

STUDIES IN PALÆOPATHOLOGY.
SOME RECENT RESEARCHES ON PREHISTORIC
TREPHING.

By the late Sir ARMAND RUFFER, C.M.G.

PREFATORY NOTE BY LADY RUFFER.

WHEN my husband left last winter on the mission to Salonika which ended in his death at the hands of the enemy, he left with me several unfinished works, most of which he intended to issue under the title of "Studies in Palæopathology." Some of the series had been published prior to his death in the *Journal of Pathology and Bacteriology* (1911, vol. xv. p. 1 ; 1911-12, vol. xvi. p. 439 ; 1913-14, vol. xviii. p. 480), and elsewhere.

According to my husband's instructions, I have filled up certain lacunæ in the present paper, and made various necessary alterations. He did not profess that it contained anything new, but it is a compilation of several authors' investigations into this subject, to be used as a reference.

It is perhaps, owing to the untimely death of the author, not exhaustively complete, but matter of interest may still be found in this paper of Sir Armand Ruffer's on "Prehistoric Trephining."

ALICE RUFFER.

THE facts relating to this science are scattered through anthropological, ethnological, and historical memoirs, and especially through papers describing excavations of ancient sites. The pathologist, therefore, unless in touch with anthropology and allied sciences, does not become acquainted with the latest pathological finds, and yet it is only by the patient accumulation of such observations that the science of the history of disease can be established on a firm basis. The object of this paper is to put on record, for the benefit of pathologists, observations bearing on their science made during the last few years, but which are scattered through various publications. I have added a few facts observed by myself.

RECENT OBSERVATIONS ON TREPANNING.

Trepanning the skull was an operation frequently performed in Neolithic times, especially in Western Europe, and quite lately

Baudouin (1908²) has again found in Western France a number of trepanned skulls dating from prehistoric times, which are interesting from the fact that some had been trepanned twice, thrice, and even four times. Evidence has now been forthcoming that the operation was not limited to Western Europe, and was performed also in Bohemia at a very early period.

The results of prehistoric surgery were sometimes very good. The cicatrisation is often so complete that no doubt can exist regarding the patient's survival for many years. In some skulls, however, evidences of repair are completely, or almost completely, absent, either because the patient died shortly after the operation, or, as some authors maintain, because the bone was removed after death.

My impression is that the majority of the openings which have been supposed to have been made post-mortem were really made during life, and that in these cases death supervened very shortly after the trepanning. This hypothesis is certainly correct in cases when, in a skull with two or more trephining holes, one or more are cicatrised, whereas one opening alone shows no signs of repair. The probability then is, that the subject was trephined several times for chronic, acutely painful, disease, *e.g.*, tumor cerebri, and that the last operation was fatal. On the other hand, when the greater part of the temporo-parietal region or nearly the whole of one side of the cranium had been removed, the possibility of this having been done on the living is very slight.¹

It has been suggested that post-mortem operations on the skull were made with the object of obtaining pieces of cranial bones to be used as amulets. Indeed, pieces of bone detached by trephining ("rondelles") were carefully preserved, for not only are some of them pierced for suspension, but their smooth borders indicate long friction against the skin. Powdered cranial bones were supposed to possess curative properties in the remote past and up to the Middle Ages, and "rondelles" were certainly worn as ornaments or as amulets as late as Gallic times.

Discovery of trephined prehistoric skulls.—The discovery of the first trephined, prehistoric human skull dates from 1685, and was found at Cocherel (1889¹). It had been twice "perforated," and these perforations are now considered to have been caused by a surgical operation, which the patient survived long enough for his wounds to heal. In 1816 another trephined prehistoric skull was discovered at Nogent les Vinages, in an ossarium containing no less than 900 skeletons. The opening in this cranium measures about 3 by 2 inches, and, at the time the skull was found, the loss of substance was considered as due to a wound or fracture, which had completely healed. Indeed Cuvier, who examined this skull, estimated that the patient survived the injury for

¹ I have seen in some Anthropological Museums skulls labelled as "trephined post-mortem" in which I could not find any real evidence of ante- or post-mortem operation.

a dozen years. It is now recognised that the aperture was due to a trephining operation, and not to an accident. In 1872 Prunière drew attention to the many trephined Neolithic crania discovered in ossaria, grottos, or dolmens of the Lozère region, and since that time many trephined skulls have been brought to light in divers places.

