EQUINE SARCOPTIC SCABIES.

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NEUMANN, in his "*Traité des Maladies Parasitaires des Animaux Domestiques*," has furnished us with an admirable description of the symptoms and course of sarcoptic scabies in the horse, the habits of the parasite, etc., but there is a paucity of English literature on the subject generally; and my object in asking for space for insertion of the following notes is to add a few points which may be of interest to some one or other, and to describe more accurately than was done in my previous article in this Journal the pathological lesions in the skin, which, so far as I know, has not previously been done in England.

SYMPTOMS.

The symptoms of this disease are characteristic, and differ to a large extent from those of the other forms of scabies; at the outset there is an eczematous eruption—a superficial dermatitis—with or without prurigo, followed by desquamation and depilation of the skin of the affected spots.

In most treatises on skin disease we are led to infer that the first symptom of the sarcoptic and other forms of scabies in the horse is itching. With regard to sarcoptic scabies I am afraid such an inference is an error; most likely it is not until prurigo occurs that the veterinary surgeon's attention is drawn to the animal by those in charge, or it may be the earliest symptom noticed if the horses be kept in the open and are not so well looked after as when stabled, or perhaps the slight eruption is passed over as nothing serious. In any case I am in a position to state that out of a total of over 120 cases in one outbreak alone, itchiness of the skin was not the first symptom.

The very earliest sign of invasion by the parasite is the presence of one or more small papules which *may* be felt on passing the hand over the surface of the skin in the direction of the hair. I say *may* be felt, because at the early stage, and if few in number, they are not always readily detected owing to the great quantity of hair on the skin, and, in many cases, to the minuteness of the eruption; they are easily seen and felt if the horse has just been clipped, or if he has a very thin summer coat, but most difficult of detection if the coat be thick and heavy. Rubbing or scratching of these, say half-dozen, papules does not as a rule induce the horse to show the slightest sign of pleasure.

The papules are so small that they feel more like pin-heads in or on the epithelium, 1-16th to 1-8th of an inch in diameter, circular, and when first formed they are acuminate or pointed, not flat on the surface, with only about half a dozen hairs standing somewhat erect on the surface of each. On turning aside the hairs on a papule and looking closely at it, one finds a few small beads of serous coagula binding them together where they adjoin the epithelium; plucking removes them, bulbs and all complete, not broken, and there remains exposed to view on the surface of the papule a minute, circular, bare, moist surface, in the centre of which one not unfrequently sees a

minute red punctiform spot, which denotes most plainly the entrance made by the acarus to the canal in the epithelium.

In the early stage of invasion by the disease these minute papules are discrete, one to four or five inches apart, and remain covered with hair for about ten days. When the hair falls off, without having been forced by rubbing or biting, there are exposed to view bare circular patches, each the size of a split pea, covered with grey powdery dry epithelial scales, in the midst of which there are sometimes small beads of yellow coagulated serum, and frequently in the latter, not always, a speck of blood-staining. The papules have now lost their acuminate appearance and have become less prominent and considerably smoother, flatter, and broader.

The progress of the disease up to the formation of a score or so of papules is decidedly slow, perhaps extending over a month, but subsequently the invasion rapidly spreads to nearly all parts of the body. It is noticed that it does not spread by progressive marginal and radial extension from one or more common centres as in psoroptic scabies, so as to cause one or more large patches of diseased skin, but by fresh papules forming at a greater or less distance from the older ones; and in this way one meets with all stages of the disease—the older bare scurfy circular spots intermingled amongst papules in the early stage; this is a feature of the disease which distinguishes it from eczema at a glance. In the later stages these spots tend to coalesce owing to the invasion of fresh skin between the bare affected spots.

If the eruption during any stage of the disease be at a part of the body where the skin is exposed to friction, *e.g.*, at the throat by the throat lash, or the inner face of the buttocks by the tail, the appearances are somewhat different from those described: there are irregular patches denuded of hair, of a reddish-grey colour, and a leathery scaly appearance. The skin of such places very soon becomes hard and wrinkled owing to thickening of the superficial epiderm—sooner and to a greater degree than the skin of other parts not exposed to friction.

In so-called chronic cases the animals are miserable wretches to look at; they seem semi-starved, periodically itchy, and are bruised and bitten; what little hair remains on the body has a washed-out appearance, and is arranged in irregular streaks or patches which have undecided margins and large papules studded here and there; the affected skin more or less all over the body is much thickened, almost hairless, scurfy, wrinkled or furrowed, and often blood-stained, but never, so far as my experience goes, is it horny. The wrinkling of the skin is most marked on the sides of the neck, the scapulo-ulnar region, and the buttocks. In some works much stress has been laid upon this wrinkling, but it is not peculiar to scabies, and can be produced at will by any dressing which has the power of hardening or tanning the skin.

Location of the Papules.—From Dr Fleming's *Sanitary Science and Police*, vol. ii., page 404, we take this extract: "In passing the hand over the parts of the body which the horses seek to rub, and especially on each side and at the base of the withers—where the disease generally commences, and whence it extends along the neck, shoulders, and back, until all the surface of the body is invaded, except perhaps those covered by long hair, as the root of the mane and tail—in passing the hand over these parts," etc.

In Professor Williams' "Principles and Practice of Veterinary Surgery" we find it stated that "The favourite seats of this form of mange are the sides of the neck and withers, whence they may extend over the surface of the body, except, according to Mr Fleming, those parts covered by long hair, as the root of the mane and tail."

In Dr Fleming's translations of Neumann's treatise "Parasitic Diseases of Domestic Animals" we find it stated that "sarcoptic scabies begins most frequently at the withers, and extends to the sides of the neck, shoulders, back, and sides. It does not easily invade the extremity of the limbs, and it respects the parts covered with strong hairs—crest, tail, legs—which remain with their hairy covering in the midst of neighbouring denuded regions. The psoropt, on the contrary, appears to seek those parts exempted by the sarcopt. Sometimes, though rarely, sarcoptic scabies commences at the head, flanks, croup, etc., this depending upon the initial point of contamination."

