

would be even closer. In other parts, such as the skin of the back and certain areas on the arm and on the thigh, the touch spots may be separated from each other by oval areas measuring about 10 cm. (4 in.) along the major axis, and about 6.5 cm. (2½ in.) along the minor axis. As a rule the touch spots bear a close relation to the hairs on the skin. Where these exist, the touch spots radiate from the point at which the hair comes to the surface, and are grouped most thickly on the side away from that to which the hair slopes. On hairless parts of the body they are also grouped around central points. The hairs are important factors in exciting the end-organs which are connected with the sensory nerves. They act as levers, and thus magnify the stimulus. Their sensory functions in some of the lower animals is very marked, as in the case of the whiskers of a cat.

The nerve endings for touch are stimulated by unequal stress on the ridges of the skin. If we plunge our finger into mercury which has the same temperature as the finger, we do not feel the mercury on the submerged part, though it is under considerable pressure. We only feel it at the surface, and if we move the finger up and down, the sensation is like slipping a ring on and off. This is because the liquid fills the crevices between the ridges of the skin, and makes equal stress in all directions.

The smallest observable pressure varies with the different parts of the skin, due largely to the structure, and hence the greater or less pressure it takes to deform the ridges. Touch is the most delicate of the skin senses—a pressure of less than 1 mgm. (about gr. ¼) may be perceived. With delicate stimuli a push (pressure) or a pull (traction) produces the same sense of touch, and to the same degree (von Frey). Tactile and pressure sensations obey the Weber-Fechner law, that is, the intensity of the sensation varies (approximately) as the logarithm of the strength of the stimulus. Nerve endings are necessary for the true perception of touch. If the exposed nerve be touched, pain is the only sensation perceived. A stimulus too weak to excite the exposed nerve is sufficient to excite the tactile end-organ in the skin.

Our ability to locate the point touched varies greatly on different parts of the body. This sense of locality is often called the "local sign" (Lotze, Wundt). Two compass points 65 mm. (2½ in.) apart, if touched simultaneously to the skin of the back, would be felt as one point. On the tip of the finger they would be recognized as two points when 2.3 mm. (¼ in.) apart, and on the tip of the tongue at half this distance. In using the aesthesiometer to test impaired cutaneous sensibility in nervous diseases, we commonly employ this method.

The question as to whether specific nerve endings exist for the various cutaneous sensations is an old one. It existed before our present knowledge of mapping the skin was thought of, but with that knowledge it assumed a greater importance than before. After mapping out the areas on portions of their own skin, some observers (Blix, Donaldson) had these pieces of skin cut out to see what nerve endings correspond to the respective areas, and many investigations have been made on human skin from the cadaver, to determine the kind of end-organs which are distributed more or less in the same way as the various sense spots. The result of all this work has been to throw considerable light on the subject, but it would be premature at present to say that any definite end-organ had been identified beyond doubt as the specific and exclusive nerve ending for a given cutaneous sense. According to von Frey (quoted by Bowditch): "The free nerve endings are sense organs for pain, the end-bulbs for cold, the terminal coils or networks for heat, and the tactile corpuscles for pressure sensations."

The evidence from clinical study and from pathological lesions is clearly in favor of the assumption that there are specific nerves for the different cutaneous sensations, and that these have pathways in the spinal cord and centres in the brain, which are not identical. Cases are recorded (especially of lesions of the cord) in which one

or two of the cutaneous senses was lost while the others remained. There seems to be a tendency for touch and cold, and for heat and pain to be retained or lost together, though this is disputed. In the brain the fibres, which are concerned with cutaneous sensations, are found to run to the optic thalamus, the corpora quadrigemina, and parts of the cortex. The cortical centres are not sharply localized, but are probably much scattered. They are supposed to be located principally in the limbic lobe (especially the gyrus fornicatus) and among the motor areas in the Rolandic region.