French discoveries of trephined skulls.—The largest number of trephined prehistoric heads have been found in France, *e.g.*, at Enteroches (Charente), Moret (Seine et Marne), Tour sur Marne, Bougon (Deux Sèvres), Petit Morin (Marne), Vienne, Marennnes (Puy de Dôme), Sorde and Fondonneau (Basses-Pyrénées).

A short account may be given of a few particularly interesting trephined skulls lately found in that country. The skull of a man who died when about 50 years old, found at Crécy sur Serre (Aisne), was pierced by two trephining holes (Baudouin, 1908²). The first was situated on the antero-superior angle of the left parietal bone near the anterior fontanelle, and the second was above the right temporal fossa, almost in the middle of the inferior border of the right temporal bone. Absence of any signs of repair suggested to the discoverer of these skulls that both operations had been performed after death. In my opinion the possibility of the operation having been done during life, and having been followed very soon by death, cannot be denied.

At Montereau sur Seine (Berthiaux, 1908³), almost 60 miles from Paris, two trephined heads were discovered in a prehistoric burial. No details concerning them are available so far.

A cranium (Baudouin, 1908⁴) of an adult female with three trepanations is probably Neolithic, but, unluckily, its origin is somewhat obscure. The patient survived the three operations long enough for a small exostosis to form on the border of one opening. The holes are small and close to one another: the first being situated in the antero-superior parietal region; a second in the same region on the right side; and the third not far behind the second. The diameters of the openings (13 and 15 mm.) somewhat exceed that of the crown of the usual modern trephining instrument, and the sloping borders of these orifices indicate that the operations were performed by scraping horizontally with a sharp flint, and not by cutting with a saw. The only striæ present are on the posterior margin of the third hole, and indicate that an instrument had been used vertically in that situation.

Six trephined heads (Schmit, 1909⁵) unearthed in one locality are good examples of the skill of Neolithic surgeons. A piece of bone 90 mm. by 57 mm. had been removed from the right parietal bone of the first cranium, and the absence of any signs of cicatrization proves that death supervened soon after the operation. In the interior of the second cranium, which presented a similar lesion, a very perfect "rondelle" was found, which measured 60 mm. by 10 mm. and from 10 mm. to 7.5 mm. in thickness. Some striæ on the superior surface of the "rondelle" are so sharp that they might have

been made with a graver's tool. The context and illustrations, however, leave one in doubt as to whether the "rondelle" belonged to this cranium or not. The third cranium had been trephined twice. A festooned opening measuring 90 mm. by 50 mm. is situated over the right temporal and parietal bones, and another, almost round, measuring 36 mm. by 30 mm., occupies the vertex just behind the left parietal bone. Both these apertures show no signs of repair. A typical trepanation, measuring 20 mm. in diameter, with borders showing evidences of almost complete repair, occupies the upper part of the occipital bone of the fourth cranium. The fifth cranium shows a deep depression, measuring 90 mm. by 55 mm. on the occipital protuberance, in the centre of which there is an artificial aperture probably made by a process of scraping. A sixth cranium was discovered in a grotto close to that in which the five others had been buried. On the left parietal bone of this skull there is a D-shaped opening, 50 mm. by 57 mm., due to a trepanation. The patient survived the operation for a long time, as the borders are completely healed.

Trephined crania lately discovered in other parts of Europe.—During the last forty years, trephined crania have also been unearthed in Switzerland, Bohemia, Poland, Denmark, Thuringia, Sweden, and from the pile dwellings on the lake of Brienne, at Chavannes, Sutz, and Locres, and quite lately a few more have been discovered in countries other than France. A skull trepanned for injury has been found in a Neolithic grave at Höckergrab in Bohemia (Grüngel, 1911⁶). It was that of a powerful man aged between 50 and 60 years, and a hole, measuring 40 mm. by 60 mm., caused by a blow or a fall was situated on its superior part. The anterior border of this hole showed the action of pus, and the discoverer of this skull believes that an operation with the object of coping with suppuration had been performed on the posterior border, and that cicatrisation had progressed far, when death supervened.

The very numerous trephined skulls of the ossarium of Sedec (Bohemia), though probably very ancient, are not accurately dated (Dudik, 1878⁷). A skull,¹ found at Mahren, of a girl approximately 10 years old at the time of death, had a frontal scar, possibly the result of a surgical trepanation. This cranium dates from the Bronze period, and, if the diagnosis be correct, the case is of some importance, as trephined skulls of children from that period are very rare. Unfortunately, details regarding this and the preceding cases are wanting.

