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Studies : No. 22

Proceedings

of

The Anatomical and Anthropological Society

University of Aberdeen.

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" No. 22.—*Proceedings of the Aberdeen University Anatomical and Anthropological Society*, 1904-06 President, Professor R. W. Reid, M.D., F.R.C.S.

Proceedings

of the

Aberdeen University Anatomical and Anthropological Society

President

Robert William Reid, M.D., F.R.C.S.

Professor of Anatomy

1904-06

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ORDINARY MEETING.

5th November, 1904.

Professor R. W. Reid, M.D., F.R.C.S., President, in the Chair.

The minutes of the last meeting were read and approved.

Miss A. V. Baxter, M.A., read a paper entitled "Observations on and Classifications of 1,500 Finger-prints taken in the Anthropometric Laboratory". Miss Baxter acknowledged the help of Mr. J. M. McQueen, M.A., and illustrated her paper with lantern slides. After a discussion on the paper, Miss Baxter was awarded a vote of thanks.

Professor Reid showed a large drum and an image from Erromanga, New Hebrides, which had been presented to the Anthropological Museum by the Trustees of the late Sir William Henderson. A lantern slide of the drum and the image in their native surroundings was also shown. Mr. D. Horn, B.A., Queensland, gave an account of the natives of the New Hebrides group of islands. After a discussion Mr. Horn was thanked for his paper.

OBSERVATIONS ON AND CLASSIFICATIONS OF 1,500 FINGER-PRINTS EXAMINED IN THE ANTHROPOMETRIC LABORATORY, ABERDEEN UNIVERSITY.

By Miss A. V. Baxter, M.A., and Mr. J. M. McQueen, M.A.

(Read 5th November, 1904.)

In the Anthropometric Laboratory in the Anatomical Department of this University, a record is taken of the finger-prints of all students at the commencement of their medical curriculum.

By the kind permission of Professor Reid, whose interest in anthropometric matters is well known to all of us, a statistical study of these finger-prints has been made, the results of which it is my privilege to place before you to-day.

But first a word as to what finger-prints are. On the palms of the hands and soles of the feet there are found minute ridges mapped out in distinct systems. These systems do not make one continuous whole but leave divergent areas, and in these are found small and independent systems with some characteristic shape. The study of finger-prints is confined to an examination of these smaller systems or patterns.

These patterns though overlooked in daily life are of great significance, furnishing us with, in some respects, the most important of anthropometric data. In all scientific matters careful observations and attention to detail are absolutely necessary. The botanist examines the plant with his lens to detect the presence or absence of bracts, scales, stipules, etc. The zoologist may succeed in classifying a bird by noting the shape and adaptations of its foot. In like manner we too are identified by minute individual characteristics, and

of these the so-called insignificant finger-prints are of the first importance. The general appearance may change, the height may increase or decrease, the features may be greatly modified, but the finger-prints cannot be altered or removed.

Closer examination of the ridges reveals the fact that they are studded with minute pores which are the open mouths of tiny sweat glands. The ridges grow simultaneously with the general growth of the body. At birth the delicacy of the ridges is in proportion to the smallness of the stature. In old age, on the other hand, the sharpness of definition becomes blurred. They are developed most in hands that do a moderate amount of work. They are often obliterated in the hands of labourers and artisans by the constant pressure of their peculiar tools. Ridges on the sides of the left forefinger of tailors and seamstresses are often temporarily destroyed by the needle.

The use of the ridges is to raise the mouths of the ducts. They aid, too, the sense of touch by enabling the character of surfaces to be perceived by rubbing them with the fingers.

With regard to the taking of finger-prints. In this Laboratory finger-prints are taken with printer's ink. A few drops are let fall on a slab and worked with a roller into an even layer. The palmar surface of the finger is placed on the slab and rolled, the object being to secure the inking of the whole surface. The process is repeated upon a white ground, and the result is a print where the ridges are marked in black and the furrows remain white. Prints can also be taken on smoked glass, on sealing-wax and on gutta-percha. Many are, however, taken in a simpler way, for tell-tale prints have been found on the panels of doors, on the window-ledge, on the dust of shelves and even in blood on the window-panes.