GENERAL CUTANEOUS SENSATIONS.—*Pain, Muscle Sense, etc.*—By muscle sense we mean the sense of weight or tension which we feel on lifting a weight. Muscular fatigue is also, probably, a modification of this sense. Muscle sense is generally considered with the general senses like pain, sexual sensations, etc.; the paths of its nerves and its cerebral centres are closely allied to those for the cutaneous senses of neighboring regions. These general senses are distinguished from the special ones by the lack of sense of locality (local sign). This is especially marked for pain. The pain may be referred to a spot widely remote from the point of irritation. Again we may interpret as pain something which apparently has to do with a totally different sense, as headache from eye strain. Pain was formerly thought to be due to excessive stimulation of any special sense, but stimulation of the optic nerve gives no pain, and touch spots are found where a pin may be thrust in without producing any sensation but that of pressure. On the other hand, there are pain spots where a pin causes pain, but no sense of touch. In spinal diseases pain may be lost, and yet touch and temperature sense (especially cold) remain. In some cases pain may be inhibited at will, probably by suggestion (hypnotism). This, of course, involves the receptive centres rather than the nerve endings in the skin.

In discussing the relation of stimuli on the surface of the skin to the various nerve endings, Sherrington gives the following apt figurative illustration:

"The surface of the skin is found to be a mosaic of tiny sensorial areas. . . . The individual fields may be reduced to mere 'spots.' Each of these 'spots' is found to subservise a specific sense—touch, cold, warmth, or cutaneous pain. Each doubtless coincides with the site of some sensorial 'end-organ' or with a tiny cluster of such. Rather, indeed, than to a mosaic may the skin be likened to a sheet of water wherein grow water plants, some sunken and some floating. An object thrown upon the surface moves the foliage commensurately with the violence of its impact, its dimensions, and with their propinquity to its place of incidence. Where the foliage grows densely, not a pebble striking the surface but will meet some leaf; and beyond that or those directly struck, a number will be indirectly disturbed before the equilibrium of the surface is re-established."

George T. Kemp.

SKIN-GRAFTING.—Since the appearance of the last edition of this work no noteworthy advance has been made in the subject of skin-grafting. The method devised by Thiersch has in this interval come into much more general use, not because it has been improved upon, but simply because with the lapse of years its transcendent merits have received a wider recognition. There is still room for improving the technique in the direction of taking grafts of larger size and more expeditiously. Some mechanical devices with these ends in view have appeared, but they are as yet so inadequate as not to deserve special mention. The chief value of the Thiersch method of skin-grafting lies in the fact that it prevents the deformities that would result from the natural healing of the wound by granulation and the subsequent contraction of the scar. A second advantage, in some cases one of extreme importance, lies in the fact that even very large surfaces may be healed promptly.

The grafts consist of shavings of the superficial por-

tions of the skin removed by a razor, and are applied so as completely to cover a wound surface which is free from granulations and presents only normal tissues. A special dressing is applied. The grafts adhere, and by the end of two days they are receiving blood from their new site. The formation of granulation tissue ceases, the wound is healed, and no contraction takes place. A soft, pliable integument is provided, of good vitality and well able to withstand the wear and tear to which a cutaneous surface is exposed. In removing the grafts, the razor does not cut deep enough to include the hair bulbs. No hair will grow from the grafts. Grafts from a hairy thigh may be planted upon the face or hands without fear of transplanting hairs.

This form of skin-grafting has a very wide sphere of usefulness. Where there is extensive loss of skin in the vicinity of a joint, as may follow a burn or other injury, it will entirely prevent cicatricial limitation of motion. Similarly, where the healing of a wound by granulation would result in a distortion of soft parts, it will prevent the deformity. Large areas of malignant disease may be freely removed and rapid healing secured. Thus, extensive areas of tuberculous skin may be dissected off, leaving a healthy wound surface, and the defect covered at once by grafts. Cancerous breasts may be radically removed, regardless of flaps, and the large raw surface, consisting of fat, muscle, and periosteum or bare bone, all covered by a good integument. A thick graft contains a sufficient supply of anastomotic vessels to allow the graft to bridge over a slight interval, independently of nutrition from beneath. For example, after a burn involving the outer half of the little finger, causing superficial necrosis of the bones and opening the first joint, the author applied rather a thick graft so as to bridge over the interval from bone to bone and close the joint. The graft retained its vitality perfectly, and the joint is neatly closed and capable of a little motion. Congenital deformities which could be relieved by making an incision, drawing the edges of the skin apart and covering the wound surface with integument, can be remedied by this method. In cases in which scar contraction has already caused deformity, the scar tissue should be freely and completely excised, the parts brought into their natural position, retained by splints if necessary, and then the wound covered by grafts. If the faulty position has not caused grave damage to the deeper structures, deformity can be relieved and lost function restored. In short, Thiersch's method of skin-grafting finds application wherever it is desired to interpolate an area of soft and healthy integument and normal tissues can be provided for its reception.

