Animal Grafting.
Its value in Practical Surgery.

F. V. Darwin M.B., C.M. 1874
In dealing with a subject so wide, and one about which so much has been written, it will perhaps be found more convenient if we study Animal-grafting under two distinct headings. We will therefore in the first place examine "grafting generally," a section which will include those cases where the graft may consist of an organ, or of a part of an organ, or of any part detached from the human body, and then we will pass on to the study of Skin-grafting. It will be found that the latter process is the one from which Practical Surgery derives the greater benefit.

**Grafting Generally**

**Definition.** Paul Bert, the eminent French physiologist, says, "Grafting occurs whenever a portion, completely separated from the body of an animal, is afterwards re-placed in such a position that it will continue to live as if its nourishing relations had never been disturbed. The temporary isolation of the separated portion deprived of those vascular ties which nourish it, its being reduced to depend for a time on its own resources, its certain death if the isolation last long enough, its renewed existence on replacement, the re-establishment of its nutritive connexion, and life
momentarily threatened rendered safe, all these are characteristic of grafting. The graft, he continues, must have surrounding connexions and must be supplied with that plastic lymph which is poured out on the surface of wounds; it must become an inherent part of the individual, must take part in the same physiological phenomena, and must perform the same functions as did the part removed when it was intact.

The graft may be an accidental section which, placed in its former site, renews its former connexions and entirely or partially preserves its original function; this may be called "simple replacement," in contrast to that modus operandi where the graft is taken from another part of the same individual or from another individual of the same or different species.

History. The origin of animal grafting is lost in the past, but we can believe that "simple replacement" dates far back, and it may have occurred to some unfortunate individual who seeing a portion of his body cut off instinctively restored the separated part to its proper place. The old writers are silent on the subject, and we must go to India in order to find the operation carefully described and successfully performed by the medical men there. De Graafe
says that the priests in India "frowned the practice of medicine and that from the most distant date they performed rhinoplastic operations. But, be it that the priests invented the operation or that they robbed the secret from specialists, it is none the less true that for ages its practice was the particular privilege of the boorhaus or potters who displayed as much skill in its performance as they did in the pursuit of their own vocation. It is said of them that in their practice they often used skin detached from the buttock of the patient or of another individual, and that they were skilful enough to be able to restore noses which had been nearly cut off.

Many centuries elapsed before the operation found its way into Europe, where at first it met with but little encouragement. In spite of the successful results which were published by a few foreign surgeons, and in spite of the observations published by W. Balfour in Edinburgh in 1814, "On adhesion with two cases demonstrating the power of Nature to reunite parts which have by accident been totally separated from the animal system," the most eminent surgeons of the first half of the nineteenth century continued to doubt the possibility of the success of such an apparently hopeless operation. Dieffenbach, a Berlin Surgeon,
failed in all his cases. He says: "If grafting be possible in man it must be borne in mind that union is not so easy in the human being as it is in the lower animals. In fact, plastic forces decrease as we ascend the scale of organised beings; it is considerable in plants and the lowest animals, detached portions of which are able to exist and become new beings, it diminishes greatly in cold-blooded animals, and further still in those of warm blood until it scarcely exists in man."

We now know that this theory is a fallacious one, and that the want of success which gave birth to it was due to the very inefficient manner in which wounds were dressed in those days.

So many successful cases of grafting have been published, both at home and abroad, during the last thirty years, that an operation, so simple in itself and one from which so much benefit can be derived, ought to be more extensively performed than it is at present.

Experiences on Man.—Mr. Bérenger-Férand, in the "Gazette des Hôpitaux" 1870, published some very interesting statistics of numerous researches and detailed accounts of 224 cases of the successful reunion of organs, or of parts of organs, which had been more or less separated from the human body.
The authenticity of some of these cases is doubtful but the majority bear the well-known names of Garengot, Chelias, Regnault, Renzi of Naples, and Hoffacker of Heidelberg.

Regnault mentions a case of complete division of the ear in which the parts were not readjusted some hours after the accident and where union took place, the wound healing by first intention. Garengot relates a case of division of the nose in which the divided portion, before being replaced, was contused and dirty having been trampled upon.

Erichsen says that Hoffacker was officially appointed to attend as Surgeon at the duels which were at no time frequent amongst the students at Heidelberg; and, as at these encounters broad-swords were used he had an opportunity of seeing a considerable rum of incised wounds, and has related no fewer than sixteen cases in which portions of the nose, lips, chin had been sliced off, and, being put on again contracted adhesions. Amongst the most remarkable of these, is one in which the end of the nose was sliced off by a cut with a broadsword and fell under a chest of draperies; it was not found for some time, but, on being recovered and washed, was stitched on, and became firmly attached. In another instance, a dog was in the room and snapped up the detached portion of the organ as it fell to the ground.
but the nose, being immediately taken out of the animal's mouth and put in again, became firmly fixed. To give an idea of what Nature can do, and does do, in these cases, it will suffice to read what did occur in twenty-seven well authenticated cases in which fingers had been more or less completely divided. In all these cases, the records of which have been most carefully examined by M. Pérenger-Terrand, the bones, tendons, dermis, and epidermis recovered life; sometimes all these parts recovered their original integrity, while on other occasions the reintegration was partial. The epidermis always suffered more than the dermis, and whenever the nail was included in the divided portion it invariably came away. It would seem that during the time the cutis vera, separated temporarily from the sources whence it derives its nourishment, had set itself to create new vascular attachments it had been unable to nurture its protecting covering the epidermis: and this layer deriving, as it does, its supply by a true process of imbibition had withered up, as if it had been a foreign body. It was only after the cutis vera had recovered its functional activity that it commenced to secrete the new epidermic cells destined to cover it. The new nail was often deformed, having fissures or nodosities, or it adhered only to the borders of the matrix. The divided portion was often without feeling for a long time, but
recovered its sensibility after a few days. The finger remained ankylosed when the section had taken place in a joint, at other times it recovered its functional integrity. Healing often took place by first intention, and at other times an extensive suppuration tended only to create a better cicatrix. The bones were united by a callus similar to that thrown out in case of fracture, but most frequently they were partially or completely eliminated. In these twenty-seven cases the ages of the patients ranged from infancy to forty-five years.

F. George Martin of Paris in a pamphlet which was published in 1873, gives the records of numerous cases where separated portions of the human body had been successfully readjusted. The following are the most interesting:

1. Successful re-formation of a nose with a piece of skin taken from the thigh after being cut off, performed by Professor Burger of Marburg.

2. First phalanx of the middle finger completely divided by a chair-cutter; readjustment in four and a half hours after the accident; complete cure in five weeks, the finger retaining all its movements: performed by Dr. Henry Bailey, Norfolk.

3. Complete division of the upper lip and nose by a cut; restoration with sutures thirty-six minutes after healing by first intention in eight days; performed
In 1855 a young man had his thumb completely severed just above the second phalangeal articulation, three hours after the accident. The thumb was replaced by Malgaigne. The patient was doing well but on the eighth day he was seized with tetanus; on removing the splint an incomplete but solid adhesion was discovered. The patient subsequently died of tetanus.

