Senile Gangrene,
with
Illustrative Cases.

by
Ernest Edmund Taylor, M.B.
Feb. 14th, 1893.

Mr. Sinclair,

Dear Sir,

In reply to your communication of the 13th inst., I enclose £1 for matriculation, which please acknowledge.

You did not enclose a matriculation form.

Yours respectfully,

Ernest Edmund Taylor, M.B., B.S.
Candidate for M.D.

Paid last year.
Feb. 13th, 1893.

Sir,

Under separate cover, I beg to hand you a thesis on Senile Gangrene, for the degree of M.D.

Permit me to state, that last year I paid fees of five guineas and one pound, when I had the misfortune to have a thesis rejected.

Yours respectfully,

Ernest Edmund Taylor.

Professor J. H. Fraser, M.D., F.R.S.
Senile Gangrene,
with Illustrative Cases.

By the generic term Gangrena Senilis vel Spontanea, is meant necrosis due to cardio-vascular changes, which sometimes takes place in old people.

We have here nothing to do with gangrene caused by mechanical, chemical, thermal, or specific agencies, except in so far as such agencies may predispose to, or determine, an attack of senile gangrene. It is to senile gangrene proper, as above defined, that we will mostly confine our attention.

It is convenient here to take a general review of senile pathology, and note to what extent gangrene is induced, or affected thereby.

With the advent and progress of old age we notice prominently changes in the epidermis and epidermal appendages, such as: a dry and wrinkled skin, due to atrophy of its sudoriparous and sebaceous glands; hair scanty, grey, or absent, owing to atrophy of the hair papillae; loss of teeth because of the absorption of the alveolar process;
the nails too are often longitudinally creased, shew a tendency to lamina-
tion, and frequently have a distinctly keratinous smell. There is usually
emaciation, and a general stoop chiefly due to deficient muscular
tonicity. Voluntary and involuntary
muscle is subject to fatty degenera-
tion, which is especially important
with regard to the cardio-vascular
system. The parenchyma of most,
if not of all organs undergoes
atrophy, and usually also degenera-
tion, (connective tissue however, does
not waste or diminish to any
appreciable extent) with the result
that the secretions are diminished
and impoverished, and functional
activity generally, is impaired.
Brain and other nerve tissue is
affected in this retrograde process,
the specialised nerve cells undergo
pigmentary and fatty infiltration,
while the neuroglia tends to
preponderate. Softening of the brain
in old people may be caused by
atheroma of a cerebral artery even
without thrombosis, the diminution
in the calibre of the vessel being
sufficient to cause such softening,
owing to the diminution in the quantity of blood to the part affected; these softenings are usually cortical, and frequently produce weakness of mind, dementia, or motor paralysis. The eyes also become hypermetropic owing to defect of the mechanism of accommodation, increased flattening and density of the lens, and weakness of the ciliary muscle; an arcus senilis is often, though by no means invariably present. It has been stated by Flayer (Maladies des Reins, vol i, p5) that the heart and kidneys are exempt from the law of general senile atrophy — with regard to the heart however, this statement is not consistent with the statements of most observers, for not only does the heart atrophy in old age, but with the exception of the blood-vessels perhaps, it is usually more affected than any other organ or tissue; there are very few post-mortem examinations of the hearts of old people in which fatty degeneration cannot be demonstrated. The arteries again,
become affected with atheroma—endarteritis deformans vel chronica—or, as it is often termed simply—calcification; any one of such vessels is a comparatively rigid tube and reacts imperfectly or not at all to vaso-motor influence, its lumen is roughened and narrowed, but is sometimes however bulged into an aneurism, due to the breaking down of an atheromatous ulcer at that situation; given such an artery, with impoverished blood which is circulating slowly owing to diminished vis a tergo, it is evident that any even trivial disturbance of the part, such as a blow, which in robust health would not have any appreciable effect, will, under these altered conditions lead to a deposit of fibrin resulting in thrombo-sis and then, if collateral circulation be not efficient (which it rarely is in these cases) the part supplied by the artery in question must inevitably die. "The natural qualities of the arterial walls are lost to such an extent that at last
the vessel is neither elastic nor contractile, and thus partly from narrowing, partly from deficient contraction of the vessel, considerable difficulties are placed in the way of the circulation, which is already slow from want of heart power. It is very easy to imagine how in such cases the circulation may entirely cease, especially in parts which are far distant from the heart." (Billroth's Surgery, Vol. I, p. 450. New Sydenham Society, 1877.) The spleen and lymphatic glands diminish considerably in weight and volume. The bones become lighter, owing to a process probably of the nature of a rarefying osteitis. With regard to temperature Charcot says: "My own researches tend to shew that the only real difference which exists between the temperatures of the aged and adult, is that in the former the temperature of the axilla is much lower than that of the rectum, whilst in the latter the difference is scarcely perceptible." (Charcot's Lectures on Senile Diseases, New Sydenham Society, 1881, p. 32.)
Senile Gangrene is more common in men than women, and as a rule attacks the lower extremity; it is extremely rare for the upper limb to suffer therefrom; it may be said not to occur before the age of fifty.