Certain details of the operation are of the first importance. The excellence of the results obtained and the extent of surface that can be covered in a given space of time depend much on the skill and experience of the operator, but the operation is not a difficult one, and no surgeon should hesitate to undertake it.

The following is a condensed description of the technique which the author has chiefly used:

As was said above, the surface to be grafted should be one of normal tissues. An operative wound usually needs no preparation for the reception of the grafts. A granulating surface may be washed every other day with soapsuds and with sublimate solution and dressed with iodoform gauze saturated with balsam of Peru, until it presents a smooth, firm, and red surface. Preparatory to operation it may be dressed with sublimate gauze. If the patient has syphilis, it is well to give iodide of potassium or mercury for a week or two before operating; otherwise the grafts are liable to perish.

If there is freedom of choice as to the place from which the grafts shall be taken, the thigh should be chosen. The day before operation it should be shaved, scrubbed with soapsuds and with 1-to-1,000 sublimate solution, and wrapped in sublimate gauze. Shortly before operation it should be washed again with sublimate solution. Time will be saved at the operation if two sublimate towels are applied as follows: Let the lower

edge of one come below the knee, wrap it round the limb, and secure its lower border by a sublimate gauze bandage round the knee; let the upper edge of the other towel encircle the thigh as high as possible and secure it similarly by a bandage. When the second towel is turned up and the first down, the thigh is at once exposed and is neatly bordered by sublimate towels. Wrap the thigh in wet sublimate gauze, and secure the towels over it.

Select a razor ground flat on one side. It is well to be provided with two. The edge must be very keen. For scraping away granulations, any instrument with a blunt edge will serve. Cicatrized borders can be removed by the Volkmann scoop or the knife. A probe aids the fingers in nice adjustments of the grafts. A pair of rough bathing mittens are a help to the assistant in getting a proper grip upon the skin. The mittens should be boiled or baked before using. The razors may be soaked in five-per-cent. carbolic solution for fifteen minutes and dipped in salt solution before being used.

During the operation the only solution to be used is one of sodium chloride of the strength of 6 parts to 1,000 of water. This is the so-called "physiological salt solution" and does a minimum of damage to the grafts. A large tin-pail of this solution should be boiled for an hour, and then kept at blood heat by being set in a vessel of larger size and surrounded by water which is kept lukewarm. At the operation four sterilized bowls should be filled with this solution, one for the hands, one for sponges, one for gutta-percha strips, and one to receive the grafts as they are cut.

Prepare strips of gutta-percha tissue three-quarters of an inch wide, and long enough to reach across the wound and lap over on each side. These should be washed with soap and water and with sublimate solution and placed in salt solution before being used. Sublimate gauze and sublimate gauze bandages should be wrung from salt solution to serve as the inner dressing. Sponges should be taken from carbolic solution and wrung out in salt solution for use.

Much depends on the position of the patient on the operating table. Build up the table by pillows placed beneath the body and head, and a smaller prop under the foot, so as to elevate the patient half a foot above the table, and allow the thigh to form a bridge, and thus be readily got at from all sides. If the surface to be grafted is on an extremity, it should be suspended vertically, in order to check hemorrhage and to permit of free handling without altering the position of the limb.

Unless the operation is a very trifling one, and in a patient of especially good endurance, ether or chloroform should be given.

This operation is performed not with antiseptic, but with aseptic, precautions. The field of operation must be sacredly guarded from the ingress of germs. The hands must be scrupulously disinfected with soap and water and with sublimate solution, and the operative field surrounded by bichloride towels. The first step of the operation is to remove any abnormal tissues. Granulations may be scraped away and cicatrized borders cut away or removed by the Volkmann scoop. Then wash with salt solution and apply at once a compress of gauze. Bind it on, or have an assistant maintain the pressure. Next throw back the towels from the thigh, take off the gauze, let an assistant grasp the skin with both hands and draw it tense transversely. Place the thumb of the left hand on the tense skin at one end of the thigh, to make a little longitudinal tension, and apply the razor to the skin at a moderate angle. Make a short sawing motion, and at the same time increase the angle at which the razor meets the skin until the edge bites into the skin and begins to raise its upper portion. This angle is then maintained, and with the continuance of the short sawing motion a graft is cut whose length is limited only by the length of the thigh. The tough corium is of great assistance in preventing the razor from cutting too deep. In width the grafts will vary from half an inch to two

inches, according to the locality from which they are taken and the skill of the operator and his assistant. Very wide grafts may be got from the comparatively flat surface over Scarpa's triangle. As fast as cut, the grafts should be dropped into a bowl of salt solution.