Naked-eye appearances of apertures due to trephining.—The holes due to the operation are usually described as being fairly regular, more or less ellipsoid, and measure, on an average, about 4 cms. across. The borders are sharp, oblique, bevelled from without inwards, and very

¹ This skull was discovered by Wankel, and described by Dudik, *loc. cit.*

often the singularly compact surfaces produced by the growth of fresh bone prove that cicatrisation took place, and that the patient survived the operation for a long time.

Reasons for trephining in prehistoric times.—Common and widespread as trephining was in Neolithic times, yet very little is known concerning its purpose or concerning the *modus operandi* of the prehistoric surgeon.

According to the theory usually accepted, the operation was first performed from time immemorial on sheep for relief of "staggers," and, later, man extended the application of this veterinary method to his species—firstly, for relief of severe and persistent headache due to causes unknown to him; and, secondly, for the removal of the splinters of a fractured bone. The theory of the veterinary origin of trephining is based on pure hypothesis, and I know no facts in support of it.

Broca suggested that the operation was performed on young epileptic or mad subjects, to rid them of the "genius," the "demon" causing the dreaded symptoms. Assuming that the ideas of Neolithic men resembled those of some modern, partly civilised peoples, who honour an epileptic or lunatic as a holy man, he maintained that the convulsive accidents, on account of which trephining was performed, endowed the patient with a religious character. The patient benefited by this superstition, for both he and his cranium were regarded as objects of reverence. The fact that, as we have seen, "rondelles" were perforated in order to be worn, lends some support to this theory. The full discussion of Broca's views, however, would entail entering into questions outside the scope of this present paper, and must therefore be left for the present.

LUCAS-CHAMPIONNIÈRE'S MEMOIR.

A paper by the late Lucas-Championnière (1912⁸) contains some valuable facts regarding the methods of the Neolithic surgeon, and of his contemporary rival in Kabylia. The author emphasised the fact that, until quite lately, trephining had fallen completely into disrepute in Modern Europe, so much so that, in 1874, Stromayer taught that, in cases of comminuted fracture of the skull, the best treatment was to wait for the elimination of bony splinters by suppuration. Lucas-Championnière maintains that, in Neolithic times, this operation was based partly on empiric knowledge and partly on a regular and extended series of observations; that it was probably performed for many reasons, and that the modern operation for fracture of the skull is but a survival of an old custom.

Geographical distribution.—The author lays stress on the fact that the geographical distribution of the operation is peculiar, for there is no evidence that the Hindoos or Chinese ever practised it, and no

specimens of trepanning have been met with in Egypt,¹ nor among the Greeks or Romans. Some trepanned crania, however, have been discovered in Gaul, belonging to an epoch corresponding to that of Roman civilisation.

In America, previously to the arrival of Europeans, the operation was not uncommon among the Redskins of the north, and in the Empires of Mexico, Central America, and Peru. The contemporary hill-tribes of Daghestan, the natives of Tahiti, the Polynesian, and Loyalty Islanders, the Kabyl tribes (but not the Arabs or Negroes in contact with them), and Montenegrins practise this operation, and thus show their belief in its efficacy.

Lucas-Championnière's experimental investigations.—The author then discusses the results obtained by several modern observers, who, using Neolithic flint instruments, have experimented on the dead



body, in order to discover, if possible, the *modus operandi* of the prehistoric surgeons.

Three methods based on these studies have been described:—

1. *Müller's method.*—The bone is slowly scraped away. The sloping border so produced is enormous as compared with the aperture, and therefore unlike that of the majority of Neolithic skulls.

2. *Capitan's method.*—A series of straight or curved lines having been drawn on the skull, a sharp flat instrument is first passed and repassed along these lines until the bone between them becomes loose and can be removed. The objection to this method is its tediousness and the time it takes—more than one hour for a small opening. Moreover, the borders of the hole thus made are sloping, bevelled, smaller than in prehistoric European trephined

¹ No case of trepanning in Ancient Egypt has been published, but lately Dr. Arnaldo Rietti and I have found at Alexandria a skull dating from 200 A.D. which appears to have been trepanned. We hope to publish the case in full before long. (Note: Dr. Rietti tells me that owing to pressure of work consequent on the war, he has hitherto been unable to attend to this matter, but hopes to write the paper shortly. The photograph printed on this page is of the skull in question.—ALICE RUFFER.)

skulls, but not necessarily smaller than the opening found in trephined Peruvian crania.