The above extracts would lead us to believe that this disease most commonly attacks the withers first, and subsequently the neck, shoulders, back and ribs, and that it does not affect the legs, mane or tail; certainly so far as my experience goes the disease does not attack the skin of the legs, mane, or tail primarily, yet in some ordinary cases and in those that were more refractory to treatment than usual the eruption and acari were found in places said to be exempt, or, at least, not affected at the outset; and I have seen it in two cases below the knees and hocks. I have never seen the muzzle affected even in the worst cases; it is difficult to say why, unless it be that the constant movement of that part is not relished by the parasites. Beneath is a table showing at which parts of the body the earliest signs of the disease first appeared in 98 cases of which notes were kept, which table will show that *it does not always originate somewhere near the withers* :—

Face	1	Withers and Quarters combined	8
Neck	5	Quarters only	18
Withers	28	Quarters and Flanks	10
Back or Loins	13		
Ribs or Flanks	15		

It is to be hoped that no one will imagine that the first two or three papules were seen in each case, no! in many cases 10-20 papules were present before the disease was detected, and several cases were not even suspected until on being clipped the eruption was seen.

It was frequently remarked that when the eruption first appeared on the sides of the withers second crops tended to spread along the back to the loins, and also down the flanks and quarters, much less frequently up the neck and along the sides of the crest to the throat, which is a spot which suffers severely when affected. On the sides of the withers, neck, and back, the eruption is usually made up of a group of papules, whereas when they first appear on the quarters, flanks, or false ribs they are more often arranged in a line.

Prurigo.—Itching, an important symptom of scabies, has been left to take second place to the eruption, because, so far as we have found, it has not appeared so soon as a few papules have formed—never in the cases we have had to deal with until a fair number of vesicles were

present, *i.e.*, until there was a well-marked eruption—excepting in one or two nervous or thin-skinned horses, in which class of animal, as is well known, this symptom may become an alarming one. The degree of itch varies greatly in different horses, and it becomes more and more intense as the lesions tend to become confluent.

It has been supposed that the sarcopt emits an acrid irritating fluid into the burrows made in the epidermis, which fluid produces the itch and the vesicular eruption, upon the serum of which the acarus lives. I think it may be inferred that the irritant emitted by a few acari cannot be very acrid, otherwise the vesicles would be more pronounced in character than they are, and we should expect to find prurigo manifested earlier in the disease than it is.

To describe the results of the itching we cannot do better than again quote from Neumann :—"Friction is a very important agent in bringing about the alterations of the skin ; it excoriates the papillæ, accelerates the formation of crusts, produces subcutaneous infiltrations, hæmorrhagic exudations, pustules, fissures, and ulcers." How true this is ; and how difficult it is then to eradicate the disease and get the skin back to its normal pliant condition those only who have had to tackle such cases can realise. The thickened epiderm, the crusts, and scabs seem to suit the parasites to a nicety ; these seem to be living in a forcing-house, and are well protected from agents likely to destroy them, the thick epiderm and scabs proving an inconvenient obstacle to the thorough penetration of dressings.

The diagnostic symptom of the disease is, of course, the discovery of the acarus ; without it there may be a doubt as to the diagnosis in the very earliest stage. Its detection is simple, and requires very little ability in the manipulation of a strong lens or a microscope with a low power. The method to be pursued is detailed further on.

Some symptoms of sarcoptic scabies in man differ from those we meet with in equines ; the disease is said to commence as a papular, vesicular, or even pustular eruption, the vesicles becoming ruptured, and so on. Although the term vesicle has been used in this paper to describe the eruption as it occurs in the horse, a careful study of the lesions (*vide* pathological anatomy) has convinced me that this kind of vesicle (if it be one) is represented by a simple infiltration of serum through the epidermis—there is no breaking down of the epithelial cell elements. Pustules, even in the later stages of the disease, when the skin is in a much more irritable state than in the earlier stages, we have not seen excepting as a result of rubbing ; but we do not deny their occurrence in the horse under conditions other than those in which we have met with this disease. Wheals, like those of urticaria, which are said to often accompany scabies in children, severe dermatitis resembling phlegmonous erysipelas, and bullæ, we have not seen. A weeping of the skin, said to be common in human scabies, has occurred only as a result of harsh treatment, by the dressings having been irritating, and in two or three horses it resulted from soft soap having been left on an already tender skin.

In *Sanitary Science and Police*, page 403, under the heading "Symptoms" there is a sentence which is not readily understood, because it is not explained in any subsequent paragraph ; it is this : "The disease is characterised by a symptomatic vesicular eruption, which *varies according to the age of the affected animal and its individual*

predisposition, as well as the stage at which the disease has arrived." We have already drawn attention to the fact of both papule and eczematous eruptions having different characters from those originally assumed, so soon as the hair falls off the surface of the papule, but we have never seen the eczematous eruption vary in the slightest degree in character according to the age of the affected animal, old or young; and when left alone the eruption has not varied in the slightest,—it has always had the same characters. Neither has individual predisposition, so far as we have seen, made any difference in the character of the vesicle.

Loss of Condition, etc.—Once the eruption is marked and prurigo sets in the animal rapidly loses condition, owing no doubt to the functions of the skin being interfered with, and to the loss of rest consequent upon the incessant itch; but we have not noticed anything worse set in.

The hairs usually grow darker over spots which were invaded by the parasite, not in every case but in a large majority; this discoloration of the hair was most marked in summer, and it was noticed that if the darkness of the hair originated in the summer weather it remained so until the change of the coat in the autumn, whereas that appearing in winter tended to fade in a few weeks. In one case the hairs over affected spots became and remained grey for about four or five weeks, and in five bay horses the hairs remained decidedly pale (a washy bay) for over two months. These hairs also grow very rapidly and longer than elsewhere. It has been said that the poison emitted by the sarcoptic acari causes this darkening of the hairs. I do not think this is the cause; it is more likely to be the result of a physiological action determining a greater amount of deposit of pigment in the hairs, as the same darkening is seen to follow ringworm, some cases of nettle rash, and other affections of the skin in which the deeper structures are affected.

Course and Contagion.—So far as we have found, this form of scabies amongst stabled horses is decidedly slow at the outset of its invasion either of a horse or stud. This is owing to the first few eczematous papules on an affected case not making much progress in number for a month or more, and then perhaps it is not until attention is drawn to the animal being itchy (the prurigo only now perhaps showing itself for the first time) that anything amiss is noticed, when most likely the horse has a good crop of vesicles.