When the finger-prints have been secured they must next be classified. This is done after Galton, placing the print in either of three classes—Arch, or Loop, or Whorl. Galton terms this his primary classification. A clear understanding of all that determines an arch, a loop or a whorl is essential before going further. A pattern is said to be an arch when the ridges run from one side to the other

of the bulb of the digit without making any backward turn or twist. The pattern is a loop when the ridges make a single backward turn but no twist. The pattern is a whorl when the ridges make at least one complete circle, or what mariners consider in reference to the compass a "complete circuit". Another characteristic serves as an infallible guide to the differentiation of the arch, the loop and the whorl. On examining the fingers beyond the last joint, it is found that the ridges nearest the joint are more or less transverse. On passing to the tip of the bulb, the ridges are found to be arched. Two ridges are taken as the boundary line of the pattern, the topmost transverse ridge and the lowest arch.

At the angles of divergence of the lowest arch and topmost transverse ridge there is a triangular plot made by a line which crosses the mouths of these angles. This triangular plot is called a delta, and by the enumeration of the deltas a pattern can be classified. An arch has no delta. A loop has one delta. A whorl has two deltas. The importance of rolling the finger here becomes apparent. The deltas are often at the margin of the pattern, and if the finger is dabbed down without rolling, the deltas may be missed altogether. They must be included if present, if absent their absence must be beyond doubt.

Proceeding then on this plan, taking care to note the presence or absence of deltas, the finger-prints can be classified into one of three large divisions—Arch, Loop, Whorl. This appears simple in theory, but in practice much difficulty is met with in the shape of ambiguous patterns, for arches shade off into loops and loops into whorls, and there is, so to speak, a debatable ground between arch and loop and again between loop and whorl.

Careful examination with a lens is often necessary before the contour of the pattern can be exactly determined. Often the core of the pattern forms a guide to classification. Once all are classified they can be arranged in various tables according to percentages, and in those which are to be discussed to-day Galton's system of tabulation has been strictly followed.

The data used in compiling the tables were the prints of 1,500 different digits, namely, the thumb, forefinger and middle fingers of the right and left hands of 250 students. The relative frequency of arch, loop and whorl in the 1,500 digits was a follows :—

TABLE I.

1,500 DIGITS OF 250 STUDENTS.

162 arches, *i.e.* - - - - - - -	10·8 per cent.
911 loops ,, - - - - - - -	60·73 ,,
427 whorls ,, - - - - - - -	28·46 ,,

Compare this with Galton's table, in which he records observations of 5,000 digits of 500 persons. His results are :—

Arches - - - - - - - - -	6·5 per cent.
Loops - - - - - - - - -	67 ,,
Whorls - - - - - - - - -	26 ,,

The difference here is probably due to the fact that in the latter table the ring finger and little finger are recorded as well as the other three.

On the little finger loops predominate, and hence Galton's higher percentage of loops and consequent lowering of the other two percentages.

The second table is intended to show the peculiarities of the different digits as regards the patterns found on them.

TABLE II.

SHOWING PERCENTAGE FREQUENCY OF ARCHES, LOOPS AND WHORLS ON THE 1,500 DIGITS OF 250 STUDENTS.

	Right.			Left.		
	A.	L.	W.	A.	L.	W.
Thumb - - - -	3·2	52·4	44·4	4·8	65·6	29·6
Forefinger - - -	18·4	52·4	29·2	18	52	30
Middle finger - - -	9·6	72	18·4	10·8	70	19·2

The percentage of arches varies from 3·2 to 18·4; of loops from 52 to 72, and whorls from 18·4 to 44·4.

For the same three fingers Galton's percentages are :—

Of arches - - - - - - - - -	from 3 to 17
„ loops - - - - - - - - -	„ 53 to 78
„ whorls - - - - - - - - -	„ 15 to 44

The similarity in results speaks for itself. The question arises—are the arch, loop, whorl patterns distributed in the same way upon the corresponding digits of the two hands. By rearranging Table II. the answer to this question is demonstrated.

TABLE III.

	Arches.		Loops.		Whorls.	
	R.	L.	R.	L.	R.	L.
Thumb - - - -	3·2	4·8	52·4	65·6	44·4	29·6
Forefinger - - -	18·4	18	52·4	52	29·2	30
Middle finger - - -	9·6	10·8	72	70	18·4	19·2

The similarity of distribution with which the patterns occur on the same digits of opposite hands is here seen to be very marked, except in one instance, *i.e.*, in the case of the whorls on the thumbs. They are only about three-fourths as frequent on the left thumb as they are upon the right.