The manner of cutting the grafts is illustrated in Fig. 4301.

In about ten minutes oozing will have ceased, the compress may be removed, and the grafts applied. It will be found that they have curled, with the cut surface inside. To uncurl them, place one end on the surface to be grafted, uncurl it, and keep it uncurled by pressure with a finger of the left hand. The whole graft may now be uncurled by making a rapid to-and-fro motion with a finger of the right hand, and carrying it along the entire length of the graft. The graft is now flat upon the surface and can be moved about with the fingers or probe. The grafts should be made to meet or overlap each other, and also the surrounding skin. Over-

lapping does no harm, for the superficial edge of a graft will die from lack of nutrition and come away, leaving a mere line of union visible. If not enough grafts have been cut, more should now be cut and applied directly. When the whole surface has been covered, douche it gently with salt solution, and apply the gutta-percha strips in the following manner: Lay one end upon the sound skin at one side of the wound and secure it by a thumb, then, with a winding motion, lay the strip across the wound and out upon the sound skin beyond. In this way the strip is laid on without in any way disturbing the grafts. Let the next strip slightly overlap the first. Continue imbricating each upon the last till the whole surface is covered by the tissue. If the surface is on an

extremity, take a wet gauze bandage and apply a snug spiral to hold the tissue and grafts firmly in place. Next apply damp salt gauze, a sheet of gutta-percha tissue to maintain the moisture, sublimate gauze, cotton, a bandage, and a splint suitable to the region. The surface from which the grafts have been taken may be covered with gutta-percha tissue and moist gauze. This is a particularly comfortable dressing, but any simple dressing will answer.

It is advisable to change the dressings every two days for the first eight days. At the end of six days the gauze had best be allowed to dry, by omitting from the dressings the sheet of gutta-percha tissue. This will obviate too great maceration of the horny layer of the grafts, and fit them sooner to withstand the wear and tear of exposure. At the end of ten days the gutta-percha strips are no longer needed. If there are any spots of granulation from faulty adjustments of the grafts, they had best be covered with yellow adhesive plaster. If the surface is uniformly covered with grafts, it needs

only to be protected for a few days by a piece of cloth spread with lanolin or vaseline.

To illustrate the value of Thiersch skin-grafting, the citation of a single case in which it was particularly called for and achieved its fullest function will suffice.

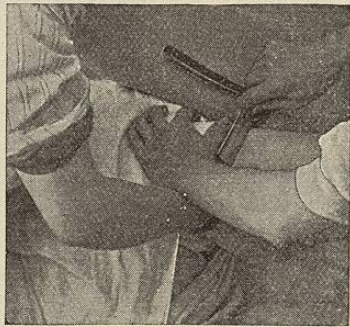


FIG. 4301.—Taking the Grafts.

In August, 1889, C. A., a girl, aged twelve, met with an injury by which a very large skin flap was torn from about the right knee. It involved the inner side of the thigh, knee, and leg, and extended outward beyond the ligamentum patellæ and crest of the tibia. In the following November I grafted the surface. Her general condition was poor, and I did not think it wise to continue anesthesia long enough to cover the large area completely; a portion was only partially covered with grafts, and intervening spaces about half an inch wide were left to cicatrize. In four weeks healing was firm. The limb had been in splints for more than a third of a year, and, when they were

left off, there was scarcely any motion at the knee. A cylinder of cloth, stiffened by a covering of oiled muslin, was spread with vaseline and suspended about the limb for a few weeks to guard it from harm. Exercise of the limb was encouraged, and occasionally moderate force was used to aid flexion. In March, 1890, the knee came to a right angle, and she was able to go upstairs one foot after the other. Freedom of motion became progressively greater until it was as perfect in the right knee as in the left, and the limb as useful as before the injury. The accompanying figure (4302) is from a photograph of the case taken in May, 1892, and shows how the grafted area offers no hindrance whatever to complete flexion.

Theodore Dunham.