There is no doubt that under certain conditions the rapidity of the spread of the disease from horse to horse varies, *e.g.*, uncleanness and insanitary surroundings favour contagion to a large extent, as also do poor condition and inferior grooming. Reynal has stated that young horses are much more liable to become affected and remain longer affected than old ones, but this is open to doubt if all horses in the stud are living under the same hygienic conditions. Reference to the following table of statistics of one outbreak will show that there is not such a large percentage of cases amongst the young horses as to bear out the above assertion of Reynal; moreover, the inveterate cases met with lately were middle-aged and older horses. However, experiences may be reversed at some future date.

<i>Ages.</i>	<i>Total in Stud.</i>	<i>Number in Each Age Affected.</i>	<i>Percentage.</i>	
3-year-olds	16	2	12'50	All these horses were living under the same conditions of work, feeding, stabling, surroundings, and attention generally.
4 " "	40	12	30'00	
5 " "	28	16	57'14	
6 " "	40	18	45'00	
7 " "	38	8	21'05	
8 " "	33	6	18'18	
9 " "	29	8	27'58	
10 " "	47	12	25'53	
11 " "	24	12	50'00	
12 " "	45	13	28'88	
13 " "	29	7	24'13	
14 " "	27	6	22'22	
15 " "	6	4	66'66	
Over 15 years	9	...	...	

It is generally maintained that this form of scabies in the horse is most contagious, but how much more or less contagious than the well known psoroptic form we have no means of judging with accuracy. I think it must be granted that once sarcoptic scabies gets "a good hold" of a few horses in a stud, and infects the grooming kit, saddlery, etc., it spreads most steadily but not necessarily rapidly; and once it has obtained such a footing it is a most difficult matter to eradicate it thoroughly. Its transmission from horse to horse in the stables of a regiment takes place most readily by means of infected grooming kit, or by numnahs and saddle-blankets being used indiscriminately. It is not readily transmitted simply by cohabitation in stables unless severely affected cases are mixed up with healthy horses, for it was found that the disease was not confined to a few adjacent horses or to a few stables, no! cases cropped up in nearly every stable out of a total of 34 stables. But there is no reason to doubt its conveyance from horse to horse by means of bedding, mangers, partitions, pillars, and such like—anything which can carry the acari may convey the disease. Our experience quite bears out that the "danger of contagion is related to the phase and intensity of the disease. At the period of their installation the sarcoptes have little tendency to emigrate, and cohabitation of healthy horses with one which is just infected is often followed by no bad results; but after the formation of scales and crusts, the parasites pass quickly from one horse to another, a slight and fugitive contact between them being sufficient to ensure infection." (*Neumann*).

Several experiments have been carried out by Gerlach, Delafond, and Bourguignon to ascertain the vital tenacity of these parasites when removed from the equine skin, experiments which are useful and instructive, no doubt; but it would be most desirable to find out how long the acari, or, that which is of more importance, their eggs, can remain alive or capable of again giving rise to the disease, after having been kept during a lengthened period in some condition more allied to their natural habitat than a glass saucer or a watch-glass is.

Communicability to Man.—It has been proved that the equine sarcopt can be transmitted to man, and, causes a great amount of irritation and inconvenience whilst there, but it does not seem to find a suitable habitat on the two-legged mammalia for the propagation of its species. During a recent outbreak it was found that none of the men attending the horses, affected and healthy, suffered from "Itch."

Prognosis.—If the treatment of an outbreak be most thorough, not only of the animals affected but also of all other horses more or less in contact, and of everything likely to convey the disease, it does not, under favourable conditions, cause anything more serious than very great inconvenience, and loss of the animals for work; but under conditions unfavourable for its suppression and thorough treatment, e.g., debility and old age, accompanied with lack of or inferior food and insanitary surroundings, death would sooner or later claim its victims, no doubt.

Diagnosis.—We all know that certain skin diseases are easily enough diagnosed when there is nothing about the stable to arouse one's suspicions, but during an outbreak of a contagious skin disease it is marvellous how suspicious and doubtful we become of any other form of skin affection. Some of the symptoms of sarcoptic scabies bear a certain resemblance to those of several other diseases, and mistakes may thus be made at first sight, especially if a microscopic examination of the eruption, if any, is not made use of.

Psoroptic Scabies.—In this form the itching is said to be a very early symptom; and the scurf induced by the parasitical irritation remains much moister than in the sarcoptic form. In well-marked cases of psoroptic and sarcoptic scabies the area of invasion in the former is gradually extended from the margins of one, two, or more diffusely affected patches, whereas in the latter there are numerous small eczematous eruptions, each no larger than a pea, mixed up with large hairless patches and streaks of healthy skin, unless the disease is very far advanced. On an affected part in psoroptic scabies we find a few hairs stick out like bristles, whereas in the sarcoptic form every hair disappears completely in small circular pea-like areas.

2. *Symbiotic Scabies.*—In this the disease is confined to the lower extremity of the legs at the outset.

Of course all three forms of scabies may co-exist.

3. *Eczema or Nettle Rash.*—Between the two there is a great difference; in nettle rash the onset of the eruption is sudden, and it usually invades a large surface of the body at once, and although more or less prurigo may accompany the rash the other features are sufficient to distinguish it, putting aside its evanescence. Then again, on pulling at the hairs on a small nettle-rash papule it is found that several are easily detached, they are not "glued" together by solid serous exudate, and their removal leaves an irregularly oval or somewhat

circular bare moist epiderm from which the epithelium has been partially removed.

4. *Ringworm (Tinea Tonsurans)*.—At the outset of this disease ten to twenty hairs occupying a small circular patch are matted together at their base ; they are easily removed, when they expose a *flat*, pale, moist surface. There is no minute papule, and no pruritus.

PATHOLOGICAL ANATOMY.

To find the Acari, Eggs, etc.—It has been stated in various treatises that to find the acari is a difficult matter. This is true if a search be made amongst the scrapings removed from the superficies only of one or two papules on a case showing the very earliest symptoms, *i.e.*, when there are only three or four eczematous papules to be found on the horse's body ; the reason is that they are deeply embedded in the skin, perhaps dead, and probably only their progeny in the shape of eggs are present ; but if they be present there is no difficulty whatever in finding them, or at least some unmistakable traces of their presence—a great deal depends upon the method of procedure. In very cold weather a little preparation of the horse's skin may be necessary, *e.g.*, by fomenting locally or by exercise, to render it warm before scraping ; for I have found it more difficult to come across acari in recently infected cases in cold than in warm weather—it may be that they burrow more deeply when the skin is not so warm as it is in summer, and when horse has been subjected to frequent or recent dressings, it should be scrubbed clean and left for some days before proceeding further.

