house, four in the second, two in the third, one in the fourth, five in the fifth, and one in the sixth. With the exception of one man, all the patients were under thirty years of age. The distance between the houses in which the disease broke out, with the exception of the second and third, was more than two miles. Between those two there was only a distance of about one hundred yards of level ground. All the affected families got their water-supply from different wells. Each family had a sufficient number of cows to provide their own milk. Their other provisions were got from various sources. They had no drainage in common. The subsoil water could not possibly permeate from the premises of any one of the families to those of another, as rocky eminences, cultivated valleys, and lakes, intervened between all the houses, with the exception of the second and third ; these two got their water-supply from two different wells, with a distance between the wells of about two hundred yards of level ground. None of the houses had a sewer in connection with it. The bedpan was used for all excretions, and emptied immediately at a safe distance from the house. During the epidemic, carbolic acid was poured into the utensil before use ; and immediately after use the contents were poured into a hole dug in the earth forty or fifty yards from the house, and covered over with chloride of lime and earth. When I visited the island in April, the first family were convalescent, and the second family were suffering from the fever. At first, I thought that the impure water which this family drank was the cause of the disease, as the water was renewed by the drainage of a manure-heap. On inquiry, I found that three other families drank the same well-water, and they were all in perfect health. I was also told that the well must have been polluted in the same way for years, and no one was anything the worse for it. On further inquiry, I was told that a servant-girl went home to the island from Bridge of Allan, four or five months before, in a state of ill health ; and that this girl was a particular friend of the first member of the second family that suffered. This was probably the origin of the whole epidemic, as will be afterwards shown.

First Family.—A member of this family was the servant-girl already alluded to. From the description which she gave me of her illness, I came to the conclusion that she suffered from typhoid fever. As soon as her employers in Bridge of Allan could get quit of her, they sent her home to Colonsay. Her clothes were not washed, and she suffered from diarrhoea after going home. Her mother and sister washed her clothes. In a short time, her brother and two sisters had an attack of fever and diarrhoea. The father and mother, who escaped, were considerably above forty years of age. This family lived in a house about two and a half miles from the second.

Second Family.—The first member of the second family that suffered was a particular friend of the girl who came home from Bridge of Allan. She went to see her friend, and remained a night, nursing her brother and sisters. Between two and three weeks afterwards, she felt ill, and went through a very severe attack of typhoid fever. In succession, a brother and two sisters suffered from the same complaint. This is the family that was ill when I visited the island in April. The first family was by that time, as I stated, convalescent.