Galton also found this peculiarity, and noted a like distribution of the whorls on the ring finger. The consistency with which such a peculiar difference occurs must therefore be accepted as a fact and not as a statistical accident.

Another noticeable peculiarity is the much greater frequency of arches on the forefinger than on the thumb and middle finger. Here the percentage is 18 on the forefingers. Galton noting the same peculiarity gets 17 per cent.

The maximum of loops is found upon the middle finger, where

on the right hand the percentage of 72 is found. On this finger Galton's maximum is 76 per cent., but he obtained the greatest number of loops on the little finger, where the remarkable total of 90 per cent. was reached.

Whorls are most common on the thumbs and most rare on the middle fingers.

Although in the two foregoing tables the similarity in percentages between the same digits is marked, the difference in frequency on thumb, forefinger and middle finger is very great. Thus on the right thumb arches are 3·2 per cent., on the forefinger they are as many as 18·4 per cent., and on the middle finger their occurrence is 9·6 per cent.

The forefinger is peculiar in the frequency with which the direction of the slopes of the loops differs from that which is most frequent on the other digits. A loop necessarily has a slope since it is formed of ridges opening downwards on one or the other side of the finger. If it opens to the outer side or thumb side of the hand it is called a radial slope, if towards the inner side an ulnar slope.

Galton found that the radial slope was rare on the middle finger, but that it occurred on the forefinger two-thirds as frequently as the ulnar slope. This ratio he proved for separate forefingers. In the foregoing statistics of 52·4 per cent. of loops on the right forefinger, 24·4 per cent. were radial and 28 per cent. were ulnar. Of 52 per cent. on the left forefinger, 16·4 per cent. were radial and 35·6 per cent. were ulnar. In neither case does Galton's rule hold ; but add together the radials of the two hands and likewise the ulnars and the percentages now are : 20·4 per cent. are radials and 31·8 per cent. are ulnars. This gives a result similar to Galton's.

Now consider the tendency of digits to resemble one another in their various combinations. Take them two at a time to determine the frequency with which both members of the various couplets show the same class of pattern. First take the digits of the same name :—

TABLE IV.

PERCENTAGE OF CASES WHERE SAME CLASS OF PATTERN OCCURS ON SAME DIGITS OF THE TWO HANDS.

Couplets.	A.	L.	W.	Total.
Two thumbs - - - -	2·8	43·6	22·4	68
Two forefingers - - -	10·8	35·6	18·8	65·2
Two middle fingers - -	5·2	59·6	12·8	77·6

Mean of totals—70·2. Galton's—72.

Table V. deals with the tendency of couplets of different name to resemble each other. The combinations to be considered are thumb and forefinger, thumb and middle finger, and fore and middle fingers of the same or of opposite hands. This gives six different combinations in all.

TABLE V.

PERCENTAGE OF CASES WHERE COUPLETS OF DIFFERENT DIGITS RESEMBLE ONE ANOTHER.

Couplets of Digits.	Of Same Hands.				Of Opposite Hands.			
	A.	L.	W.	Total.	A.	L.	W.	Total.
Thumb and forefingers -	2·8	34·6	16·4	53·8	2·8	35·2	16·8	54·8
Thumb and middle fingers	2·4	46·4	12	60·8	2·2	45·4	11·6	59·2
Fore and middle fingers -	6·2	44·2	13·8	64·2	6·4	44·6	13·6	64·6

The mean of totals on same hand = 59·6.
On opposite hands = 59·5.

The above table may be regarded as follows ;—

TABLE VI.

Couplets of Digits.	A.		L.		W.	
	Same.	Opposite.	Same.	Opposite.	Same.	Opposite.
Thumb and forefinger -	2·8	2·8	34·6	35·2	16·4	16·8
Thumb and middle finger	2·4	2·2	46·4	45·4	12	11·6
Fore and middle fingers -	6·2	6·4	44·2	44·6	13·8	13·6

The couplets are closely alike in every instance, the resemblance being even closer than that found in Galton's statistics. The complete agreement of the results shows that the relationship of any one particular digit to any other particular digit is the same whether the digits in question are of the same or opposite hands.