The following method is recommendable : choose an infected part of the body where there is a marked eczematous eruption, clip the hair off the surface of some of the papules, and with a sharp knife scrape the tops of several of the papules, the scurf, and skin as deeply as possible, down to the derm ; and collect the scraping in a corner of an envelope for future examination. The object of scraping very deeply is to remove epithelium containing the galleries and their contents, and there is thus more likelihood of coming across adult acari than if the scrapings be superficial.

When about to examine the scrapings either with a powerful lens or a microscope, place them in a dish, such as a watch-glass, which may or may not be very gently warmed ; on the addition of more spirits of wine than the scurf will soak up, followed in a few minutes with twice as much water, a tossing of the scurf follows, which loosens the epithelial cells and parts them from any acari to which they may have been adhering. This method is, to my mind, preferable to the caustic potash one, for not only can the scrapings be examined at once, but air bubbles are dispersed, the epithelium is rendered transparent, acari, eggs, etc., are much more readily seen, and the material can be treated subsequently as one chooses without hindrance to permanent preservation.

Steeping in spirits of wine and water for 24 hours gives better results ; maceration in acetic acid is another good method for temporary work, but if it be wished to preserve any of the material the acid must be thoroughly removed.

The following remarks on the methods of examining scurf, etc., are

intended more for the use of students and beginners in microscopy. Remove some scurf from the bottom of the collecting dish or watch-glass, place it on a glass slide, and tease out the thicker flakes of epithelium with needles, then add a little more fluid or glycerine, put on the cover-glass, and examine. If it be desired to separate acari, eggs, etc., from the scrapings for preservation and minute study, the cover-glass need not be put on, but a search made without it for acari, etc., which, when found, should be gradually pushed with the needle bit by bit to the edge of the fluid, care being taken to frequently verify the position of the objects, which then may be removed with the aid of a needle to another slide. A few drops of spirits of wine should be placed on the material so collected and allowed to evaporate near some source of warmth, followed by washing and dehydration with alcohol, clarifying in any of the usual menstrua, and mounting.

On examination perhaps the first idea that is conveyed to one's mind is that the scurf is dirtier and yellower than usual, and then of the abnormal material present probably that which first attracts attention is the excreta, then perhaps an egg or two are met with, but one may have to search most carefully the scrapings of several vesicles before a single acarus is found (and then it may be hidden more or less by epithelial cells adhering to its surface) if the scurf comes from a case in the earliest stage. But acari in all stages of development, from the egg onwards to the ovigerous female, are found if the scrapings be sufficiently extensive and deep, and if taken from a number of papules covered with the eczematous eruption as well as less recently affected skin; but scurf removed only from a bare old patch may give hours of less satisfactory work.

The excreta from the acari is usually found lying on some plates of epithelium, in groups of fairly regularly elongated or oval-shaped pellets, of a yellowish-brown or greenish-brown hue.

The eggs of the sarcoptic acari are characteristic: they are extremely large compared with the size of the parasite, oval in shape, and have a rather transparent border and granular interior. During the development of the contents of an egg into an acarus the granularity gradually assumes the form of the parasite, and previous to the escape of the latter from the egg its legs and feelers can be distinctly seen through the beautifully transparent shell. The escape of the young acarus is effected by the shell splitting three-fourths of the way down its long axis to form two lips, which subsequently part to form two pieces by extension of the splitting.

It is needless for me to describe the appearances of the acari during the various stages of their life and growth, as I cannot add anything of the least importance to what has already been detailed in Neumann's "*Traité des Maladies Parasitaires*."

Extraneous Material found in Scurf.—When examining scrapings for the detection of acari and their eggs there are many objects which at first sight are apt to lead the unwary student astray, hence a short description of a few of them may perhaps prevent some one from repeating some of the mistakes the writer has made.

1. There are variously shaped bodies seen, the most common being circular or oval, of a yellow colour, having a distinct cell-wall or shell and homogeneous or granular contents, which might in a hurry be mistaken for the eggs of the sarcoptic acarus, but their small

size is sufficient to differentiate them at a glance *vide*, a, b, c, d, e, f, k, m, n, o, in Fig. 1.); besides, the most common are decidedly yellow, whereas the sarcopt egg has a transparent margin. They have been found in scrapings from healthy horses as well as those that were suffering from scabies, nettle rash, urticaria, etc.; and not being certain as to their origin or ultimate transformation I refrain from saying more about them than that I imagine they belong to the vegetable kingdom.

2. Crystals of oxalate of lime are frequently found on the skin, where they are left most probably by the urine through splashing, soiled bedding, or ground. They are easily recognised as small circular bodies with a radiate appearance running from a central spot: *vide* (g), Fig. 1.

3. In Fleming's *Sanitary Science and Police*, page 407, Vol. ii., attention is with good reason drawn to the fact that several parasites, whose natural habitat is hay, the plumage of fowls, and the coats of many pet and wild animals, are to be found on the skin of equines, but they are accidental and infrequent contaminations, cause no injury, and may be perfectly harmless. As they might be mistaken for the acari which cause scabies attention is drawn to them here.

1. Two genera of the gamasidæ: (a) *Gamasus pteroptoides*; (b) *The dermanysses* of fowls, etc.
2. (a) The trombidii, red mites or harvest bugs, which give rise to a most intense itching and might be mistaken for psoric acari; (b) *The cheyletæ* found on mouldy forage, etc.
3. The sarcoptidæ detriticoles (*Tyroglyphinæ*), which subsist on decomposing animal and vegetable material.
4. The listrophores of rodents, which are said not to cause the slightest irritation to the skin.
5. The analgesinæ, epidermoptinæ, and cytodites of birds.
6. The sarcoptes mutans, which cause scabies of the legs of fowls, and the sarcoptes lævis, the same on the body of fowls.