A weak and fatty degenerated heart, associated with atheromatous arteries is the almost invariable cause, and to this may be added also, impoverished blood and a defective innervation of the whole cardio-vascular system. Stasis of blood may commence in the capillaries owing to the lethargic circulation, and spread thence to arterioles and arteries; or a thrombus may form on a calcareous patch in a main vessel, and either occlude it at that point, or extend thence and plug the vessel at a more distal site, usually where it bifurcates; or, an embolus may be detached and cut off the blood supply in the region of its impaction.

If the circulation in the part be arrested very gradually, mummifi-
cation or dry gangrene is the result, because the fluids of the part affected are removed by the veins and lymphatics. On the other hand, if the circulation be suddenly and entirely cut off, a moist gangrene ensues, owing to the fluids of the part not being removed by the veins and lymphatics.

Mummification or dry gangrene is the commoner form; it often commences without any apparent exciting cause, sometimes however, there is a history of some trivial injury, such as a slightly torn toe nail, a prick or bruise. Premonitory symptoms such as tingling, itching, sensation of weight and coldness, may exist in the limb for weeks before the advent of gangrene, but, in many cases all subjective symptoms are entirely absent, and the first thing to attract attention may be the appearance of a dark brown spot surrounded by an inflammatory zone, on one of the toes, very often on the inner side of the great toe.
close to the nail; this spot changes to a black colour and soon involves the whole toe perhaps; at this time there is generally a burning, smarting pain in the part affected, and sometimes cramps in the calves is complained of. The gangrene may spread to the remaining toes, the foot, or reach even to the knee. Sometimes a line of demarcation appears at the metatarsophalangeal joint, and the gangrene is here arrested; the black shrivelled, and disorganised toe drops off and cicatrisation takes place. If the sharp paroxysmal pains which accompany spreading gangrene be subdued by opiates, it is remarkable how little constitutional disturbance exists; sometimes it is entirely absent, and, if a line of demarcation form, the gangrenous part may fall off and the patient recover.

Inflammatory or moist gangrene is much more serious than the dry form. The initial stage frequently simulates an attack of gout, and it has in some instances been mistaken
for that disorder. The affected toe quickly swells and is angry looking, the whole foot and ankle becomes oedematous, inflamed, and discoloured, and gaseous and sanguinous bullae may appear thereon. This form of gangrene is much more likely to extend to the knee than the dry form is, and further, a line of demarcation is the exception, not the rule, as in dry gangrene. Moreover, moist or inflammatory gangrene is much more frequently started by an injury than the dry variety, and from the first the Constitutional disturbance is considerable and grave. Purulent infection frequently occurs, and the patient may and usually does die of septicaemia.
Treatment.

The exhibition of opium in some form is certainly needful in order to allay pain, but whether it has any direct beneficial effect on the affected part may be doubted, for although under its administration the pulse becomes firmer and arterial tension raised, it must be remembered that the vessels of the part affected are mostly rigid, and suffer to a more or less extent from vasomotor paralysis. Now, the effect of pain, inter alia, is to slow the circulation, and hence pain in senile gangrene intensifies one of its chief causes. But by the administration of opium the pain is relieved, and its depressing action to a great extent removed, therefore the circulation improves. This was so in all four cases narrated, but the beneficial effect of opium was most marked in Case III (quot vide). In actual practice this is what happens, that so soon as the system gets under the influence of opium, the general circulation improves.
some depressing effects, but these are more than counterbalanced by the good done in the banishment of pain. The bineconeate of morphine causes less headache and less constipation than the other preparations of opium, and it is probably best to use it. Stimulants such as brandy or sp. ammoniaco should be administered at regular intervals, and a nutritious and easily assimilable diet given.