These tables, though of great value and interest from a statistical point of view, are of little practical importance. The value of finger-prints to-day depends not so much on statistics as upon their use for purposes of identification. The first of our countrymen to recognise this use was Sir William Herschel, who, while in India forty years ago, frequently took the finger-prints of natives for this purpose. He used them to identify persons who had executed bonds, and so cases of fraud were obviated. They were likewise used somewhat later for the identification of Government pensioners in India. Among these personation was not difficult, for both in appearance and in name they were often exactly alike. The taking of finger-prints, however, was found sufficient to settle any doubt as to identity. The system attracted no great attention at the time, and it was not until Galton took up the subject and elaborated it that public interest was aroused.

For purposes of personal and individual identification the primary Arch, Loop, Whorl classification was found to be insufficient, as there were so many varieties of patterns, especially among loops and whorls.

Galton introduced a system of suffixing, which he called "secondary classification". Here an index was added to the A. or L. or W.,

by which the particular form could at once be known. Often it was difficult to distinguish between arches and loops, and these doubtful patterns were written A^{l} or L^{a}, according as the tendency of the pattern was more to the arch or loop type respectively.

So also there were patterns written L^{w} and W^{l}.

Again, complex patterns may be written thus: L^{ry}, where the *r* indicates that the loop is an invaded one, and the *y* denotes that the core of the loop is eyeletted.

In the secondary classification it was often necessary to count the number of ridges in a loop. This was done beginning at the innermost ridge and counting to the outermost of a loop. When the centre ridges in a loop were uneven the middle one was taken. If the core was a staple the limb of the staple farthest from the delta was selected.

With regard to the outermost ridges there are two types: one where a single ridge divides to form the boundary lines of the pattern, and the other where these boundary lines are formed by two ridges diverging.

By this system of classification a very accurate description can be got, and a finger-print directory may be formed by means of which the peculiarities in the patterns of each set of digits are recorded. Galton shows how such a directory can be formed.

Since Galton's book on "Finger Prints" was published in 1892 a criminal investigation system has been instituted in Britain, which includes the taking of finger-prints of all criminals according to the methods recommended by Galton. The Government adopted this because they found that—

1. Finger-prints cannot be altered.

2. Finger-prints are not liable to be obscured except in persons engaged in particular kinds of manual work.

3. Finger-prints can easily be recorded.

4. Finger-prints can be used for purposes of proof in a court of law.

In the Report of the Commissioner of Police of London for 1903,

it is stated that at the close of the year the total number of finger-prints recorded was 60,000.

The excellence of the results may be gathered from the fact that during that year alone there were no fewer than 3,642 identifications made by means of finger-prints.

Within the last few days three cases of conviction by means of finger-prints have come under my notice. In the first the prints had been left on the glass of a fanlight by which the burglar gained access to the premises.

In the other two cases finger-prints were left by thirsty burglars on drinking-glasses. In one case the prints on the glass were identified at Scotland Yard as those of an ex-convict whose prints had been taken some time previously. In the other case the marks on the glass were photographed and found to correspond with those on the fore and middle fingers of the accused.

Another point in favour of finger-prints as regards identification is the fact that no two prints have been found to be exactly alike. Galton estimated that the chances of two persons having similar prints was about one in 64,000,000,000. And as the population of the whole world is only about 1,600,000,000, the probability of two persons having exactly similar prints is sufficiently remote.

In connection with Anthropology there arises the question whether or not finger-prints are distinctive of races. The only statistics to be had on this point are those of Galton, who compared the prints of English, Welsh, Hebrews, Negroes and Basques. After careful study, he concluded that there was no very marked characteristic distinguishing races. The prints of negroes seemed on the whole to give an idea of greater simplicity, but this is by no means certain. Nor does intellect and culture appear to affect finger-prints. There was found to be little difference between the prints of great thinkers, of statesmen, of students and those of the inmates of the London asylums.

In the direction of heredity, however, more positive results have been obtained. Galton examined some 150 prints of fraternal couples

in conjunction with F. H. Collins. The frequency with which some peculiar pattern was found to characterise members of the same family convinced him of the reality of an hereditary tendency.

Taking a hundred to be the possible number of resemblances, Galton found that there were about 10 per cent. of these occurring in the prints he examined. This number is certainly enough to prove the influence of inheritance, but it is too small to show that the patterns are themselves directly inherited. Professor Brooks in discussing this point says: "Does it not seem rather that the patterns are indirectly influenced by some other inherited character, such, perhaps, as the ratio in the embryo between the growth of the ball of the finger and that of nail". It may be that the resemblances in finger-prints of members of the same family are due to acquired characters and not to actual inheritance.