The Skin Lesions.—Equine sarcoptic scabies is a superficial dermatitis set up by the sarcoptic acari burrowing into the epithelium, and is marked by an eczematous eruption, with perhaps in addition lesions consequent upon prurigo. Apart from those alterations seen to have taken place on the surface of the skin of affected parts described under the heading of symptoms, many changes have taken place in and beneath that membrane. At pages 405-407, Vol. ii., *Sanitary Science and Police*, we find stated "it appears to be generally acknowledged that there is no proof that the sarcopt of the horse makes a burrow in the epidermis, as no trace of it has been discovered. This, however, may be owing to the burrow not being visible, either because of the thickness of the skin, the perpetual gnawing and rubbing it undergoes, or to the pigment which is present in the integument of nearly every horse." That equine sarcoptic acari do make burrows, and deep ones too, in the epidermis I have already had the honour of demonstrating (*vide Journal of Comparative Pathology and Therapeutics*, Vol. v., pages 131-133), although these burrows may not be visible in the living skin, it being too thick, opaque, and deeply pigmented; but they are readily seen on sections being made. We will consider now

FIG. 4.
Two eggs of the Sarcoptic Acarus.

Fæces lying upon plate of Epithelium.

FIG. 1.

Some extraneous materials found in scurf.

FIG. 2.

Section of Papule.

- a Channels.
 b Egg.
 c Epithelium raised by infiltrate.
 d Infiltrate.

these acarine burrows and the inflammatory process accompanying their formation.

The Channels (*vide* a Fig. 2). Their location is *most commonly* confined to the epithelial layer of the skin, and so deeply do the acari penetrate into it that the deeper cells of the rete malpighii are nearly always implicated in the process of channel formation. It is reservedly stated above that these canals are most commonly confined to the epithelium, the exceptions having been furnished by a very few out of a great number of pieces of skin removed, in which channels made by the acari were found immediately underneath the rete malpighii, but I think they were segments of canals running across portions of the derm intervening between two or more dips of the epithelium. The canals are far from being uniformly clean cut: in the epithelium they are most irregular in outline, and are anything but uniform in diameter throughout their course (perhaps this is owing to the yielding and resilient nature of the epithelium), and they are at many points more or less blocked up with exudate or blood extravasate. Those underneath the epithelium (luckily few in number) are also irregular in shape and have ragged walls; the tissues or cells forming the latter are almost invariably sloping away from the point of entrance to the channel, hence we judge they are made by the acari simply pushing aside the structures that lie in their course, and not by digestion of the cell elements.

Their direction in the epithelium is obliquely towards the rete malpighii, in a wavy winding or zig-zag course, and they are wider at some parts than usual.

It was noticed when describing the symptoms that there was in the centre of many of the papules a minute hæmorrhagic spot: this we find to be due to the acarus having pierced the rete malpighii and touched the vascular tissues beneath. At the site of penetration clusters of leucocytes are seen in the derm, and blood extravasate in the channel (*vide* Fig. 1. page 131, Vol. v.).

The formation of these channels is not a simple and uncomplicated process—a mere separation of the epithelial cells from their normal position to form channels—it is accompanied by effusions, exudations, and extravasations. So far as we can judge the following appears to be what takes place: first there is an infiltration of serum into the different layers of epithelial cells adjacent to and surrounding the canals formed and being formed by the acari, and it is in this way that the affected epithelium is raised above the level of its healthy surroundings (*vide* B, Fig. 3). This infiltrate affects primarily the stratum corneum, owing, we presume, to its being the least resistant, causing it to split up into flakes or layers, the spaces between which are filled with fluid (*vide* c and d, Fig. 2 and a and b, Fig. 3). Some of this infiltrate escapes through the stratum corneum and coagulates on its free surface, as noticed under heading of “Symptoms.” As soon as this transudation occurs the canals recently formed by the acari become more or less filled with coagulable fluid, and it is this circumstance which may account for the difficulty we have experienced in tracing their course accurately in many pieces of skin removed. In the earliest stage of invasion by the parasite this infiltration is limited at first to the epithelium covering two, four, or more papillæ, but sooner or later it assumes larger dimensions, especially so, if the skin

be irritated by rubbing consequent upon the prurigo ; yet the degree of dermatitis varies considerably, and cannot always be explained by the presence of prurigo. Then on the exudation becoming more extensive the stratum granulosum shares the fate of the stratum corneum in splitting up into flakes ; it thus forms irregularly-shaped spaces walled in by septa composed of stretched flattened spindle-shaped epithelial cells, which spaces are filled with an inflammatory exudate more or less rich in cells. In a former article on this subject (*vide* Vol. v. of this Journal, page 132) I stated that "one's attention is particularly drawn to :—1st the large amount of exudate and *proliferated* epithelium on portions of the free surface of the epidermis ;" this is a statement which it is advisable to retract, for on closer study of this part of the subject I cannot say the epithelium does proliferate. Again, when speaking of the exudate in the epithelium I said "These patches of exudate vary in size, and are found not only upon the epithelium but also in its substance ; they have taken deeply the stains used," etc. ; as the latter term is very vague I fear it might imply that the whole exudate is uniformly stained, but this is not so ; it is the corpuscular elements which have taken the appropriate stains deeply, not the mass uniformly. The liquid exudate poured out from the papillary vessels into the epithelium as well as into the cutis leaves, as may be gathered from the above, many of the accompanying cells lying embedded between the cells of the rete malpighii and of the stratum granulosum, but we have not found any cells of the latter penetrated by leucocytes. A point which was most striking was that the more abundant the inflammatory exudate in the epithelium, *i.e.*, the greater the pressure of fluid raising the layers of the epithelium, the more depressed were the subjacent papillæ ; in many instances they were found entirely effaced, the rete malpighii running in a straight line across the field, so that all semblance of papillæ was entirely lost.

The subepithelial exudation which accompanies the superficial exudate already noticed is that which has been causing the papule formation, and it is usually localised to the immediate neighbourhood of these papillæ situated underneath the superficial exudate ; here are found the usual accompaniments of inflammatory action of the lesser degrees (*vide c.*, Fig. 3).

The deeper layer of the cutis is, generally speaking, unaffected, the exceptions being found in cases where the animals have been rubbing themselves in consequence of the prurigo, and then we find a more or less diffuse exudation of leucocytes, not necessarily underneath or even adjacent to affected portions of the epidermis, but far removed from the seat of the lesions in the epithelium caused by the acarus.