The affected part should be at the outset enveloped in cotton or salicylic wool, for it is of great importance to maintain the temperature of the limb as far as possible. Then gangrene occurs, the odour may be kept down by means of charcoal and iodoform applied to the part; speaking generally, it is not necessary to change the dressing oftener than twice a week. In moist gangrene however, if there be much discharge, it becomes necessary to dress oftener. Dressing the affected part always causes the sufferer pain, so unnecessary interference should be avoided.
With regard to operative measures, if the gangrene be of the dry type, amputation is rarely called for; speaking generally, I am not in favour of amputation at all if the gangrene be of the truly dry type. For, if we wait for a line of demarcation and then amputate above it, the gangrene will often start afresh in the stump; again, if the result be left to nature, a fairly good stump will generally be made, which, if it be not sufficiently useful, we may then fashion more to our liking, without much risk of gangrene commencing again.

In moist gangrene the question of amputation is much more important, because septic products are being absorbed into the patient's system, causing great constitutional disturbance, which may, and usually does end in death due to septicaemia. If the whole foot were affected with moist gangrene, then immediate amputation should certainly be advised before any grave constitutional disturbance has time to set in. Amputation should be done through the lower third of the
though, for although the nearer we amputate to the trunk the greater the shock, yet it is necessary in these cases to operate in a region where there are vessels sufficiently large to maintain the circulation in the stump, and this condition would be less likely to obtain if we were tempted to amputate anywhere below the knee, and it is important to amputate as wide of the gangrenous part as possible in order to avoid the serious event of the gangrene attacking the stump, as Mr. Hutchinson says: "amputation near to the gangrenous part should always be avoided unless indeed, when after repair has considerably advanced, there is proof of well restored circulation." Therefore it is best in the great majority of cases of moist senile gangrene involving the whole foot, to amputate at once above the knee, if it be done at an early date it will give the patient the most reasonable, and perhaps the only chance of recovery, provided always, that there are no grave contra-indications such as would obtains in diabetic patients.
Billroth says: "We are never able to predi-
cate the duration of senile gangrene,
or the probable limit of demarcation
with any degree of certainty. In the
cases that I have met with, the
duration of the process up to the
spontaneous separation of the gan-
grenous parts, or till death, varied
between a month and two years.
This is as distressing for the surgeon,
as for the patient. In senile gangrene
no general rule can be laid down
as to when or where we should
amputate. In general, so far as I
have seen, the results of the regula-
tion expectant treatment are so
unfavourable, that I have determined
in future, to amputate at an earlier
date at the foot, or above the malleoli,
unless the patients be too much
reduced." (Clinical Surgery, New Sydenham Soc:
1881, p. 411.)
Case I.

M.M., aged 85, widow, first seen on April 22nd, 1890.

No hereditary tendencies to disease could be discovered; there was no evidence of the existence of gout, rheumatism, syphilis or struma; her general appearance was healthy and her surroundings were good; her only complaint was about paroxysmal smarting pains in the right great toe, which she said commenced three weeks ago, and had gradually increased in frequency and severity, and now seriously interfered with her rest at night. The toe on inspection presented nothing peculiar, but deep palpation elicited considerable tenderness in the region of the ungual phalanx. A thermometer placed between the great and second toes of the affected side registered 97.5°F; the temperature on the sound side was 98°F, and in both axillae 99.2°F. The patient was a well nourished, intelligent, healthy looking old lady without any obvious morbid appearances. The heart and lungs were healthy.
Sp. gr. of urine 1018, faintly acid, without albumen or sugar. The radial and temporal arteries felt slightly atheromatous. There was an absence of all subjective sensations, except in the affected part. The special senses were remarkably good. A well-marked arcus senilis was present.