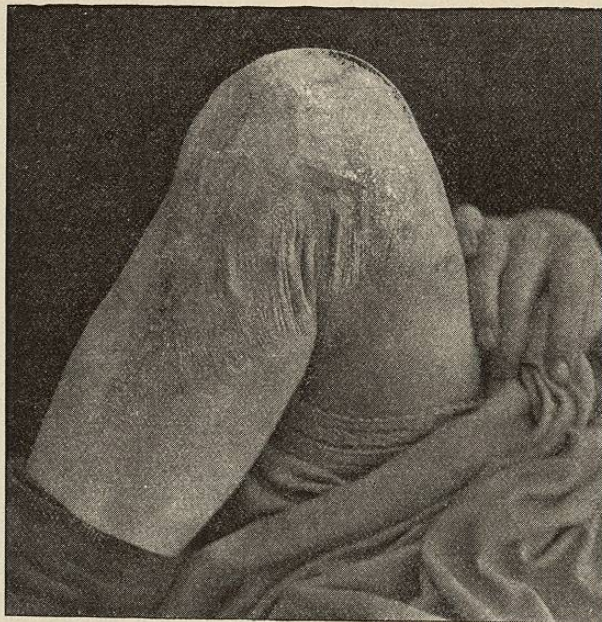


FIG. 4302.—Shows the Condition of the Knee (in Case C. A.) in May, 1892.

toses. Although it is not unlikely that future investigations may yet place some of the toxtituberculids in the list of cutaneous tuberculosis, they should not at the present time be so regarded.

As in tuberculosis situated in other parts of the body,

SKIN, TUBERCULOSIS OF THE.—The discovery of the tubercle bacillus by Koch has had two effects on modern dermatology. One is the formation of a new group of dermatoses in which actual proof of the existence of the organism has been furnished according to the laws of general pathology, and the other is the attempt at reconstruction in the disturbed pre-existing dermatological classifications. This second effect has in turn caused another group of diseases to appear which in contradistinction to the true tuberculosis of the skin have been called toxtituberculids. The group is a large one and includes lichen scrofulosorum, erythema induratum, lupus erythematosus, lupus pernio, and certain rare derma-

three methods are known by which a lesion may be recognized as tuberculous. (1) The recognition of the tuberculous granuloma which consists of new-formed connective tissue and giant cells, and which is sufficiently characteristic for diagnostic purposes. (2) The actual presence of the bacilli. (3) The test by inoculations of guinea-pigs with the suspected tissue. Briefly speaking, all the cutaneous diseases which have up to the present time been identified by either of the last two methods as tuberculous have all contained the tuberculous granuloma, and those diseases which have from time to time been regarded as of possible tuberculous nature on clinical grounds, and which have not contained the specific granuloma, have failed to give positive bacteriological results in the end.

While there are a few other rare affections which might be added, roughly speaking, true cutaneous tuberculosis may be classified under five heads:

- (1) Tuberculosis verrucosus cutis.
- (2) Tuberculosis cutis orificialis.
- (3) Tuberculosis disseminata.
- (4) Lupus vulgaris.
- (5) Scrofuloderma.

I. TUBERCULOSIS VERRUCOSUS CUTIS.—(Synonyms: Verruca necrogenica; Lupus verrucosus; Lupus scléreux [Vidall].)

This type of cutaneous tuberculosis was first well described in 1886 by Riehl and Paltauf. These authors gave a description of the histology of the lesions and identified the bacillus in cases inoculated from diseased animals. They also showed the similarity of their cases with anatomical wart, and since the publication of their paper the two affections have been classified together.

Verruca necrogenica, or anatomical wart, consists in a lesion due to the handling of dead bodies, and is due to direct inoculation from this source. Its favorite site is on the back of the knuckles, and consists of the occurrence of pea-sized warts, which are extremely chronic in their course. They are apt to be fissured and pigmented, and at times become crusted from superficial infection and pustulation. The typical lesion of tuberculosis verrucosus cutis has slight clinical differences. Its favorite site is the back of the hand and forearm. The lesions start as small ovoid warty patches which extend peripherally at an extremely slow rate until they involve considerable areas of the skin. Associated with the warty development are often papules of a dark purple color and more or less hyperemia of the skin. The surface is apt to be moist and crusted, and pus can usually be expressed from between the warty excrescences. The central portion may undergo involution into the scar-like atrophic skin seen in an old lupus case. True ulceration does not occur, but involvement of the lymph glands draining the area is not infrequent. As rare sequelæ may be mentioned infection of the lymph channels with the formation of tuberculous nodules which break down and form ulcers, and the extension of the disease to the lungs.