In the "Gazette des Hôpitaux" of 1875, Dr. Bourcetgoum of Montrechard published the following interesting case. A labourer aged fifty-six had the knuckles of the middle and ring fingers cut away by machinery; on arriving at the Doctor's house each wound was found to be about two centimetres long and one and a half broad. The man was sent back for the pieces. About a quarter of the nail remained on the piece belonging to the ring finger was removed; to the piece belonging to the middle finger was attached a portion of bone about the size of a lentil; this was also removed. The pieces were then soaked for a few minutes in lukewarm water and replaced, being retained in position by strips of sticking plaster. The wounds healed by first intention excepting a portion of that in the middle finger which corresponded to the piece of bone which had been removed. Thence, two months after the accident the cicatrices were scarcely visible, and the fingers were as useful as ever.
Experiments on Animals.— In 1863 Paul Bert published a memoir in which he gave detailed accounts of numerous experiments performed by him on rats. He took the tail of one rat, deprived it of its cutaneous covering, and placing it under the skin of another rat obtained union. Varying the experiment, he subjected the tail numerous experiences, such as placing it for some time in a glass tube, exposing it to various temperatures, putting it in contact with different liquids and gases, and after all these changes he invariably obtained union. This gentleman also performed what he called the "Seamane graft," by which he soldered two rats in complete a manner that a drug or reagent administered to one animal was found to produce exactly the same effects on the other.

In November 1869 Vulpian presented to the Biologica Society of Paris, from the part of Dr. Philipaux, a rat in which a grafting of spleen had been successfully performed. This gentleman introduced inside the abdomen of this rat the spleen of a young cat twenty-five days after the spleen had been twelve millimetres long, four broad, and three thick. Three months and six days after the grafted spleen was found to be of the same color and to present the same appearance as the proper one; moreover it had increased in volume being now ten millimetres long, nine broad, and four thick. A deep surface small afferent and efferent vessels
could readily be seen.

In this experiment the graft had been made from one animal to another of the same species, and so far did not disprove the law laid down by Paul Bert, Legros and others, namely "that grafting will not succeed unless practiced on animals of the same or very near species."

But in December of the same year Vulpian showed to the same Society and in the name of the same gentleman a tooth grafted successfully on the crest of a cock.

The experiment was as follows. M. Philipeau having made a small opening in the crest of a young cock placed in it the incisor tooth of a guinea pig a few hours old. The tooth was complete, was provided with a bulb, and was placed in such a manner in the crest of the cock that the bulb lay on the bottom of the wound whilst its free extremity faced the exterior. When planted the tooth was eight millimetres long and two in diameter. The bird was killed ten months afterwards, and it was then found that the tooth which in its insertion had been completely hidden in the wound now projected five millimetres, and that its entire length was thirteen millimetres.

In the Hunterian Museum there is a preparation of the testicles of a cock completely adherent to the belly of a hen, where they had lived for a long time.
without losing size. Hunter says that he has planted on the crests of the gallinaceaum race human teeth immediately after they had been extracted, and that they always contracted from adhesions, while careful injection showed him the existence of vascular connexions between the transplanted teeth and the crest.

Vitality of the Graft. This may be defined as the power which allows a part completely separated from the body to continue to perform, after being grafted, the organic vital evolutions which, before being separated, it was capable of discharging.

Vitality has been shown to exist in certain tissues for a long time after the death of the individual, and probabilities therefore are much greater of its persistence in a part removed from a living organism. It will be advisable in studying the vitality of the graft to consider in the first place the anatomical structure of the graft, secondly the conditions relating to the solution of continuity, and finally the surrounding influences which may affect the graft.

I. The success of the operation of grafting greatly depends on the anatomical structure of the graft; we know cætedis pannus, the simples and more vascular texture the better will adhesions be formed. Never experience has proved that almost all tissues are capable of being successfully transplanted.
partilaginous, and tendinous textures continue to lie and to enjoy all their vital properties after transplantation. Others, however, disappear little by little; thus the muscular fibre loses its fibre and is reduced to its cellular sheath, or it becomes converted into fat, and the nevus fibre presents the successive phenomena of degeneration and ultimate disappearance.

Paul Bert's experiments on the tails of rats showed that this complex structure, which is composed of oesos, cartilaginous, muscular, and fibrous tissues, continued not only to lie under the skin of the animal on which it had been transplanted, but also to grow with the same rapidity that it had previously done. In fact, not only did these tails grow but they became susceptible to the same pathological processes as when in their normal state. For instance, fracture of the tail, after it had been completely attached under the skin, united by the throwing out of callus not differing in the slightest from normal callus. The muscular tissues invariably became atrophied, either disappearing, or becoming converted into fat.

In man after completely separated fingers have been readjusted the same process has been shown to take place; but it must be acknowledged, however, that the operation here is but rarely successful in toto, the bone being as a rule entirely or partially eliminated. There are three distinct and well-marked stages in
The existence of every graft. In the first stage the graft is separated from the body to which it belongs, and subjected to the influence of external surroundings; the second stage it is sheltered from these influences and is immediately bathed by the "plasma" form put around it; the third period marks definite admission within the new organism, whose blood enters into direct communication with those of the grafted part.

II. The circumstances relating to the solution of one of the graft depend on the manner in which the skin has taken place: the part may have been cut clean by a sharp instrument, it may have been cut away, may be by means of the teeth, or by having been jammed in by a door violently shut. One would be inclined to believe that in the latter cases where parts are more or less contused and shattered the chances of union would be greatly imperilled, and yet numerous observations prove that complete success has followed readjustment under such circumstances while on the other hand numerous failures have occurred where the section has been clean and regular. Contusion is no doubt an unfavourable contingent, but irregularity of surface is not of much material importance. The great desiderata are to make adjustment complete and then to keep it so. It is of no use facing the cut surfaces firemin
bringing them together, with the intention of rendering them
level and regular, and thereby facilitate union. Anato-
mists have taught us that the human body, and in
fact the whole animal kingdom affect but little, if at all,
geometrical forms; level surfaces specially are rare. Union
will take place equally as well when two surfaces are
engrained one with the other, as when two level surfaces
are brought into contact; always providing that no vacuum
exist between the two opposed surfaces into which few,
impurities, or air can enter.