Lucas-Championnière's method.—The operation is performed in several stages. *First stage*—The bone is perforated by rotating the point of sharp flint. *Second stage*—A circle of perforations extending to the inner table is made, so close to one another that the perforations run into each other. *Third stage*—These openings are further connected by cuts with a sharp instrument, the cutting edge of a flint for instance, so as to obliterate the dentated border more or less completely.

The edges of the opening in trephined prehistoric, or modern, savage skulls are always bevelled, and the loss of substance in the external table therefore exceeds that in the internal table. The orifice is triangular, or square, or irregular, but rarely quite round, and this irregularity of the openings may have been the reason why many trephined, prehistoric skulls passed unnoticed in the early days of anthropology. In some Neolithic skulls a smaller opening is present near the larger one, and the object of this is unknown. In Peruvian skulls, on the other hand, the borders of the opening are often festooned; and it did not escape Lucas-Championnière's notice that this operation, in prehistoric times, was not necessarily fatal, for the obliterated osseous canals of the bevelled edge, and the smooth, compact bone prove that the patient long survived the trepanation. Repair, however, was not always uniform. Multiple trepanations, though not rare in Neolithic times, are seen more frequently in Peruvian skulls, and still more often in contemporary Kabyls.

Lucas-Championnière's investigations in Kabylia.—Lucas-Championnière was led to study trephining among the contemporary Kabyls, and he describes two methods used in Kabylia. The first consists in cutting through the cranial bones by making straight strokes with a short rectilinear saw. In the second method, the surgeon using an instrument like a gimlet makes a complete circle of small perforations, then connects them all by short cuts with a saw, and finally removes the piece of bone thus circumscribed. Sometimes both methods are combined. It must be noted, however, that Lucas-Championnière never saw the operation actually performed by Kabyls (see also below).

Lucas-Championnière's views regarding incomplete operations.—The author insists that the evidence as to the superstitious use of cranial "rondelles" as amulets is not altogether satisfactory. He explains incomplete trephinings in Neolithic times by supposing that the operation was perhaps divided into two stages (see *infra*), and that, in some cases, after the removal of the external table, the second part of the operation was not carried out. It is by no means clear, however, how the external table alone could be removed by Lucas-Championnière's method. Incomplete trepanations also are not rare in contemporary Kabylia.

Lucas-Championnière's views regarding the operation on children.—

The theory that trepanation was performed on children (Broca) is not supported by evidence, as only one trephined infantile skull dating from Neolithic times has been found in France, and none have been discovered in Kabylia, America (before the conquest), or Montenegro. On the other hand, several trephined skulls were those of extremely old people.

Lucas-Championnière's views regarding site, etc., of operation.—The favourite situations for trephining in prehistoric times were the posterior part of the frontal, and especially the parietal bones as far as the occipital bone, on which the operator never trespassed much. The sagittal suture was avoided so carefully that it has been suggested that at a time when man was unacquainted with the use of iron, he knew enough anatomy to avoid the longitudinal sinus, and some authors have gone so far as to believe that Neolithic man had some knowledge of the motor centres. The Kabyls choose the same regions for the operation, and they also have learnt how to keep clear of the dangerous region, the longitudinal sinus.

As a rule, no traces of an accident are noticeable in trephined Neolithic skulls, and the operation therefore either was not done for traumatism, or, if performed for that reason, the splinters were carefully removed with the neighbouring bone.

No information exists regarding the dressing, if any, used by prehistoric peoples. Kabyls apply to the wounds: (1) Tar; (2) honey which has been cooked; (3) butter melted and cooked (Lucas-Championnière).

Discussion of modus operandi of prehistoric people.—Discussing the various methods supposed to have been used by prehistoric peoples, Lucas-Championnière rejects the theory that the aperture was made by simple scraping, for the following reasons:—(1) Such an operation would take a very long time. (2) It would be attended by much hæmorrhage. (3) A rondelle could not be removed in that way. This last argument appears to me conclusive as far as a large number of cases is concerned. (4) This technique would be useless when the bone to be trephined was really hard. (5) The cranial openings would be unlike those actually found. (6) The bevelled border would be much wider than is usually the case.