Another point which, for want of sufficient data, is still not quite decided, is the question of the persistence of the patterns throughout life. Galton considers that from birth to death finger-prints never change. He bases his belief on two sets of data; first, on eight so-called "Hoogli prints" taken in India, first in 1878 and again in 1892, that is, after a lapse of fourteen years; second, in his own laboratory are ten double sets of finger-prints, the interval between the first and second impressions varying from nine to thirty-one years. In all cases the prints are exactly similar, with one slight exception, where two ridges in a child of two and half years became one ridge in a boy of fifteen years. Cuts and scars also seem to be permanent, but burns only temporarily destroy the ridges.

In the laboratory here, no double records have as yet been obtained; but some ten or fifteen years hence, when the students of to-day come back to revisit their *Alma Mater*, it would be interesting if they remembered to take a second record of their finger-prints, and so furnish material to prove that the patterns are permanent.

SHORT DESCRIPTION OF THE PEOPLE OF THE NEW HEBRIDES.

By D. Horn, B.A., Queensland.

(Read 5th November, 1904.)

The New Hebrides group comprises about thirty islands, twenty of which are fairly well populated, and eleven of a size varying from Aneityum, which is forty miles in circumference, to Santo, which measures seventy miles by forty.

The chief islands are, Santo, Erromanga, Malekula, Tanna, Aneityum and Aniwa.

The group is scattered over a distance of 400 miles, and is situated about 1,000 miles north of New Zealand and 1,400 miles north-east of Sydney. The islands are all volcanic in origin, but the lava has been poured over a bed of coral. Active volcanoes are still found on Tanna, and other islands of the group. The islands are thickly clad with forests and with the luxuriant vegetation found in all tropical countries. There are palms and ferns in endless variety, and immense forests of Kauri pine and sandalwood. There is great plenty of food plants. The banana, bread-fruit, cocoa-nut, yam and taro grow to perfection.

The population is now estimated at about 70,000, about one-third of the number inhabiting the islands before the advent of the white man.

The people are of a low and degraded type, and although in appearance they resemble the aborigines of Australia, they are much more intelligent. They are considered to be the descendants of Papuans and Malays who peopled those islands at an early date.

In appearance the people are very short in stature, ugly, with low receding foreheads, broad faces and flat noses. Some have crisp

woolly hair, others have long wavy hair, worn twisted into innumerable cords. In common with other dark races, they have a great love for ornaments, such as nose and ear rings, bracelets, etc. Their bodies are adorned with paint of various colours, but their clothing is very scanty, a short kilt of woven grass being the only article of apparel worn.

The men are constantly fighting in some of the islands, and this used to be the only occupation which was considered worthy of their attention. They never part with their weapons, in the use of which they display marvellous skill. The chief offensive weapons used are spears, bows and arrows, killing-stones, clubs and tomahawks. These weapons are always beautifully carved with the images of their gods, or of some warrior whose fame lives in the tribe. The young boys are carefully taught how to use all of these weapons with skill, and they accompany their fathers and elder brothers in all their wars, and are initiated into all their cruelties and lusts as a necessary equipment for their life of warfare.

As is the case with all degraded races, all the work is done by the women. The cultivation of the fields, the fencing of the plantations, the weaving of the clothing, and other domestic duties are performed by them. It is considered disgraceful for a man to work. To keep the women in a state of subjection, and to prevent them from revolting against this custom, a number of them are periodically killed and eaten as a warning to the others.

Polygamy is universal, and each man keeps a number of wives sufficient to maintain him in a position befitting his rank.

Infanticide is common. The old and helpless are put to death, and widows are killed so that their spirits may accompany those of their husbands into the other world.

Vice of all kinds is rampant among the people, and in many places has not been lessened by the coming of the white man.

Although the people are degraded they live in well-built huts collected into villages, under the command of recognised chiefs. The villages are kept scrupulously neat and clean.