**Progress and Treatment.**

The right foot was at once swathed in salicylic wool, and Liquor Morphinae Bineonatatis, in ten minimum doses, was ordered at bedtime, with the result that the pain and insomnia were thereby much lessened; however, in about three weeks it became necessary to exhibit the medicine twice a day, and, at the end of twelve weeks it was being taken three times daily. At this time three tablespoonsfuls of brandy were given each day, and a nutritious diet was ordered. The tip of the great toe gradually shrivelled up, and at the end of three months was grey-black in colour and the terminal phalanx was quite dead. A faint musty odour emanated therefrom, but
the smell could certainly not be called offensive — the gangrene being essentially dry — All this time the patient's general health was excellent, she was cheerful, and insisted upon regularly attending to some of her household duties. In the following August, the second toe of the same foot was attacked, and by the end of the month the terminal phalanges had dried up. By this time too, the whole of the great toe had become involved, and towards the end of the year the whole of the second and part of the third toes had mortified. It is to be noted that hitherto there had been no deterioration in general health, the appetite continued good, the mind clear, and there was little pain except now and then some aching, expressed by the patient as a "nagging pain" at the affected part; there was no rise of temperature or any untoward symptom.

On January 27th, 1891, Mrs. M. went to town on business, caught a chill, and two days afterwards pneumonia supervened and she died on Feb. 2nd.
at which time the whole of the first, second and third toes were dead and quite dry, without any obvious line of demarcation having formed.

Only a partial and incomplete examination of the foot was allowed. The great, second and third toes were mummified and their contained phalanges black and dry. There was no line of demarcation between the sound and disorganised parts, but there was a sort of borderland, the vessels of which were blocked by blood clot. It was impossible to identify any of the structures in the affected region, but the vessels of the foot generally were atheromatous and occluded by coagulated blood.

Case II.

I. D. at 91, a widow, first seen on March 18th, 1890.

Her family history was, as much as could be obtained, quite unreliable. She would not admit having at any time been intemper-
ate; though her veracity in this respect might well be doubted. Her general surroundings were far from hygienic. A fortnight ago she felt pain in the left great toe, and at the same time discovered a dark-red colouration on its inner side spreading half way under the nail. She had no recollection of having injured her toe in any way. When first seen, the greater portion of the toe was black, moist, and smelled horribly. There was a red inflammatory zone extending round the toe and for one inch on to the dorsum of the foot. The temperature in the axillae was 99°F, and that of both feet 98.2°F. The patient was in great pain, she had had very little sleep for a fortnight, and looked pinched and anxious. The tongue was furred, red at the tip and sides, and the breath offensive. Acidity, flatulence and constipation existed. She complained of occasional palpitation and faintness. The apex beat could just be felt on palpation, and the first and second cardiac sounds were very weak. Pulse 70, weak, irregular,
and compressible. She suffered from varicose veins, which were especially evident in the left leg, the internal saphenous vein being tortuous, fezzy, and its valves undoubtedly incompetent. Both ankles were oedematous, the left one being the worse. The urine was scanty, acid, sp. gr. 1030, with a trace of albumen.

**Progress and Treatment.**

The gangrenous part was dressed with iodoform and tow, and the whole foot enveloped in wool. Three or four tablespoonfuls of brandy were given daily, and pil: opii grj at night. These measures gave great relief, the pulse improved, the pinched and anxious expression of face disappeared, and the patient became comparatively cheerful. The gangrene nevertheless, spread rapidly, and by April 2nd. the whole of the great and about a third of the second toes were affected. The patient had now very little pain so long as the foot was left undisturbed. The temperature at this time was 98.6°F. An enema of soap and water was given about twice a week. Charcoal poultice
was substituted for the iodoform and tow, and was much more efficacious in keeping down the smell.

By April 7th, the whole of the second and part of the third toes were gangrenous. The whole foot was greatly inflamed, swollen, and extremely sensitive to the slightest touch, and intense shooting pains, extending up the back of the leg to the knee, were bitterly complained of. The temperature in the axilla ranged between 98° and 99°. The pulse was feeble and flagging. The patient died on April 14th and retained consciousness to within half an hour of her death.

The foot was examined: it was in a sodden state, most of the vessels contained blood clot, the plantar arteries were distinctly atheromatous, and the bones of the disorganised first, second, and third toes were black and eroded. The gangrene was typical of the moist variety.
Case III.

M.C. at 85, a widow, first seen on March 22nd, 1892.