III. The surrounding influences which may affect the graft
are various. We know that fermentation and animal de-
composition take place more readily, in a temperature rang-
ing from 80° to 100° above zero; in lower temperatures decom-
position, though possible, is much retarded. When one removed
from the organism the graft rapidly gets into equilibrium
with the temperature of the atmosphere in which it may
be placed; and considering the smallness of its volume
will, unless removed, speedily succumb to the influence
of that temperature. The length of time during which the
graft remains separated from the body is of the greatest
importance, and it will readily be believed that the longer
it is transplanted, the greater are the chances of success.
The duration of isolated existence which will destroy the
chance of success cannot be definitely stated: grafts
surrounded with corings, as shown by Bert, have been
successfully transplanted in animals after seven days,
violation, while skin and cutaneous grafts have taken as
twenty-four hours after separation. In summer or in warm
climates the separated part preserves its vitality for a short time only, a delay of a few hours will prejudice success. Paul Bert certainly succeeded in grafting tails
of rats which, placed in glass tubes, had been exposed
for five or six minutes in a stove where the tempera-
ture was over 180°, but these experiments were made in glass
covered with a covering. They will not succeed so well
in a graft which, instead of being completely warmed
with vitriol, has only one surface, and
often a very limited one, by which fluids may enter
and in which vascular connections may be estab-
lished as in those cases of sections of noses, ears, and
fingers. A low temperature, on the other hand, is opposed to
organic decomposition, and tissues thus protected can
survive for a long time their fitness for being grafted.
Bert proved, in his wonderful series of experiments,
tails of rats and strips of skin are capable of adhering
after being exposed for many hours in ice, or even
a refrigerant mixture many degrees below zero.
If the temperature plays an important part when
graft is in a state of violation, it plays no less
important role after the transplantation has been com-
pleted. Experience has proved that cold applied
subsequently to the operation always acts favourably,
promoting union, and, in many cases, has been
The
means of preventing a gangrene which was rendered imminent by the turgescence of the graft. Fresh water exerts a beneficent influence if the immersion of the graft continue long enough, and if the temperature of the water be high.

These experiments furnish us with indications for the style of dressing to be adopted, and for the plan of treatment which ought to be pursued after the operation of grafting has been performed.

After treatment. — The following is the method which according to Paul Bert has yielded the best results.

The opposing surfaces, having been freed from blood and other impurities, ought to be brought in apposition as quietly as possible. For cleansing the parts a weak solution of carbolic acid and water will be found very useful. After the bleeding has ceased, and to effect this it will often be necessary to ligist or tie some vessels which otherwise would not only bleed for a long time, but which might give rise to a secondary haemorrhage that would be certain to break down any slight adhesive already effected between the two surfaces; after the haemorrhage then has ceased the adjustment of the parts ought to be immediately proceeded with.

This is best effected by using small strips of diachylon plaster, or by means of sutures; and of these two methods the one which can be the more easily applied, and which
by bringing the two surfaces into the closest possible contact is more likely to give good results, is the one that ought to be employed. Great care must be taken that the deeper portions of the wound are brought well together so that there be no pulling outward, no compression and no derangement—complete immobility and immediate adjustment being the chief sources of success.

If secondary haemorrhage does occur, the bleeding point must be looked for and ligature, torsion, compression employed to arrest the flow of blood. Chloride of iron or any such coagulating agent may never be employed, as these always play the part of free bodies, and destroy all chances of union by first intention. If the bleeding arise from the graft itself, as long as it is not abundant, it need not be arrested, but care must be taken however that the blood does not infiltrate the deeper portions of the wound.

When all haemorrhage has ceased, and after the sutures have been applied, the edges of the solution of continuity must be cleaned and carefully dried; using for this purpose very fine sponges or lint which has already been used.

Over these edges a layer of gutta-percha must be extended in order to prevent the admission of air or of septic germs; this layer will at the same time produce uniform and gentle pressure.

The whole should now be covered with a few layers
of cotton-wadding kept in position by a bandage carefully and
lightly applied; remembering that this wadding is not in-
tended to produce heat but that it is used to prevent
the pressure of the bandage being felt.
During the first few days the wound must be ex-
amined twice every twenty-four hours. If the strip be
found turgid, livid, or congested, as will often occur
the nose has been grafted, compresses soaked in a mixture
of alcohol and water must be applied; leeches will be
found useful, keeping them on the organ until it assumes
its normal colour.
At the end of forty-eight hours or a little later, according
to the progress the case may have made, and according
to the appearance of the wounds, some of the stitches can
be removed; the greatest possible care being taken not
to disturb any adhesions which may have already been
formed. If all goes well, and no complications have ar-
isen, it will be well at the end of four or five days
to increase the amount of wadding in order to obtain
greater heat around the graft. For if at first the graft,
having then no vascular relations with the organism;
require cold in order to preserve its vitality, later on,
when these relations are established, a certain amount
of heat is imperative in order to facilitate the circu-
lation and thereby help the nutrition of the graft.
Liquid or solid topical appliances are useless, if not
hurtful: the dressings must be of the simplest.
After a few days union may take place in the wider extent of the wound; at times, however, a part of piece or less extent not having adhered primarily remains patent, this must be treated as a common wound and attempt made at healing by granulation. Cases have occurred, especially in ambulance practice where a nose or an ear has been replaced by the same organ taken from a man who had just been killed, and several authenticated cases of this kind have been reported.

II. Skin Grafting

It will be more convenient to divide the study "skin grafting" into two sections, considering in the first place, grafting where the entire thickness of the skin is transplanted, a process which may call "dermic grafting"; and secondly, the cases where the epidermis alone is employed, this may be called "epidermic grafting." Under the first of these headings we will also scan some very interesting cases of transplantations of mucous membranes, which have been lately performed and which have yielded magnificent results.


Dermic Grafting

History.—The accounts of the first experiments in skin grafting are very vague, cases indeed have been reported as far back as 1705, but of so marvellous a nature that their authenticity may well be doubted. It was not till the commencement of this Century that Baronio of Milan, Meismann of Leipzig, Dieffenbach of Berlin and others, attempted grafting experiments on animals; and of these all excepting Baronio and Dieffenbach met with little success. In his “Medicine Operativa” published in 1839, Velpeau mentions numerous cases of restoration of organs which had been accidentally separated from the body, and he expresses a conviction that the operation is perfectly possible; but he deems the cases of heteroplastie surgery which had been previously published, not believing that persons could be found willing to part with a nose, ear, or whatever might be required to complete the operation.

In a thesis published by M. Lanthelae of Montpellier in 1848, he affirms that the loss of certain parts of the body could be restored by two distinct operative methods: one, “autoplastie,” in which the required portion is taken from the individual himself, and the other, “heteroplastie,” when another individual makes the loan.

In a communication on “Cicatrization of wounds by grafting”
which appeared in the "New York Medical Gazette" of August 1870, Professor Frank Hamilton says that in 1854 he proposed to a patient with a large ulcer of the leg transplanted on the same a cutaneous strip from the thigh, and that a graft of from two to three centimeters square was to have been used. The operation here was performed for some reason or other was not performed. But in 1854 this gentleman performed his first attempt on a patient who, owing to an accident, had lost a large quantity of skin from the leg, leaving a large one. Fifteen months no cicatrization whatever had taken place in this large wound, but after grafting it held up in nearly days.