Lucas-Championnière admits that some operation resembling Capitan's process may have been used where the cranial openings are square, but maintains that his own method was the one generally used. The fact that the opening is not festooned (as it should be if Lucas-Championnière's method had been used), this author endeavours to explain by the supposition that, after the operation, the surgeon had taken the trouble to "correct" these irregularities, though, in my opinion, such "corrections" would have served no useful purpose, and would have caused a good deal of unnecessary pain.

Lucas-Championnière's Views regarding the Reasons for the Operation.

The author points out that the evidence of the superstitious use of cranial "rondelles" as amulets is not altogether satisfactory. He believes that the only object in view was the cure of disease supposed to have its seat in the head, and especially of the diseases usually attended by severe headache. The relief afforded by the removal of splinters from a fractured skull may possibly have suggested an operation in cases where the pain was due to hidden disease, and, on this theory, surgeons may be said to have practised "cerebral decompression" as early as Neolithic times.

The Kabyls trephine sometimes for accidents, and more often for persistent headache. Such is their confidence in the beneficent results of this operation, that, should it be unsuccessful once, they willingly undergo another. Sometimes, the external table alone is removed. We may point out, however, at once that later investigations do not confirm this author's accounts of Kabyl methods. The art of trephining is a family craft, and the operators believe in it most thoroughly; for the *Hakeem* (medical practitioner), Lucas-Championnière's informant, had been trephined three times, and his father twelve times. Three of his brothers were operators also. The author mentions that the Cornish miners, at the beginning of last century, thought so little of the operation that they insisted on being trephined after accidents to the skull, and proceeded home immediately after the operation. One Cornish surgeon had operated sixty times, and another had assisted during his apprenticeship at forty trephinings. He supposes that, in Cornwall, the custom dated from prehistoric times.

Objections to Lucas-Championnière's suggested Method of Trephining.

There are several objections to Lucas-Championnière's conclusion that a similar method was used by prehistoric surgeons. In the first place, the "rondelles" which I have seen in French and other collections are never notched, as they would be had this method been used. Secondly, I have not seen dentated borders of a trephine wound except in one Peruvian skull. Lucas-Championnière gives a photograph of this skull in his memoir, and admits that this patient must have died very soon after the operation, as all signs of repair are wanting. For my part, I consider it far more probable that this opening was made after death by the embalmer in order to remove the brain. The Egyptian embalmers, it is well known, extracted or washed out this organ through the nose. It is true that Lucas-Championnière succeeded in trephining a skull by this method so skilfully that the borders of the opening were not festooned. This fact does not meet the objection just raised, for what may be comparatively easy to a skilful surgeon of the nineteenth century may have been impossible to a Neolithic

surgeon. The borders of an opening thus made must have been festooned unless our prehistoric colleague took great pains to round off the aperture after the operation, and, personally, I can think of no reason for his doing so. Fourthly, in Lucas-Championnière's diagram of the operation, no less than thirteen perforations are indicated. Granting that no such large number would be required, yet an operation requiring several perforations of both tables of the skull with a sharp instrument must have been a most dangerous one, each drilling increasing the chances of wounding the dura mater. Even the Kabyls carefully avoid wounding this membrane. Fifthly, it is extremely difficult, if not impossible, to perform by this method an operation limited to removal of the external table of the skull, and we have seen that such incomplete operations were by no means rare.

Proof that Lucas-Championnière's method was not always used.—There are two facts which show that two methods entirely different from Lucas-Championnière's were occasionally used.

Firstly, before the European invasion, this operation was sometimes performed in Peru by marking off a small area of the skull with straight lines, and then incising with a powerful instrument along these lines. This method is clearly shown in a skull in the Trocadère Museum (Paris) which exhibits four deep cuts, and from between them a piece of bone, almost round, has been removed. The incisions were made with a very sharp and powerful cutting instrument, and not with a scraping instrument, and the operation had evidently been bungled by the surgeon, whose incisions were too long and too close together. I have seen no incision resembling it in European skulls, and the scars suggest a technique and instruments very different from those used in Europe.

Secondly, a prehistoric skull in the Lisbon Museum shows clearly that the area of bone to be removed was first circumscribed with a powerful instrument, *e.g.*, a strong flint knife. On the top of this skull, a deep ellipse-shaped furrow encloses a piece of the bone measuring about 50 mm. by 40 mm., but the furrow does not penetrate the whole thickness of the bone, and lines and scratches round this groove demonstrate that the instrument often slipped during this operation. For some unknown reason, the trephining was never completed, although the patient apparently survived for some time. In this case, Lucas-Championnière's method was certainly not used.