The patient was born of remarkably healthy parents, her father died at 85, and her mother at 73. It is to be noted that both her father and grandfather suffered from gout, but not, the patient said, severely. She was a well-nourished, apparently healthy woman, of temperate habits, in easy circumstances, and in the enjoyment of excellent surroundings.

Twelve days prior to consultation, the patient had slightly wounded the inner side of the left great toe, close under the nail, while cutting her nails with scissors. A day or two afterwards the wound commenced to itch, discharge, and ache.

When seen, the whole foot was oedematosous and sensitive to pressure, the inner half of the terminal phalanx of the left great toe was black, sodden, and offensive. The temperature of the affected foot was 99°F, that of the axilla being about normal (98.4°F). She complained of occasional "flutterings" at the heart, and faintness.

The cardiac impulse could only be
felt occasionally, both cardiac sounds were weak and irregular, the pulse was 80, irregular, and soft. Varicose veins existed, but not to a marked degree. The urine was very acid, sp. gr. 1030, and contained a trace of albumen, but no sugar.

**Progress and Treatment.**

The foot was smeared with carbolic oil, iodoform dusted on the toe, and the whole enveloped in wool; this dressing was changed every third day. Liquor Morphinae Bineconatis in ten minims doses was given three times a day, and a tablespoonful of brandy every four hours. In two days the pulse had improved considerably, but the gangrene spread, and the pain became so severe that hypodermic injections of morphina had to be resorted to at night in order to give the patient some rest. So far there was no change in the temperature. Iodoform was now discarded and charcoal poultice substituted, with the result that the hitherto penetrating and offensive odour was almost entirely subdued. By April 2nd a distinct line of demarcation had
formed at the bases of the first, second, and third toes. As operative interference was not deemed advisable, a poultice of equal parts of Charcoal and Linseed, dusted with iodoform, was applied every twelve hours. Red lines (inflamed lymphatics) now became evident spreading from the seat of disease to half way up the leg. The temperature was now 101°F, and the pulse ranged between 90 and 100, very weak and irregular — one sudden syncopal attack had already been cut short by a hypodermic injection of digitalina — and death took place on April 8th.

Only a very imperfect examination of the foot was permitted. It was noticed that the slough had not finally separated, but the first and second toes were adhering only by a few tendinous sheaths. An incision was made behind the internal malleolus to expose the posterior tibial artery at its bifurcation into the plantars; it was found distinctly calcareous, and the internal plantar artery contained decolourised blood clot, undoubtedly thrombotic in nature.
Case IV.

J.B. at 76, a retired grocer, first seen on May 5th, 1892.

The patient's father and grandfather had suffered from gout, their health otherwise had been good, the former died at the age of 60 from pneumonia, and the latter at the age of 72 cause of death unknown.

There was no history of tuberculosis, syphilis or nervous disease. The patient had enjoyed excellent health until he was about fifty years of age, then gout set in, and he had had periodical attacks ever since. He was about middle height, rather stout, joints large and somewhat stiff, the radial and temporal arteries felt atheromatous— in short, he was typically gouty in constitution.

He stated that last night (May 4th.) just as he was about to get into bed, he trod on a small tack, the point of which entered the ball of the right great toe. At the time he thought the wound to be of a very trivial nature, nevertheless it caused him a sleepless night, and he firmly believed that another attack of gout had commenced, so the
following morning (May 5th.) he consulted me.
There was an erythematous blush enveloping the entire toe and extending half way on to the foot, there was some oedema about the ankle, but none about the left lower extremity. His temperature was normal (98.4°F); a thermometer placed between the first and second toes on the affected side registered 99°F. The heart was sound and fairly strong; pulse 75, regular and full. With the exception of a faint trace of albumen, the urine on examination yielded negative results, which is not usually the case in a typically gouty subject.