It will be seen that the lesions described above resemble most closely those which take place in the formation of a vesicle or blister (the word vesicle has been freely used throughout the paper for want of a better), but we do not consider the two lesions exactly similar, for we believe that in a vesicle, or a blister, there is distension, vacuolation, and disintegration of some of the epithelial cells, with the consequent formation of blisters or blebs ; this is not the case in the so-called vesicle of equine sarcoptic scabies ; so far as we can make out there is simply a collection of exudate or fluid between septa or layers of epithelium, which fluid is purely an exudate from the blood-vessels of the papillæ. It may be owing to this exudate not being sudden and

very abundant that no disintegration occurs ; perhaps it is only a matter of degree.

What has just been described we take to be the usual course of the pathological process, but in a few instances there have been divergences from what we shall call the normal.

1. Two cases were accompanied by intolerable prurigo and the usual naked-eye appearances of papules and vesicles, excepting that some of the latter had been rubbed and were "raw" looking. A papule was removed from each case, and it was found that there was more than a simple and uncomplicated dermatitis, in as much as sphacelus of a few papillæ was taking place in each of the two papules. On section there was seen to be a broad band of leucocytes stretching in a straight line across the base of the papule, forming a line of segregation between the living tissue beneath and that above. Situated over about three-fourths of the segregating line were portions of two or three papillæ in a state of necrosis, whilst over the remaining fourth was an empty slit or space parallel with the epiderm, and above this slit was epithelium which apparently had been separated from the tissues beneath. It may be said that the above mentioned were not papules caused by sarcoptic acari, but it is concluded they were, as several of the sections contained portions of acari in the accompanying exudate in the epithelium ; hence it is probable that the papules were ordinary ones to start with, but were injured by the rubbing, which caused them to be partially raised by force from the subjacent derm ; and the necrosis of a portion of tissue in each was not owing to the dermatitis having been so severe as to cause rapid destruction and sloughing of the papillæ concerned.

2. We have noticed that, contrary to what takes place in sarcoptic scabies of the human being, canals have been found beneath the epithelium, though only in a few instances, and in these the channels seemed to run through only one or two papillæ, but our surprise may be guessed at when two canals were found deep in the derm of one large papule removed. Much though we may be inclined to think so, we are not justified in attributing their formation to the action of acari or some other animal ; more proof is required than the mere presence of a canal adjacent to some dead material ; however, the fact of canals having been found in such a position may be a guide to some worker in the field of skin diseases. The papule mentioned was removed from a severe case of sarcoptic scabies ; and previous to its excision the skin had been scrubbed with soap and water, and all exudate removed from its surface. Its summit was not acuminate, its base was broader than that of the ordinary papule, and it felt as if more deeply seated *in* the skin than the ordinary sarcoptic papule. It was fixed in a 5 per cent. solution of perchloride of mercury, washed, hardened in iodised alcohol, embedded in celloidin, and cut. In a series of sections two distinctly separate and wide canals could be traced running through the epithelium in a *straight* line downwards for a distance of about one-twelfth of an inch into the derm, each then turned sharply at a right angle and ran along in a wavy direction parallel with the epithelium for a distance of a third of an inch, and ended somewhat abruptly. Closely adjacent to the termination of each channel was a large mass of leucocytes and young connective tissue completely enclosing some dead material, which by

the inflammatory action around was evidently being pushed on its way towards the epithelial surface above. In the canals nothing but a few unknown crystals were seen; and it was amazing to see how the shafts of hairs in the course of the burrow had been turned aside or cut through and distorted into all sorts of figures, how sudoriferous and sebaceous glands and ducts had been incised; and yet in spite of all that there was extremely little, in fact, scarcely any inflammatory exudate or extravasate bordering the channels. We do not promulgate any theory as to what caused these channels or what the pieces of dead encapsulated material were, for the simple reason that nothing was found to give any clue; and supposing the channels, for such they must be called, were made by acari, why is it that no trace of excreta, etc., could be found?

There is a record of nests of eggs having been found beneath the skin in an article in the *Veterinary Journal* for 1886, Vol. xxii., page 16, on "Scabies in the Camel," by Mr Haslam, who says "occasionally the disease is so violent that the acari are found in the muscular and subcutaneous tissue of the abdominal walls. I have also found nests of eggs in bloodless, dead muscular tissue." We can realise how difficult to be overcome this disease must be if the female acari deposit eggs underneath the epithelium, and if they be afterwards hatched. But are they hatched there? Certainly in the burrows formed in the epithelium of the horse acari, eggs, excreta, and crystals are found, but nothing having the least resemblance to an acarus or an egg has been found in any of the subepithelial channels, which is matter for consolation to those who have to treat and eradicate the disease.

It is said that it is only the female acarus which after impregnation burrows, and that she dies at the end of the channel she has made, after she has deposited a certain number of eggs. These are points which we have found most difficult to verify or confute as occurring in equine sarcoptic scabies, because when sections of an affected piece of skin had been made it was impossible to distinguish whether sections of acari were those of a male or female. Some simple method of investigation will require to be adopted, perhaps such as collecting a known number of male and female acari, placing them on a piece of skin which may be kept moist and at a temperature of about 90° F. for a certain length of time in an incubator, and subsequently finding out what has become of each.

I have not had an opportunity of examining sections of skin which had been affected with long enduring scabies, and so cannot describe the pathological alterations which have taken place when it has become corrugated and thickened.

TREATMENT.

As the appearance of one case of scabies in a stud is usually a precursor of others, steps should be adopted at once to check any further spread of the disease by every means in our power, at the same time bearing in mind the probable necessity of keeping all apparently healthy horses at work. To obtain this end in view, after having put aside the affected horse for treatment—in quarantine—it is necessary to treat all the horses in the infected stable, to disinfect,

i.e., to apply parasitocides to the stable walls, partitions, etc., not forgetting saddlery, harness, blankets, stable gear, grooming kit, and wagons; and if the men who groomed any of the horses in the infected stable, or if the horses themselves, have been moved to other stables, remedies should be applied to the occupants and everything in these latter stables as well; in addition a system of thorough inspection of all the horses as frequently as possible should be carried out. Of course people will say this gives a lot of trouble and perhaps unnecessary annoyance, but it must be acknowledged that it is better to "nip the disease in the bud" than to allow it to get a good hold by infecting two or three horses in different stables. We all know it is rare to get a single case of scabies in a stud where one man grooms several horses, or where horses are groomed by different men daily. The system of treating cases as they occur without taking necessary precautions to prevent the spread of the disease is much to be deprecated.