HILTON SIMPSON'S INVESTIGATIONS IN KABYLIA.

Recent observations on the modern *modus operandi* in Kabylia and New Caledonia throw some light on the question of the technique used in ancient times. The facts relating to Kabylia were observed by Mr. Hilton Simpson (1914⁹) during a stay of more than two months at El Kantara, "the mouth of the Sahara," and during a journey of one

month's duration, in the spring of 1913—among the Shewia Berbers of the Wadi Abdi, and the Valley of Bouzina, in the western parts of the Atlas Mountains.

The author gives a description and illustrations of a complete set of Kabyl-trephining instruments, nine in number, and all bearing unmistakable signs of having been used. Marks of burning upon their wooden handles which, from their appearance, could scarcely have been made when the blades were hafted, showed that, apparently, these instruments had been passed through the fire.

These instruments are: (1) Scalper (Arabic name, *Matabaa*).—A cylinder of iron about $1\frac{1}{8}$ inch in depth and $1\frac{3}{8}$ inch in diameter, made of a strip of iron with one sharp edge, bent round until the ends touch without being joined. Where the ends meet, one is joined by fusion on its blunt edge to a round bar of iron about 13 inches long, so that the cylinder is at right angles to the bar. The other end of the bar passes through a round wooden handle 4 inches in length, and is bent round at right angles to prevent this handle from slipping off. (2) Retractor (Arabic name, *Shefira*).—An iron blade $2\frac{1}{2}$ inches in length was fitted into a round wooden handle $3\frac{3}{8}$ inches in length. The blade where it joins the handle is rectangular in section and about $\frac{1}{8}$ inch wide, but it gradually becomes flatter and wider until at the distal end it is about $\frac{3}{8}$ inch wide, the end being slightly rounded at the corners and presenting a fairly sharp edge. This end is bent over at right angles to the rest of the blade to form a hook. The whole blade slopes slightly backwards for the handle. (3) Retractor (Arabic name, *Shefira*).—An iron blade projecting about $1\frac{3}{4}$ inch of its length, the blade is rectangular in section and about $\frac{1}{8}$ inch wide, but the distal end is flat, widening to a width of $\frac{3}{8}$ inch, is bent round at right angles, forming a hook, the fairly sharp edges of which are slightly rounded at the corners. (4) Hook or Retractor (Arabic name, *Mongash*).—An iron blade about $1\frac{1}{8}$ inch long, inserted in a lathe-turned wooden handle, presumably of European origin. Where it joins the handle, the blade is rectangular in section and about $\frac{1}{4}$ inch wide, but it narrows to the distal end, which is little more than $\frac{1}{16}$ inch in width. The distal end is bent sharply round to form a small hook. (5) Drill, also used as an elevator (Arabic name, *Hervert*).—An iron blade about $2\frac{3}{4}$ inches long projecting from a round wooden handle $3\frac{1}{4}$ inches in length. Where it joins the handle, the blade is $\frac{1}{4}$ inch wide, and it gradually increases to a width of $\frac{3}{8}$ inch near the distal end; it narrows abruptly, leaving a "shoulder" on each side, at the distal end, so that the last $\frac{3}{16}$ inch of the blade is only $\frac{1}{8}$ inch wide. This end is rounded and has a cutting edge. The "shoulders" on the blade would serve to prevent too large a hole being made through the skull when the instrument is used as a drill. (6) Saw (Arabic name, *Monshar*, or *Manshar*) consists of an iron blade projecting $3\frac{7}{8}$ inches in length, fixed into a round wooden handle $2\frac{7}{8}$ inches long. The blade is rectangular in section where it joins the handle, and is about $\frac{1}{8}$ inch wide. It curves downwards almost at right angles, 2 inches from the handle, and then curves outwards again at the distal end, where the blade is flat with a serrated lower edge containing eleven teeth. The serrated edge forms a segment of a circle, the teeth being upon the convex. (7) A second saw.—Very similar to No. 6. An iron blade $4\frac{5}{8}$ inches long and in a wooden handle about $2\frac{3}{4}$ inches long. The curves in this saw are not so sharp as in No. 6, there are thirteen teeth on its convex edge. Neither of these two saws is sharp. (8) A third saw.—An iron blade $2\frac{1}{4}$ inch in length with a round wooden handle $3\frac{7}{8}$ inches long. The blade for $1\frac{1}{3}$ inch from the handle is rectangular in section, and about $\frac{1}{8}$ inch wide; the last $\frac{7}{8}$ inch of the blade is a flat rectangular surface with three serrated edges. The teeth are fine and sharp.