**Progress and Treatment.**

Ammonia and bark were exhibited, together with pil: opii gr. at night, and brandy in tablespoonful doses three times daily; the foot was enveloped in cotton wadding. Two days afterwards, the wound had sloughed and was offensive, so a charcoal poultice was applied twice a day. By May 10th., that is six days after the injury, the great toe was gangrenous, the whole foot further, was much inflamed, swollen and
tender, and, as there were no signs of the arrest of the gangrene, the patient was earnestly urged to have the leg amputated above the knee, as affording the likeliest chances of recovery. At this time there was little constitutional disturbance, the kidneys were fairly healthy, the temperature had risen barely a degree and a half, the tongue was clean, and the heart action good. Unfortunately I believe, for the patient, his relatives and friends advised him not to submit to operation. By May 15th. the whole foot was gangrenous; constitutional disturbance was still slight, so amputation was again advised, and again refused. Five days later his temperature almost suddenly reached 104°F, there were anorexia, headache, vomiting, albumenuria, and nocturnal delirium, the pulse was rapid, weak, and irregular, and all the symptoms of septicaemia supervened, and the patient died on May 24th., by which time the gangrene had extended to the calf of the leg.

An examination was not allowed.
Comments. With regard to the mechanical, chemical, thermal, or specific agencies which may predispose to, or determine an attack of senile gangrene, we have in Cases III and IV, two very striking examples of mechanical lesions, which, had they taken place in healthy adults would have been of no moment, yet, under the altered conditions, were provocative of a spreading gangrene which in each case terminated fatally.

An eschar produced by an acid, a frostbite, burn, or scald in the same situations, would in all likelihood have been followed by similar results; for, if a local thrombosis be once started, whether by such agencies or not, the low physiological resistance of the surrounding tissues is often unable to prevent or arrest its spread.

The consideration of specific agencies (under which head I would include chiefly the gouty, rheumatic, syphilitic, and tuberculous diatheses) as predisposing to, or determining senile gangrene, are undoubtedly of
some importance.

Gout, that markedly hereditary disease, is a powerfully predisposing and determining cause of senile gangrene. And this is not to be wondered at, if we consider the conditions which obtain in gout: they are (inter alia) a deposition of urate of soda in the articular cartilages, bursae, fibrous, and other tissues, associated with degenerated arteries, and frequently cardiac valvular lesions, granular contracted kidneys and so forth; and again, the predilection of a gouty attack to manifest itself (not only primarily, but frequently) in the first metatarsophalangeal joint, renders that site a comparatively easy prey to senile gangrene. Case IV exemplifies this to some extent; the patient's right great toe had always been the first to suffer in his gouty attacks, and it was in the same situation (a permanently damaged one) that gangrene first started; of course in this case there was an injury to the part, and this too has to be taken into consideration; it is probable however, that had
a like injury taken place to the left and undamaged foot, the consequences might not have been so serious, more especially as the general circulation was good.

Concerning chronic rheumatism, by which is usually meant Chronic articular rheumatism, we know that it is to a very great extent hereditary, and frequently does not manifest itself until the advent of old age. Chronic articular rheumatism may be developed out of, or follow, acute rheumatism (rheumatic fever), but it would probably be well to exclude the latter and its sequelæ from present consideration, as being somewhat foreign to the senile state. Chronic rheumatism is more common in females, it usually attacks first the metacarpo-phalangeal joints of the index and middle fingers, and it invades both upper extremities symmetrically. Senile gangrene on the other hand, usually commences in the great toe, is asymmetrical, and more frequent in males. It would seem then, so far as I am able
to discover, that chronic rheumatism, unlike gout, does not predispose to, or determine an attack of senile gangrene, except in so far, perhaps, that it intensifies the senile state, and thus lowers the general vitality.

In old people whose tissues have been damaged by syphilis, either congenital or acquired, it seems reasonable to expect that the advent of senile gangrene would be facilitated. Syphilis is an infective granuloma, and no tissue is exempt from its ravages; if the arteries of the leg were permanently damaged thereby, the circulation and nutrition in that extremity would certainly be impaired; and again, it is likely if syphilis were contracted late in life, that a syphilitic onychia might form the initial lesion as it were, causing an attack of gangrene, which might with all propriety still be classed as senile gangrene.

In the tubercular diathesis, we often come across old people who have joints chronically affected by tuberculosis, and one might expect
that if a tubercular metatarsophalangeal joint, say, were injured, gangrene would more readily supervene, than if the patient had to contend with his senile changes only.
163, Cemetery Road,
Sheffield.
February 1893.

I declare that the foregoing thesis has been composed by myself, and that it contains the results of original observations.

Signed:— Ernest Edmund Taylor