The treatment of affected horses should be preceded by clipping all the body most thoroughly, excepting the mane, forelock, and tail, unless in a very few or perhaps neglected cases, followed by singeing, and it is advisable to carry out these operations in some enclosure the floor of which can be wetted, and where the wind cannot blow the hair and skin *debris* about; it is also recommended that the hair be collected and burned where it fell in preference to carrying it about previous to burial. The clipping machines should be steeped periodically, at least after each horse is clipped, in a strong solution of some anti-parasitic, *e.g.* petroleum, benzin, naphtha, turpentine, tobacco juice, etc., in case they are used on a healthy horse, as otherwise they might convey the scurf containing the eggs of the acari to other horses. Clipping is a most necessary aid towards the cure of this form of scabies at all seasons of the year, because dressings, especially those made largely of oil, reach the skin much more readily, and thorough cleanliness of the coat can be afterwards obtained. It is surprising how many horses in an infected stud will on being clipped show signs of the disease which were not detected previous to the clipping; or it may be found that a larger surface of the skin is involved than was suspected; perhaps in place of four or five papules felt before the horse was clipped twenty or more are found when a good view of the short coat is obtained.

A separate stable must be set apart in which the affected animals are to be treated, and men, stable utensils, grooming kit, etc., must be kept apart in that stable; there must be no interchanging of the men, no free and easy system of taking anything whatever from the stable in which affected horses are kept for use in one occupied by healthy horses.

After having been clipped and singed the whole body of the horse is smeared with a mixture of soft soap and water, and the greatest of care should be taken that not an inch of the body escapes—the parts apt to be missed are the skin of the mane, forelock, tail, groin, and intermaxillary space—and this liquid soap may with advantage be left on for two or three hours. The subsequent treatment may differ slightly from that of some practitioners, but nevertheless it is strongly recommended with the greatest of faith in its weight towards a cure, and with the well-founded belief that when it is thoroughly carried

out half the battle is won ; the same amount of trouble in obtaining cleanliness of the skin may not be so necessary in the psoroptic scabies, but I am convinced that without most thorough cleansing of the skin sarcoptic scabies does not yield readily to treatment, no matter what the dressings applied are made of. Get rid of the scabs, the tops of the eruption, and in this manner many of the acari and their eggs and the disease is partly cured by hygiene alone ! We must not trust to medicine only ; let it be cleanliness first and remedies afterwards.

After the soap has been on the body two or three hours (not twelve to twenty-four hours as some French authors recommend, for we have found that the soft soap we obtain in England blisters many horses if it be left on the skin that length of time) the horse should be sweated, either at exercise by lounging or by being ridden with an empty sack on its back—if so, the sack should be afterwards soaked in some powerful parasiticide or be boiled—instead of a saddle ; in fact, make the animal sweat somehow, open the pores of his skin, as is the saying, by Turkish bath, fomentations, or some other means ; then lather him from head to foot, using hot water, the addition to which of bicarbonate of potash aids materially in softening the skin. During this lathering scabs, scurf, crusts, etc., should be carefully and diligently removed with the aid of the finger nails, or even a scraper or curry comb in some cases. This is a portion of the treatment which must be thoroughly carried out, no matter the trouble or time spent upon it, as it is one of “the secrets of success” in the cure. Now the body should be sluiced clean with warm water followed by cold, scraped, dried with the aid of cloths—which latter must be treated as infective—and then the horse should be lounged or exercised until thoroughly dry. The above method of cleansing the skin may be repeated twice or thrice if necessary before the anti-parasitic remedy is applied—it all depends upon how scurfy and dirty the coat is.

The horse when clean is now ready for being dressed with an anti-parasitic remedy ; and that should, if possible, be selected which, so long as it remains on the body, will destroy the acari it is brought into contact with, if at the same time it does not blister the skin, or raise such a scurf in a few days as to form an impediment to subsequent applications, and that is to be hailed with pleasure which leaves the skin in a soft pliant state in addition to fulfilling the above desiderata. Whatever dressing is used, too much care cannot be exercised in rubbing it most thoroughly into every part of the body surface ; simply smearing on will not do. This is a portion of the treatment that should not be left to the men to do as they please, for in our experience the best of stablemen leave some parts of the body untouched ; the washing and dressing should be done under the eyes of some one who can be held responsible, for preference the veterinary surgeon. Few remedies beat the old-fashioned time-honoured dressing composed of oil of tar, sulphur, and oil, with or without the useful addition of bicarbonate of potash ; next comes in value in our eyes a solution of Jeye's perfect purifier (Jeye's Fluid), as weak as $1\frac{1}{2}$ ounces to a gallon of water ; next, chlorinated lime solution (3 ounces to the gallon of hot water), then Little's Sheep-Dip, and Helmerich's or sulphur pomade (sulphur 2 parts, bicarb. of potass. 1 part, lard 8 parts). Many others are extolled and are no doubt most excellent, *e.g.*, solution of tobacco, the liquid refuse of

tobacco factories, stavesacre, and a solution of creosote (viz., creosote 1 pt., spirits of wine or water 10 pts., and oil or lard 25 to 40 pts.).

M'Dougal's Sheep-Dip has been lauded as a dressing for mange. No doubt it may be an excellent dressing for sheep when affected with certain skin eruptions, or for parasites which do not burrow into the epithelium, but from my experience of it in South Africa (where perhaps it had not a fair chance, the horses being exposed to the sun), and during an outbreak of sarcoptic scabies in 1892, I shall in future hesitate before using it, and shall prefer some other remedy for the disease we are considering to that one which raises such an obstinate scurf some days after it has been applied; there appears to be something in it which is irritating to the skin when invaded by sarcoptic acari, and the subsequent scurf raised forms a stronghold for the progeny of the acari; the scurf was difficult to remove, and cases dressed with this did not progress towards recovery as others to which different dressings had been applied. I found on examining scurf removed from horses which had been dressed three or four days previously with M'Dougal's Dip not only eggs in all stages of development, but also immature acari. I was astounded when I came across the acari, and at once thought the dressings were not strong enough, or that they had not been properly rubbed in, but found on further investigation that it was neither the fault of the strength of the applications nor deficient rubbing-in. The eggs can live in the dressing, their shells appear only more condensed, but their inmates are still "to the fore." This fact gave me a hint as to the most effective method of dressing, namely, oft-repeated *weak* dressings with parasitocides, so as to destroy succeeding progeny, aided by removal of all scab and scurf by washing.