In the "Gazette hebdomadaire" of 1872 M. Defurt of Paris had practised, in February 1870, a cutaneous graft on a granulating surface in order to fill up a loss of substance in the eyelid of a patient, and thus prevented the formation of an ectropion.

The latter operation has been successfully performed in this country by Lawson, Wolfe, and others; in France by de Meckler; in Austria by Holmvolh; and in the countries by the leading surgeons. The methods for operating have been multiplied, every having his own plan. Some graft cutaneous strips on a granulating surface with or without previous removal of the cellular tissue in the deep surface; some employ a single strip of skin, while others divide the strip in
Experiments on Animals. The complete and satisfactory performance of these experiments is extremely difficult, besides, the only tangible advantage derived is the possibility of repeating and performing them as often as we wish. Moreover, it does frequently happen that it is impossible to place animals in similar conditions to those which in man gave indications for the operation, and so, be the experiment successful or not, we will learn nothing that will help us in our practice on man.

From numerous experiments, chiefly performed on the Continent, we will select the following:

Lantilhac, in a thesis published in 1848, records two grafts of rabbit on rabbit, both of which were successful, while two of dog on dog were both failures.

In 1863 Paul Bert had one graft of cat on cat, one of cat on cat, and one of cat on rabbit, all being successful.

Mr. Armagnacq, in a thesis published in 1874, had two on dogs, both failed; four on rabbits, one failed; and seventeen successes out of twenty-one grafts on guinea-pigs. This gentleman says, "In experimenting on grafting it will be found that the presence of a small layer of loose cellular tissue placed between the graft and the wound is not so injurious as has hitherto been supposed; in fact, this tissue, though but slightly vascular, is far from being inert, and it is in the intimacy of its mother..."
"that the phenomena of nutrition and of inflammation (which is simply a hypernutrition) take place. "The soldering of the grafts is effected by the interposition of an embryonic texture in which the cells at first are round, but they soon push out prolongations, and these become entangled with each other from a growing tissue, which helps to keep up the cohesion between the surfaces. These new cells are also produced on the surface of the wound, but here the graft has only a feeble hold. "If this cellular tissue which lies on the deeper surface of the graft be removed or meddled with, adhesions "not take place so readily, if at all. "If a junction has taken place between the vessels of the graft and those of the wound, cells must have a "present to create this union. Where do these cells come? "What is their mechanism? It may be, however, that "gaping orifices of the capillaries in the graft receive "by a process of imbibition the nutrient fluids poures "out from the surface of the wound, and this may be "to maintain the vitality and nutrition of the graft "and moreover to form the tissue destined to fill it "a definite and fatal manner."

The graft ought never to possess any adipose tissue. Know that the adipose emulsion, though not exactly pathological one, is one which nevertheless is scarcely stationary, often undergoing anatomical changes, frequently disappearing entirely.
Experiences on Man.——These may be divided in the first place into three cases where the cutaneous strip has been taken from man, either from the same or from another individual; and secondly into three cases where the graft has been taken from an animal.

We will call the former "autoplastic," and the latter "zoo-plastic" grafting.

Autoplastic Grafting.——By means of this operation it is intended to supply a loss of substance, a loss which may be the result of a wound, of a burn, of an ulcer, or of any such cause; or it may have been produced by a surgeon when endeavoring to remove certain structures contracted by previous cicatrices or by harmful adhesions, as for instance in cases of ectropion, of webbed fingers, of Canerum cruris, etc., etc.

In the majority of these cases the graft has been taken from the individual himself, from a region less conspicuous, and where the laxity of the skin supplied without any inconvenience the portion required.

But in some cases the graft has been taken from another individual, who for love or money gave the portion required. And, again, at times the graft has been taken from an amputated limb, or from a tumour, or even from a body recently dead, and the union has been the same in all circumstances.

In the "Gazette Hebdomadaire" of 1872, LeFort published the
following case. After operating on an old man aged 62 for the purpose of curing an ulcer in, a large granula\nbose was left, and it was plain that unless covered with skin borrowed from somewhere this area would cicatrise cause a return of the ulceration. Accordingly he removed a cutaneous strip from the inner aspect of the patient's forearm, and after paring it to the size required it was placed on the wound. The graft was kept in place by means of a piece of gauze heated and collodion, no sutures being used. The success was complete, and within a month afterwards a slightly deeper cicatrization of the grafted portion was the only trace left of the operation. (Lancet, November 1870, presented to the Clinical Society in London, a case where he had successfully grafted two large strips of skin for the curing of an extensive ulceration.

In the "Wiener Medicinische Presse" of 1871, the following very interesting case was published. A woman aged twenty-seven was admitted into the Vienna Hospital suffering from a variceous ulcer, three inches long and a half broad. The ulcer was situated immediately above the nictus. During the first week emulsions of a solution of caustic potash were applied, though the ulcer became covered with granulations, there was no attempt at cicatrization. Then she had been on week in the Hospital the hand of a young man, who was in excellent health, was amputated.
disease of the wrist joint. Eight minutes after the amputation Hofmoll detached from the skin of the hand a large cutaneous strip which he placed on the ulcer, fixing it in position with great care by means of bandages and of a thin wooden plate. At the end of twenty-four hours the apparatus was raised, and the skin was found to have become thoroughly implanted, and its colour was also unchanged. On the seventh day the epidermis became detached from the strip, and the papillae of the cutis were then visible. In six weeks the assimilation of the graft with the rest of the skin was complete, and hardly any traces of the operation remained.

Sopolastic Grafting. In the impossibility of obtaining cutaneous strips from man, Surgeons have obtained them from animals, sometimes using the external integument, and, at other times, mucous membranes. The results hitherto, excepting in transplantation of the conjunctiva, have not been reassuring. The following two cases, however, gave good results. In the “Gazette des Hôpitaux” of July 1872, M. Dubreuil published a case where he had operated on an aged patient suffering from a large wound on the upper portion of the right cheek, the result of the cauterization of an epithelial ulcer in that locality. He applied a strip, three centimetres long and one broad, taken from the abdominal wall of a grey bitch: this piece of
When though too small in size to cover the entire defect of the wound prevented the formation of an eschar, also a retraction of the labial commissure, both of which accidents at one time appeared imminent. There was a shedding of the epidermis and of the hair in the first. A year afterwards, though the patient had in the interval suffered from an attack of facial erysipelas, traces of the graft remained, and the cure was a remarkably good one.

M. Cogié of Nancy communicated to the French Institute in 1872 the following instructive case. This gentleman was consulted by a man who had a large suppurating ulcer on a level with the left external malleolus. The wound, which had been inflicted by a splinter of a shell, had resisted all treatment and even epidemic grafting had failed. On the day of the operation the wound was forty-five millimeters long and thirty-seven broad. Strips taken from the skin of a rabbit were placed on this granulating area. The result at first was very satisfactory, but a few days after the operation the wound was attacked by hospital gangrene, an epidemic of that disease being then prevalent in the hospital, and for a time the ultimate result seemed imperilled. In spite of this misfortune, however, six weeks after the operation the patient was completely cured, and it was noticed that the cuticle had not been at all infected by the hospital gangrene.
Grafting of mucous membranes. It will be interesting to glance at transplantations of mucous membranes, inasmuch as their history is so closely allied to that of skin grafting. There are two classes of cases to be considered.