(9) Elevator (Arabic name, *Mhez*).—A flat iron blade about $3\frac{1}{16}$ inches wide, protruding about $1\frac{3}{8}$ inch from a round wooden handle $2\frac{1}{2}$ inches long. The distal end curves very slightly indeed, and is fairly sharp. The corners are not rounded, but one of them has been broken off.

The method of trephining used by the Kabyls is as follows:—

The first stage of the operation consists in removing a portion of the scalp in order to expose the place to be trephined. This is effected by making the "funnel-like" instrument (*matabaa*) white hot and placing it firmly, like a branding-iron, on the head; a flicking movement of the instrument then removes the piece of scalp thus burnt round. The great heat, as well as sterilising the *matabaa*, also prevents excessive bleeding from the scalp. The retractors (*Shefira*) are then used to draw away the scalp around the place to be trepanned, in order to give room for the use of the saw. Presumably, the hook (*Mongesh*) is also used for the same purpose. A hole is then drilled in the skull by spinning the drill (*herwerl*) between the palms of the hands. This is to let out any pus and blood that may be under the skull, but the hole thus made would also be useful as a starting-place for the saw. The saw is then applied to the "good" bone just clear of the injured part. Only a very small amount is sawn through, after which the elevator on the hook is inserted in the incision, and, if possible, the "bad" bone slightly raised to let out pus and blood. Great care is taken that the dura mater is not pierced, for the operator thinks that the patient must die if this is done.

Only the small incision, with the saw described above, is made on the first day, but on the next and each succeeding day, the process is repeated until the whole of the "bad" bone has been removed. So little is sawn through each day that it takes from fifteen to twenty days to remove a portion of skull as large as a penny piece. The part sawn away is lifted from the head by the elevator or the hook.

When the "bad" bone has at last been removed, no artificial bone or plate is placed over the cavity, and the skin is induced to grow again over the wound by the daily application of fresh dressings of a mixture of honey and butter, and the stem and leaves of an herb, powdered as fine as snuff. This herb grows locally upon the hills, and belongs to a species of *labiatæ*. The daily dressing is continued sometimes for as long as one month, at the end of which time the patient is cured. No form of anæsthetic is used. There is no evidence of any attempt to sterilise the saw, the retractors, or the elevator (unless we accept the burns on the handles of the instruments as an indication that they have been purposely sterilised by heat), and the rags used as bandages are of the dirtiest description. The surgeon does not wash his hands as a rule before or after dressing a wound.

A native surgeon stated that he trephined as many as five or more heads annually, the reason for the operation being usually heads "broken" by blows from sticks or stones. Operations for the removal of damaged bone from the arms and legs were performed in the same manner and with the same instruments.

The Kabyl operation therefore, according to this author, is performed to remove splinters of bones after accidents. It is difficult to reconcile this statement with Lucas-Championnière's assertions: Firstly, that some patients have been trephined twice; and secondly, that the Kabyls trephine chiefly for headaches. Neither of these authors mention whether Kabyls attach any religious importance to the operation, nor whether they regard the removed bone as a charm or amulet.

TREPHINING IN NEW CALEDONIA.

G. Nicolas gives an account of a totally different method in use among the contemporary New Caledonians. The operator makes a crucial incision on the scalp with the sharp edge of a large broken bottle or a razor, and, having turned the flaps aside with his fingers, files away the bone with a cutting and sharpened shell. The operation is often badly carried out, for it may be incomplete, or, contrariwise, the membranes of the brain may be injured. The wound is then closed by placing a shell over it, and Nicolas himself has felt such a shell *in situ*. The cutaneous flaps being turned back, a dressing of certain chewed herbs is applied. The chief indication for the trephining is persistent headache, and a man who had suffered excruciating pains after a fall on the head reported that he had been completely cured by the operation.

Trephining is carried out fairly often. One skull completely and another incompletely trephined were found in a cave containing some hundreds of skeletons.

CONCLUSIONS.