If oily dressings be applied they should remain on the skin for four or five days before removal; it has been found to be a good plan to daily rub into the skin that portion of the dressing which comes to the surface of the hairs; but the use of fresh dressing daily raises on the skin of many horses an objectionable scurf. Oily dressings should be made up with the blandest of oils, for the reason that the skin has already been sufficiently irritated or inflamed by the acari, the oil being intended simply to soften the cuticle and to prevent other reagents injuring it; and they are to be preferred as a rule to watery solutions, as they penetrate the cuticle better and leave, if weak, the skin softer and more pliant. The strength of the dressings should vary according to the sensitiveness of the skin and the temperament of the horse, because some stand stronger applications than others, and some horses are made to show signs of prurigo with dressings which the majority do not mind in the least; but these peculiarities are few.

A most thorough and careful rewashing and redressing should be resorted to, the coat should be thoroughly scrubbed with soap and water, then sluiced and scrubbed again with cold water, followed by scraping and lounging to get the body warm—a procedure which may be repeated daily for three, four, or even six days, *i.e.*, until nearly all semblance of scab and scurf disappears, and then when the coat is fairly clean the dressing may again be applied. And the weaker these dressings are the better, provided they are just sufficiently strong to

kill the acari, as the skin will then remain soft, and less after-scrubbing will be required; it is a mistake to use strong dressings.

There is a certain condition of the skin in which we meet with large swollen areas, resembling urticaria but differing from it in being moist or "weeping" and very tender; it is caused usually by the soap not having been thoroughly removed from the skin by the washing and hosing; it need not create any alarm, for although the skin involved is very tender, and if a large surface be implicated the horse is stiff and sore, it is easily rectified by the application of weak lead lotion and frequent hosing with cold water; of course, the redressing with parasitocides must be in abeyance until the skin becomes healthy again.

To effect a cure of these old-standing, so-called chronic, cases of scabies, in which we meet with a tough pachydermatous skin, accompanied or not by prurigo, and in scrapings from which it is said no trace of an acarus can be found, is a matter of long continued most careful and assiduous sweating or fomenting, combined with frequent sluicing with cold water, scrubbing, and washing to soften the cuticle and to get rid of the scurf.

Full rations should be given, as the horses soon fall off in condition once the disease has obtained "a good hold;" but no bedding or moss litter should be provided—they do quite well with nothing but the bare stone floor to stand on, on which sand may be sprinkled freely to prevent slipping; nor should they be blanketed, but if the latter be imperative care should be strictly observed to boil them several times after removal from affected horses, and to replace them with fresh clean blankets the same day on which they are dressed.

Disinfection of the stables by scraping the walls, mangers, hay-racks, partitions, etc., and washing with a strong solution of chloride of lime must not be forgotten, as also disinfection of the affected horse's appointments. We cannot quite understand how it is that one dressing cures sarcoptic scabies, as we have heard some people say, and some French authors assert; perhaps it is that they consider the disease as cured because no itching has appeared after the first dressing. It is questionable and very much open to doubt if one dressing can cure this form of scabies with absolute certainty; in our experience the majority of the animals affected have had to be dressed at least twice or thrice, not necessarily before the itch, if there had been any, disappeared, but before they were considered safe or free from the disease, the convalescence being marked by the growth of "downy" hair on the implicated portions of the skin; even then the disease has been known to break out afresh on the same animal at some spot distant from or close to the primary seat, not as a result of contact or cohabitation with affected horses, for there had been no chance of contagion being conveyed, but as a result, we imagine, of re-infection, probably by eggs unhatched previous to the last dressing giving origin to acari. As a result of this experience, it was found advisable to place horses after they had been apparently cured in stables set apart for their special use (convalescent stables), so that they would not mix with the healthy horses, where they were retained for at least two months, and from which they did their work daily. During this period they were dressed once a week with some parasiticide in a weak watery solution, their saddlery, accoutrements, and

blankets were disinfected twice or thrice, the stable periodically disinfected—all of which means of disinfection were carried out at one and the same time, and the grooming kit was steeped in a strong solution of chloride of lime once daily.

Means of Prevention.—Conjointly with treatment of the affected, means of suppression of any source of contagion should be adopted, and that which is to be recommended is clipping each stableful of horses, scrubbing them with soap and water, followed by dressing with a weak solution of some parasiticide; each part of the leather-work of the saddlery may be washed with hot water, and the animals' blankets and such like steeped in a watery solution of a parasiticide, or boiled (in the latter case it will be advisable to remove temporarily the leather-work); at the same time most thorough scrubbing of every part of the stables with hot water and a solution of chloride of lime, assisted if necessary by scraping the walls, mangers, and hay-racks; and the grooming kit should be steeped daily in an anti-parasitic remedy; the bedding of the cleansed stables should be burned, and if considered necessary no fresh material used for three or four nights. The above process of disinfection may be repeated as considered necessary.

Inspections.—On the occurrence of a case of scabies every horse in the stud should be most carefully and systematically inspected as frequently as possible (once a day if that be practicable), to detect any horse showing symptoms in the earliest stage. An error will be committed if grooms or any such person attending to the horses be trusted to report cases, because the majority of such men will bring to the notice of veterinary surgeons only cases that are well marked or show signs of itch; if we mean to suppress an outbreak we must get hold of the cases in the earliest stage.

HÆMOGLOBINURIA OF THE HORSE.

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To the opening volume of this Journal I contributed an article on Hæmoglobinuria (Azoturia) of the Horse, in which I discussed at considerable length the then prevalent views regarding the pathology of the disease, and described my own observations regarding its lesions. At that date the view generally held regarding the nature of the disease by veterinary surgeons in this country was that which found expression in the article on Azoturia in Professor Williams' text-book of Veterinary Medicine, that is to say, the essence of the disease was supposed to be "a hyper-nitrogenous condition of the blood and system generally, due to over-feeding and want of exercise; the excessive secretion of urine and excretion of urea being physiological results due to the presence of effete products, metamorphoses of nitrogenous food in the blood."

In the article above referred to I contended that this view of the pathology of the disease was erroneous and even absurd, and I showed that while there was no evidence that there was a constant or notable increase of urea in either the blood or the urine, there was easily