In the first place there are cases where grafts of mucous membranes have been applied to wounds of the external integument in order to hasten cicatrization; the graft being taken either from man as was done by Czerny of Vienna, or from an animal as was practised by Houze. Czerny, in the "Wiener Medizinische Zeitschrift" of 1871, published three successful cases where he had planted on wounds of the arm slices of mucous membrane taken from a nasal polypus two hours after the removal of the latter. He also grafted with success a slice of the uvula. In all these cases the epithelium of the mucous membrane lost its cilia, and became converted into pavement epithelium.

The second class of cases are those where the transplantations have been performed with the view of replacing analogous membranes, destroyed by burns or such like causes, and by this means preventing the formation of harmful cicatricial adhesions, and also allowing the re-establishment of the functions of the organ. The first attempts in this direction were made by Wolfe of Glasgow in 1872; his results were published in the Glasgow Medical Journal of 1873, and his example was followed by de Wecker, the eminent French Ophthalmic Surgeon.
Transplantation of the Cornea has for a long time occupied the attention of Ophthalmic Surgeons, but unfortunately the success attending the operation has hitherto not been very encouraging.

Dr. Wolfe of Glasgow, after having successfully transplanted the conjunctiva, endeavoured to extend the operation, and attempted to implant the entire cornea of a rabbit on the eye of a man completely affected with leucoma. He had hopes to cure a disease which had resisted all treatment. French Surgeons had for some years previously made attempts in that direction but, owing to the impossibility of measuring exactly the size of the strip required, failed.

Mr. Power of St. Bartholomew's Hospital presented to the Ophthalmic Society a child on whose eye he had contrived to graft the cornea of a rabbit, but unfortunately the membrane had become opaque.

This gentleman afterwards performed the same operation on a soldier, and the membrane remained transparent for six weeks. Mr. Power contented himself with taking from the rabbit a circular strip of that part of the cornea which is found entirely isolated from those neighbouring tissues whence it derives its nutrition. It has been suggested that a strip of corneal conjunctiva would give better results. In this case if the conjunctiva adhered as it often does, the small band of mucous membrane besides the advantages it presents for fixing and keeping in situ the new cornea, might suffice to assure its temporary vitality.
Methods employed in dermic grafting. The method most in vogue amongst French Surgeons, and which has given most satisfactory results elsewhere, is the following. Always select a region where the skin being loose and movable will allow of a fold being easily lifted, and let the chosen region contain the smallest possible amount of adipose tissue, and likewise let it be devoid of large veins. The upper and outer anterior surfaces of the forearm and of the leg will be found to be the most suitable regions. You may plug or cut the selected part, or apply a pencil in it for a few minutes, in order to cause an influx of blood to the graft, and an accumulation in it of that nutritive material which will nourish the graft for that period of time during which, whilst waiting for its new vascular connections to be established, it has to depend on its own resources.

The temperature of any part which has been whipped is at first lowered, and it is only after an interval of some minutes that it again commences to rise. This interval, generally lasting from eight to ten minutes, must be allowed to elapse before severing the graft. With the thumb and index finger of the left hand lift up a fold of skin which, after that retraction which invariably follows removal, making the graft rise about half its extent, will be sufficient to fill up the gap. Transect this fold right through the centre with a razor-bladed bistoury, and divide it from its attachments; free the strip from any adhesions
tissue it may contain, and immediately apply it on the required surface.
This surface must previously have been thoroughly cleaned of all impurities, pus, ointment, or foreign bodies; if it be a bleeding surface remove all clots and stop all oozing.
It is of the utmost importance that the edges of the graft and those of the wound be brought into the most intimate relation. Having effected this, cover the whole thing with gold-healer's skin, and over it place a layer of gutta-percha, in order to entirely prevent the entrance of air and of atmospheric germs. Immediately over this apply many layers of fine cotton wadding in order to keep up a uniform temperature around the graft, and also to enable the maintenance of gentle pressure by means of a bandage carefully applied.
Do not lift up the wadding for four days after the operation, and then see through the gold-healer's skin how the graft is progressing, and if there be no urgent need for interference immediately replace the dressings. If the gold-healer's skin be a little loosened or lifted up by cured fluid base this out by making a small puncture which must be immediately closed with another small piece of gummed gold-healer's skin and a layer of collodion. This protecting and impermeable coat will act as an artificial epidermis, and cicatrisation will take place without any suppurative function. As in the case of cutaneous wounds, if the graft appear to be doing well do not touch the wound.
Avoid making punctures, or pinching and pulling the graft about. In fact avoid all these little manoeuvres which are employed by some people to ascertain the stability of the wound, and which often suffice to impair and destroy the success of the operation.

The graft is removed so quickly that the patient suffers little or no pain, but some surgeons recommend previous cooling of the skin by application of a refrigerant mixture of ground ice and salt.

In the fourth volume of the "Annales D'Ophtalmiques," de Metler describes what he calls "graffes en mosaique.

He lifts a thin fold of the skin of the forearm, transfixes it with a bistoury, and finishes the section with curved scissors, nearly removing successively small skin grafts which after resection measure from six to eight millimetres square. These small grafts are carefully spread on the wound with a blunt stilette.

To cover a surface of about four centimetres square, from fifteen to twenty of these grafts are required.

This mosaic grafting is very useful when it is required to cover an irregular and thoroughly unequal surface, so that in the eyelid after the operation for excision; in this case the small strips can and do adapt themselves to the convexities of the wound. At the same time after adhesion has taken place there remain none of those unsightly projections so often seen after large grafts have been used, as the linear creases between the grafts keep them in position. Moreover,
There is no sensible retraction because the thin bed of cicatricial tissue which separates the grafts has its residual action divided equally in all directions, and is attached to the sound skin whose natural elasticity counterbalances its action.

**Indications for dermic grafting.** If the cutaneous graft be sometimes employed with the intention of hastening the cicatrization of certain wounds, by shortening the duration of the treatment and by rendering the cicatrices less apparent, there are some cases where its employment is imperative. In instances, for preventing and for curing some of those facial deformities which are not only offensive and hideous to be behold, but which may disturb the functions of the eye, or even completely destroy that organ, as does occur in cases of cataract, and more specially in cases of traumatic cataract.

M. de Wecker gives the following indications for the employment of skin-grafting in Ophthalmic Surgery:

1. The graft might always be employed in all those cases of burns which, involving the eyelids or neighboring parts, give rise to those suppurating wounds the injurious cicatricies of which threatens to deform or displace the eyelid.