The conclusions to be drawn from the new facts related in this review are as follows:—

I. The operative methods of Neolithic people are very imperfectly known.

II. Further investigations with regard to Kabyl methods are necessary, as the Kabyl methods described by the French author are not identical with those mentioned by the British traveller. This may be due to the fact that the observations of the two authors were made in different parts of Kabylia. Both may therefore be right.

Contemporary Kabyl methods differ greatly from those used in contemporary New Caledonia. Neolithic people therefore may have employed not one but several methods, either at the same time or consecutively, or in different regions.

III. Contemporary Kabyls trephine for accidents, and, according to Lucas-Championnière, for persistent headache also. Contemporary New Caledonians trephine chiefly for the relief of headache. Similarly, Neolithic people may have trephined for injuries, but as most of the trephined skulls show no signs of accidents, headache was very probably the chief indication for this operation. No fresh evidence has been obtained to show that a religious signification was attached to trephining.

IV. Lastly, I would suggest that the trephining hole is situated in the upper and posterior part of the parietal bone, probably because this region was most easily accessible to the operator in a period when beds and chairs were not used. The contemporary barber-surgeon in the East, when operating, invariably squats in front or behind the

patient, and in thus doing copies his colleagues of ancient times. A picture on a tomb at Beni Hasan, dating from over 3000 years, shows the barber-surgeon squatting before a man, on whose head he is performing some kind of operation. The walls of a tomb of Sakkarah are decorated with bas-reliefs representing operations, and among them, some operation on the penis of a youth.¹ In this bas-relief, also, the surgeon squats down before the sufferer, whose hands are held before his face by a man standing behind, who thus not only prevents untoward movements, but also hides the operation from his prisoner. In another bas-relief, the patient, still standing up, rests his right hand on the squatting operator's head. Other bas-reliefs of the same tombs are not sufficiently well-preserved to allow a diagnosis of the operation to be made, but in all the surgeon either squats on the ground or sits on a low (stone?) stool either before or behind his patient. The Neolithic surgeon probably took up the same position, and the patient's head was either held by an assistant or by the operator himself, and, like his contemporary Egyptian colleagues operating on the scalp, he encircled and held the head firmly with his left arm, and operated with his right hand.

Excellent hold is obtained on a person's head either in this manner or by fixing the head between the knees. It is best for the operator to sit a little higher than the patient, *e.g.*, on a stone, and for the patient to squat between the operator's legs. Whether the surgeon sits before or behind the patient makes no difference, for, in either case, the upper parietal region is the region most easily reached.

In order to study the question experimentally, I have asked several people, ignorant of surgery and not acquainted with my object, to sit in the position thus described. I then asked one of them (the operator) to catch hold of the other person's (the patient's) head and pretend to drill a hole into it. The point invariably chosen for this drilling was the parietal region; and, strangely enough, not the vertex but the side of the parietal bone, and usually the left side. These points correspond almost exactly with those which were most often trephined in prehistoric skulls, and I suggest therefore that the reason why prehistoric surgeons trephined most often the parietal region of the skull was because that region was by far the easiest to operate on, when both patient and operator squat on the ground.

REFERENCES.

1. CARTAILHAC "La France préhistorique," Paris, 1889, p. 281.
2. BAUDOIN, MARCEL "Étude d'un Crâne Néolithique à double trépanation," "L'Homme préhistorique," 1908, tome v. p. 207.
3. BERTHAUX "Le Préhistorique à Montereau," "L'Homme préhistorique," 1908, tome vi. p. 85.

¹ The picture is supposed to represent a circumcision, but I can see no evidence of that.

4. BAUDOIN, MARCEL . . . "Etudes d'un Crâne préhistorique à triple trépanation exécutée sur le vivant," *Bull. Soc. d'Anthrop.*, 1908, p. 436.
5. SCHMIT, EMILE . . . "Présentation de quelques crânes néolithiques trépanés," *Bull. Soc. d'Anthrop.*, 1909, p. 206.
6. GRÜNGEL, F. V. . . . "Einige prähistorische Funde aus dem Saager-Land," *Prähistorische Ztschr.*, 1911, Bd. cxi. p. 304.
7. DUDIK, D. . . . *Ethnologische Ztschr.*, 1878, S. 227.
8. LUCAS-CHAMPIONNIÈRE . . "La Trépanation préhistorique," Paris, 1878 ;
"Les Origines de la trépanation compressive," Paris, Steinheil, 1912.
9. SIMPSON, HILTON . . . *The Journal of Anthropology*, 1914.