Etiology.—The known sources of infection are the sputum of phthisical subjects and infected meats. As regards the first, mention may be made of children who in creeping around the floors of hospital wards have become infected on the front of the knees, direct infection during ritual circumcision, and cases of auto-infection in phthisical subjects. Infection from meats occurs in cooks, butchers, handlers of hides, and in those who have charge of tuberculous cattle.

Pathology.—In these lesions the tubercle bacilli exist in larger number than in lupus vulgaris, but they are less numerous than in tuberculosis cutis miliaris. They cause less reactive connective-tissue growth than in lupus vulgaris, and the corium is not completely filled with the granulomatous development. The papillæ above the infiltration are enormously hypertrophied in height, and if seen without the underlying tuberculous corium they cannot be distinguished from many other warty growths. In this type the tuberculosis appears as a linear infiltration quite unlike the nodular appearance of lupus vulgaris,

but both giant cells and cheesy degeneration are always present. In cases that have been infected from without, small abscesses and cocci can be noted in the superficial portion of the section, but they have no pathological value.

Diagnosis.—Small anatomical warts may at times be distinguished with difficulty from simple warts, especially if the history of the patients does not show the mode of origin. In such cases excision of a piece for diagnostic purpose is justifiable, and will clear up the diagnosis. The larger types of verrucous tuberculosis somewhat resemble patches of chronic eczema, but they can usually be differentiated by the fact that eczema is harder and less friable, instruments do not easily penetrate the lesion, and there is never any tendency to the formation of scar tissue in eczema.

Treatment.—The indications for treatment do not differ from that of other forms of tuberculosis of the skin. The overlying hypertrophic tissue should be removed by instruments and the tuberculous tissue thoroughly scraped away with the curette or destroyed by caustic applications. Strong salicylic-acid plasters repeatedly applied have been recommended for the removal of the excessive epithelial growth. These in turn have to be followed by some caustic, as acid nitrate of mercury. This method is especially valuable in lesions of large area in which it is desirable to treat small portions at a time, but it has the disadvantage of being painful.

II. TUBERCULOSIS CUTIS ORIFICIALIS.—(Synonyms: Tuberculosis cutis vera; Miliary tuberculosis of the skin; Tuberculosis ulcerosa.)

This form of cutaneous tuberculosis is due to the secondary involvement of the skin either by contiguous extension from tuberculosis of the mucous membranes or by an infection from a contaminated discharge of a remote tuberculosis of the viscera.

In the beginning the lesions consist in a number of miliary tubercles. These rapidly coalesce and break down, the resulting ulcer forming the typical lesion of the disease. The main characteristics of the ulcer are the same as those of tuberculous ulcers situated on the mucous membrane. The floor is made up of indolent reddish-yellow tuberculous tissue in which the single miliary tubercles are apparent, if they are not covered up by a superimposed development of granulation tissue, and the edges are, as a rule, rather irregular in contour. The compactness of the tuberculous tissue and the superficial nature of the ulceration allow of only a thin purulent discharge, which may or may not result in the formation of a crust. Generally there is little pain. The course is slow, although more rapid than that of lupus vulgaris. Although cases have been reported to have healed by cicatrization, nearly all the ulcers show no tendency to improve, but gradually spread by peripheral extension.

The regions commonly affected are those of the mouth, anus, and genitalia. Kaposi has reported twenty-two cases, and has added much to the accepted knowledge of the disease. He states that the condition is not of extreme rarity, nor is it confined to advanced stages of tuberculosis of the lungs or other viscera.

Treatment.—Treatment consists usually in palliative methods, as dusting with iodoform or applying antiseptic solutions, but little hope can be entertained of a cure of the lesions without destructive interference with the base of the ulcers.

III. TUBERCULOSIS DISSEMINATA.—In this class are included the rare examples of tuberculosis which show a general cutaneous distribution. Very few cases have been reported, but they are in sufficient numbers to demonstrate the possibility of tuberculosis becoming disseminated by the circulation. The diagnosis in the cases reported by Pelagatti and others was confirmed by pathological findings. Most of the patients were young children, but the lesions do not seem to be identical. At times the eruption is unusually acute for a tuberculosis, and consists in the formation of papules, pustules, and vesicles in which the bacilli can be demonstrated,