2. The graft may be employed with advantage in those cases of partial or complete cataract, consequent on a cicatricial retraction, occurring in the neighbourhood of the eye from the results of burns, canes, fractures, etc., etc.
(3) Grafting replaces with advantage most, if not all, the methods used in blepharoplastie surgery.

(4) The graft ought to be employed in all those cases where the eyelids have, as the result of accident or operation, undergone a considerable loss of substance, and thereby given rise to a suppurating wound.

In cases of deep burns of the entire hand grafting will be found of great help in preventing "webbed fingers," or in curing this affection if it has been already produced; where all the integument is completely destroyed or deeply affected it is the only form of plastic surgery that will do any good.

In those extractions about the mouth resulting from burns, cancerous oes, or from creatures following the removal of a tumour, grafting will greatly aid any plastic attempts; and being in itself an unsophisticated operation will do no harm if it proves unsuccessful.

## Pathology of the dermic graft

The experiments, already referred to, of Paul Bert on the grafting of the tails of rats, proved that the vascular relations between the graft and the surrounding tissues are established at the end of forty-eight hours.

Other observations have shown that in cutaneous grafting, as practiced on animals, a superficial section of the epidermis reaching scarcely to the Malphigian layer was followed three or four days after being transplanted by a slight congealing eczema similar to that produced by normal
epidermis.
In animals at the end of four or five days the cells in
the Malphigian netwok are partially softened and break
down, the intercellular substance becoming more liquid
and very granular.
The phenomena attending the adhesion of the graft
are the same as those which are present in healing of
wounds by first intention.
On making sections of grafts of from five to eight days
old, Paul Bert and Martin observed as follows.
"The tissue underlying the strip is infiltrated, so to speak
"with embryophytic nuclei, and with a few round or
"juxtaform cells, the quantity of these elements being great
"in the more superficial parts. The nuclei are all of the
"same size, and some of them are surrounded by a mass
"of protoplasm. On the part of the graft the same pheno-
"mena are observed, and the space between the two
"surfaces is filled up with similar elements."

Grafting of the Conjunctiva of the Rabbit. -- Wolfe
of Glasgow was the first who performed this operation, and
he published two cases in the Glasgow Medical Journal
of 1873.
A workman at a Cambridge Foundry had been struck
the left eye with a piece of red hot iron, which caused a
deep burn with destruction of all the conjunctiva in the
lower hemisphere of the eye, and of part of the cornea.
Six weeks after the accident the lower eyelid was completely sutured to the cornea, and its ciliary border was on a level with the upper border of the pupil; the eye was fixed, and deeply imbedded in its socket. Mr. Wolfe was on the point of abandoning all surgical interference when the idea of replacing the lost tissue by using the conjunctiva of a rabbit suggested itself to him.

On the 3rd of November he performed the operation as follows. Having put the patient and the rabbit under chloroform, he proceeded to divide freely all the adhesions until the eye regained its natural mobility; passing immediately to the rabbit he removed a large portion of conjunctiva sufficient to cover the loss of substance in the eye of the patient. This graft was kept in position by means of four threads; the eyelid was then doubled up, the eye closed, and covered with some dry lint and a tuft of a bandage. On the following day the eye presented a very satisfactory appearance, the conjunctiva was not more inflamed than usual, but had been expected under such circumstances. The graft presented a grayish appearance. On the 5th, the patient complained of a sharp pain, and there was much shedding of tears; the graft had almost completely lost the gray look, it was puffy and glistening, and in some parts of it granulations could be seen. On the 9th the inflammation had subsided, and the new conjunctiva was red and completely adherent; the ligatures were removed. The patient went out on the 11th; the eyelid was then perfectly free from all.
adhesions, the eye was movable in every direction, and the new conjunctiva had preserved its vitality as could be seen by its vascularity and its smooth and glistening aspect. A few days afterwards Dr. Wolfe made an artificial pupil, and on the 3rd of January the case was still doing well.

Professor Otto Becher of Heidelberg also had two successful cases in 1874, notes of which appeared in "Annales Oculistiques." One was the case of a young man who had had some molten zinc thrown in his eye in February 1874. When the wound healed there remained an adhesion, between the outer angle of the eyelid and the globe of the eye, occupying an extent of five millimetres of the lower eyelid, and invading the outer third of the cornea. On the 5th of June an operation was performed which gave only partial good results, as a new symblepharon remained though it was much smaller than the old one. In September a new operation was performed. The membrane bands were cut and fixed to the internal aspect of the eyelid, and to fill up the gap thus made a piece eight millimetres square taken from the conjunctiva of a rabbit was used. This graft, which almost completely filled the wound, was fastened to the conjunctiva by four very fine threads attached to each angle. The eye was kept closed by means of oozing and a flannel bandage.

In the first few days nothing uncommon occurred, on the third day a few small vessels were distinctly visible, but still the colour of the graft was clearer than that of surrounding parts. On the sixth day the picture nearest the cornea
gone way, and the graft assumed a triangular shape. The final result was most satisfactory. The eyelids were free, the eye had assumed its former mobility, the coaptation of the graft was perfect, and it was nourished by the circulatory apparatus of the eye on which it had been planted. On prickling the graft a small drop of blood oozed out, but nevertheless the transplanted portion could be always recognised by the clearness of its tint.

The operation has been successfully performed by Ophthalmic Surgeons both at home and on the Continent, and this is a proof that the success of grafting is in no way endangered by the difference in the species of the two individuals. However, it must be confessed that the region affords much material help, niemuch as the graft is kept in position by the eyelid, which moreover being very vascular and supple gives forth a gentle heat sufficient to excite the vitality of the graft and to maintain existence in an organised tissue during its detachment.

In the "Annales Oculistiques," M. de Weelker gives the following directions for performing the operation.

"After putting the rabbit to sleep separate its eyelids and extent the membrana reititans, free all the ocular conjunctiva and that of the cul-de-sac in order thus to obtain a large strip measuring from three to three and a half centimètres in length, and from one to one and a half in breadth. Lay the strip thus obtained on a glass plate placed over a vase filled with warm water, taking care to put the
'epithelial surface of the conjunctiva outside as so not to confound the two surfaces. It is only when everything is set that the eyelids of the patient should be disengaged, and the parts on which the graft is to rest pared. All bleeding being stopped the lower eyelid, if it be a case of lower symblepharon, is evaginated, and the eye pulled sharply upwards; the conjunctiva is then carefully on the wound, and by means of very fine silk ligatures the edges must the graft must be carefully joined to the edges of the wound.
To fix a graft covering the whole of the inferior cul-de-sac as well as the lower portion of the orbit no less than twenty sutures will be required, and these sutures must be left alone until they eliminate themselves. Moreover it will be found useful to put in the centre of the strip a suture which will penetrate through the eyelid. The eye must be kept closed under a bandage carefully applied, and the dressings must be removed with the greatest care.
III. Epidermic Grafting

If the original starting-point of general and of dermic grafting be obscure, that of epidermic grafting is not so. Having been first thought of by J. F. Reverdin in 1869, the gentleman being at the time an "Interne" in the Paris hospitals, the date of its invention is recent.

Having observed that the small crescentic islets, which are sometimes found on the surface of wounds, hasten their healing, Reverdin asked himself if it could not be possible to assist Nature by grafting on the surface of a wound artificial islets which might act as centres from which cicatrization would extend.

In December 1869 he presented to the Surgical Society of Paris a case where the results had exceeded his expectations, for not only had the small epidemic islets adhered to the granulations, but they soon commenced to extend, and became centres of cicatrization.

The most distinguished surgeons adopted the practice. In Paris Jaccelin, Guerin, etc., from France the practice was taken up in this country by Pollock, Ferguson, Holmes, Bryant, and many others; from England the practice passed on to Austria and Germany; Germany, a pupil of Billroth, obtained marvellous results.

Reverdin, though calling his method "epidermic grafting," employed at first a graft composed not only of the entire
thickness of the epidermis; but including as well a small portion of the cutis vera; but he says, "The latter is completely inert, and if it were possible to transplant epidermis by itself the results would be better." This statement has given rise to much controversy, and while some of Aberdeen affirms to having successfully grafted epidermis which had been obtained by merely scraping the skin, Goldie, Sé, and Reverdin have always failed when attempting this procedure.

Some surgeons think the horny layer to be inert here and endeavored to graft only the cells of the deeper layer of the epidermis, and employ a different process. Of Glasgow, in the British Medical Journal of 1871, Mr. Leck published the following case.

Having surrounded the surface of an ulcer with a film of gutta-percha dissolved in chloroform, he poured on it the serum from a blister. He affirms that in three days the entire wound was covered with a cutaneous covering.

This does seem wonderful, but we can credit it if we believe in the influence which the epidermic cells in the Malphigian network are said to have on the embryonic cells of the granulations. The process is analogous. The serum of a blister contains crowds of epidermic cells, and this fluid is moreover well calculated to preserve the vitality of histological elements. Nor, if this fluid, whose temperature and whose chemical composition render it so tolerable (that is, able to tolerate) and inoffensive to a wound, if unaltered, is h
deposited while still warm on a granulating surface of the same temperature, it will easily be understood that by virtue of their specific weight the cells entailed in this fluid will gather on the surface of the granulations, and there find themselves in the best condition for existing and in the best position for accomplishing either a metamorphosis or a special influence on the embryonic cells.

Methods used in epidermic grafting. — In the "Archives Générales de Médecine," Pierre-Adolphe Latarjet describes his process.

"With the index finger and thumb of the left hand sketch the skin from which the graft is to taken; this skin ought to rest against a receiving surface, and the outer portion of the leg is about the best to choose from. Slowly introduce the point of a lanceet, held almost flat, about half a millimeter underneath the skin, and make the point come out four or five millimeters from the place of entrance. Then by further pushing in the blade the cutting of the edges is effected on either side, and the little strip is left in the lanceet whence it is made to slide, by means of a pin, in to the wound: the latter must previously have been well cleared of all dirt and impurities. Always select a spot where the granulations form the healthiest for depositing the graft. The little strip has a tendency to curl up, but this will be prevented by moistening the point of the lanceet with water or saliva. Great care should be taken that it is the "raw" surface of the graft which is placed in the wound.
"The graft once well spread and in its place, it should be fixed by a small strip of diachylon plaster not very tightly applied, and the whole covered with simple dry dressing. The plaster must not be raised for forty-eight hours, and then great care should be taken in order not to disturb the adhesions already formed.

"If the graft has taken, it will be seen as a small white, softened, unblunted, and slightly depressed surface; and this is the state of affairs. Remove the plaster and continue the simple dressing.

"Several grafts may be used at the same time, but care should be taken that they are placed at some distance from each other, and always on healthy looking granulations; if these be not healthy, local applications for effect must be previously employed.

Mr. Pollock, of St. George's Hospital, suggests a slight modification which consists in the making of a small wound amongst the granulations into which the grafts should be placed.

Moist dressings are most injurious. It has frequently been observed that grafts which were progressing most favourably became withered and ultimately became detached on the application of carbolised and water. Mr. Juscelin of La Charité mentions a case where chlorinated water was used in the dressing of a wound which had been grafted, and where no progress was made until dry dressings were employed when the grafts began to extend, and the wound to cicatrize.
Reverdin has grafted, with success, from one individual to another, from a black to a white man; he has taken grafts from an amputated limb, from a corpse immediately after death, and also from animals. It has been observed that in syphilitic patients the grafts taken from themselves never do so well as when the graft has been taken from a healthy person. In old people, also, the grafts taken from themselves rarely succeed, but when the strip has been transplanted from a young and healthy person the result has been invariably satisfactory.

Indications for Epidermic grafting. — There is no class of wounds in which the epidermic graft may not be successfully applied.

In the Lancet of January 1871, Mr. R. W. Goldie reports a case of traumatic ulcer which had existed for twenty-eight years; it had once healed, but had been opened during fourteen years, persisting all treatment. Three epidermic grafts of the size of a pea were applied on the ulcer, cicatricial islands were shortly afterwards formed which extended themselves to the edge of the wound, and a complete cure resulted ultimately.

Mr. Dawson (Lancet, November 1870) by using a graft the size of a farthing piece cured an ulcer of the leg which had resisted treatment for five years.

Mr. Mason (Lancet, October 1870) cured two ulcers, one for three and the other for five years duration, by epidermic grafting.

The epidermic graft is of great use in those deep and
extensive burns which occurring in the hand threaten websly
of fingers; or which occurring in certain regions, as in the
neighbourhood of joints or of natural orifices, may by causing
abnormal adhesions entanglement or even destroy the proper
junctions of these parts.
In the Medical Times and Gazette of December 1870, Mr. Arnott
reports the following interesting case.
A young woman was admitted into the Middlesex Hospital
on the 13th of September, with a helicoid formation occupying the
skin from the middle line of the throat, and extending as
far as the right side of the neck. Presumably and painful nodules
had formed on the cicatrix of a severe burn which had occurred
five months previously. The day after admission Arnott excised
the diseased portions, dissecting widely the nodules and thus re-
mooving much skin.
Immediate union having failed, after waiting for the wound
to begin to granulate, Arnott grafted two pieces of cuticle,
of the size of a pea, which he had taken from the inner po-
tion of the patient's arm.
Bearing to the situation of the wound, and the consequent dif-
ficulty in keeping the parts fixed, the dressings shifted about,
and one of the grafts slipped down to the angle of the
wound where it became adherent, and rapidly incorporated
itself with the cicatrix. The other graft grew rapidly.
Seeing this success, Arnott applied two more grafts, and the
patient being now more careful in her movements, and keep-
ing the neck as quiet as possible they both took root.
On the 20th of October the whole of the surface of the wound was completely covered with a natural cicatricial tissue, supple, and on which nothing mobile could be discovered.

Grafting to a great extent prevents the contraction of cicatrices, and it does so in two ways.

Eichsen, in "Science and Art of Surgery," volume 1, says, "Cicatization advances with greater rapidity around the edges of the sore, the "centre taking the longest time to heal; in consequence of the ac-
"tivity of the process appearing to diminish the further the new skin extends from the old tissues. The new skin is formed at the edges only, and never primarily in the centre of an ulcer, unless islands of old skin be left there undestroyed to serve as centres of cicatization. It would appear to be necessary for the healing process, that granulations have some of the old tissues to be modelled upon, from the plastic force of which these "is an impulse given that causes their development into "analogous structure."

Now we know that epidemimie grafts do replace these islands of undestroyed skin, and perform their functions.

Again, Paget says: "Contraction of a sore appears to be entirely a mechanical process, and not a vital action; and is owing to the conversion of the excudation cells of the granulations into the filaments of cicatricial tissue, which being more "closely packed and becoming occupy less space."

We know that epidemimie grafts will produce only epidemimie, and this never becomes converted into contractile tissue,
Development of the Epidermic graft. According to Ravai

... and other observers the macroscopic phenomena which occur during the development of an epidermic graft are as follows. At the end of twenty-four hours the surface of the strip appears to have become whiter, thicker, puffed, and sometimes a little convoluted. At the end of forty-eight hours a very thin, small, pale grey zone is already formed around the graft, being separated from it by a thin transparent circle. At the end of a period ranging from three to four days it is possible to distinguish on the edge of the graft another zone more or less broad, and presenting peculiar characters: it is shiny, and of a deeper red than the surrounding moist granulation. Then this red zone commences to be formed; it will be noticed that the graft and its areola sink beneath the level of the wound. This zone which is red in the evening is next morning of a pearly grey colour; a new red zone is formed around it, and so it goes on increasing. A cicatricial suture is thus formed, and little by little the central parts become whiter. At the end of some days the graft desquamates, and seems to have disappeared; but if the wound be exposed to the air the strip will be brought into view, and it will then be seen that it is only the superficial layer that has desquamated. The phenomena which take place around a graft are the same as those which occur around the edge of a wound during the process of cicatrization, and which are so well described by Eichsen, as quoted above.

The graft continues to grow from its periphery by pushing...
out prolongings towards the nearest cicatrized part, and in a short time forms bridges which considerably diminish the extent of the wound. The size of the epidermic islands is limited, they are never larger than a shilling, but on a few rare occasions some have attained the size of a florin.

Histology of the Epidermic graft. — In the "Lyns Journal Médical" of 1871, Mr. Poncelet published the following as being the microscopic phenomena observed by him:

On making a section of a graft four days after it had been transplanted, and when it had become adherent to the granulations, this gentleman observed that the horny layer, whose elements are so easily detached, had become diminished in thickness. The cells in the rete mucosum had preserved their arrangement, and no sign of proliferation was to be seen among them. The superficial layer of the cutis vera had become intimately connected with the granulations, the intercellular substance of the two having become blended. The vessels in the cutis vera had penetrated into the middle of the embryonic elements, and were long anastomosed with those of the wound. Epidermic scales were visible in the Malphigian network, more frequently below the horny layer. On examining the section of a graft which had been adherent for ten days, Mr. Poncelet observed that the thickness of the rete mucosum had become considerable, and that numerous epidermic scales were entangled in it. The superficial layer of the cutis vera which had been included in the graft
had completely disappeared, and its place was now occupied by a layer of epithelial cells which were in direct continuation with the embryonic cells. Mr. Ponsor considered this to be the first stage in the transformation of an epithelial cell into epidermis. These epithelial cells he affirms to be formed by a junction of the cutaneous tissue of that portion of the cutis vera it has replaced with the embryonic cells with which it is in direct communication. He could discover no signs of proliferation in the epithelial elements.

In "Surg. Hospital Reports," Volume XIII, Bryant says that grafts undoubtedly stimulate cicatrization. He believes that the grafts grow by proliferation of their own cells, and in support of this theory mentions the case of a white man suffering from an ulcer of the leg on which he transplanted four small grafts taken from a negro. The four grafts together were no bigger than a grain of barley. In ten weeks the grafts had covalesced, and formed a layer of black skin twenty times larger than the original strip.

Pollack mentions a similar case, and holds the same theory. Reverdin and Breton have obtained white cicatrizes after using black grafts.

In negro wounds often leave white cicatrizes. Whether the epidermis be formed by a proliferation of epithelial cells, or whether it proceed from embryoplastie nuclei formed molecule by molecule, or the midst of a blastema secreted by the neighboring elements or by the capillaries, is a vexed question, and one we cannot at present determine.
In conclusion we may safely assert that grafting, and more especially, skin-grafting affords the greatest possible assistance in the treatment of wounds; and it seems strange that such little prominence has hitherto been given to the subject.

It is true that shortly after Reverdin published his researches the practice was adopted, and improved upon by some of the most eminent surgeons in this country; and we find cases and observations relating to it in the Medical journals and Hospital Reports published in 1870 and 1871. Of late years, however, we find but little mention made of the subject in medical literature. Whether surgeons have given up the practice, or whether they do not consider their cases of skin-grafting of sufficient interest to merit publication, is a question not easily answered. I am inclined to think, however, that the latter supposition is the true one. During the time that I was a student at the Edinburgh Royal Infirmary, and during the ten months that I was one of the House Surgeons at the Liverpool Royal Infirmary, I saw many cases of grafting; the House Surgeon invariably performed the operation, and had sole charge of the case.

During winter in Paris I visited the Hospitals of la Charité, la Pitié, and the Hôtel Dieu; and in my attendance on the Clinical lectures of Jaccelin, Verneuil, and Richet I heard no mention of skin-grafting, and can but presume...
in their wards in which the operation had been performed.
We cannot deny the value of skin-grafting.
Of what common occurrence is an "eclabbed leg," that bête
noue of every surgeon, and how often does the treatment ex-
tend beyond local applications? And yet cases of ulcers, of
twenty years' standing, which have resisted all treatments
and have eventually been cured by grafting, have been
published; and doubtless similar results have been ex-
perienced by all hospital surgeons who have given the
practice a trial.

How offensive to the sight, and how embarassing to
the unfortunate patients are those hideous contraction after
extensive burns! Whenever the surface of a burn begins
to be covered with granulations, and more especially if
the burn be near a joint, or about the throat and neck
the wound should be planted with epidemic grafts.
These will hasten cicatrization, and diminish the risk of
contraction.

After the removal of large tumours, leaving behind a
large surface which has no chance of healing by first
intention, the epidemine graft ought to be employed.
And we ought mention many more cases where grafting
is at least useful if not imperative.

If unsuccessful, the operation does not interfere with the progress
of the case; it is a simple and almost painless, it requires
little or no skill in its performance, and above all the ad-
vantages emergent on success are estimable.