In the communities there are several grades or castes, and a man's influence depends mainly on his rank. Each grade has generally a distinctive mark by which its members are recognised even in islands where their language is unintelligible. The members of different grades are strictly kept from intermarriage. A man may, however, be raised in grade by the command of the chief or the consent of the whole tribe. The ceremony accompanying this promotion is generally performed at midnight, during full moon, and near a sacred spot which no one but a priest may occupy. There is feasting and dancing also to the music of drums and singing.

Cannibalism used to be universally practised throughout the group of islands, and after every fight the bodies of the slain were eaten.

Some of the religious beliefs are very curious. The spirits of departed chiefs or great heroes were supposed to be embodied in certain stones, animals, trees, or carved images representing human beings or sacred animals, and these objects are held in the greatest veneration. There is a kind of priesthood of sacred men, to whom great power is attributed, and who alone have access to the idols of the tribe and to the holy places. Although they invoke the help of their gods in warfare their chief religious duty seems to lie in the task of appeasing their wrath, and this is accomplished by means of human sacrifices. No great undertaking is commenced, no ceremony of any kind is considered complete without the sacrifice of at least half a dozen human beings.

All have a firm belief in sorcery. When the aid of sorcery is invoked for the purpose of taking vengeance on an enemy, some article of food or clothing belonging to the intended victim is brought to one of the sacred men, who calls on the gods to carry out the indicated punishment.

At every feast there is a great deal of talking done by the chiefs, and before the food is divided a great dance is held. Men and women are all gaily decorated with paints and feathers. The men dance in an inner circle and the women form a circle outside of them, and certain

intricate evolutions are carried through to the accompaniment of the music of drums and clapping of hands and the yelling and singing of the dancers. These public festivals are held in a place set apart, in the middle of which there is a sacred tree, generally a banyan or pine-tree.

Another peculiar belief is in the power of *tabu*. If a chief or any one tabu or consecrate something to a certain purpose, the one who breaks the tabu is sure to suffer for his sacrilege.

The above sketch of the character of these people does not apply to all the islands. In some of them the people have been changed from warlike cannibals into peaceful tillers of the ground and followers of other peaceful vocations, and the morality of some of the islands is now as marked as the former degradation. All agree that this result has been achieved by the efforts of the self-sacrificing missionaries who braved the rage of the cannibals and overcame the almost insurmountable difficulties in their way of christianising these islands. As well as the natural difficulties which faced them they had to encounter the determined opposition of unscrupulous traders, who did not hesitate to initiate these already degraded people into new vices. The drum and image which you have seen are the last of their kind made on the island of Erromanga, and this fact is sufficient to indicate the result of the work of the brave men who carried the light of our civilisation into this darkest of earth's dark places.

ORDINARY MEETING.

10th December, 1904.

Professor R. W. Reid, M.D., F.R.C.S., President, in the Chair.

The Minutes of the last meeting were read and approved.

Anatomical variations found in the course of practical work in the Anatomy Department of the University were described by several members of the Society.

Professor Reid showed and explained a series of models of the brain, ear and facial muscles which had been presented by Mr. Thomas Bryant, Consulting Surgeon to Guy's Hospital, London, to the Anatomical Museum. The models were made by the late Joseph Towne, for fifty-three years modeller to Guy's Hospital, and were the first attempts in this country in modelling parts of the human body in wax. They were mostly made from dissections by the late Mr. Hilton. Professor Reid also gave a short account of the life of Joseph Towne.

RECORD OF ANATOMICAL VARIATIONS.

Date of observation, November, 1904.
Sex, Female.

Additional head to biceps flexor cubiti (left).

The usual two heads were normal, while the additional head formed a strong fasciculus, posterior to the other two, and arose about the level of the insertion of the coraco-brachialis, $\frac{1}{4}$ inch to its outer side. The external cutaneous nerve did not pierce the coraco-

brachialis but gave a filament to this third head of the biceps. The superior profunda artery gave off no anterior branch, but an unusually long branch to the biceps took its place.

(Signature of observers) A. J. WILLIAMSON.
A. G. ANDERSON.

Date of observation, November, 1904.
Sex, Female.

Rectus sternalis muscle.

There are two of these, taking their origin in the aponeurosis of the pectoralis major over the seventh costal cartilage. The internal one passes almost vertically up about ½ inch from the median line to the fourth costal cartilage, bending inwards to be inserted at the junction between manubrium and gladiolus. It is mostly tendinous, having only a small fleshy belly reaching from fourth to third costal cartilages.

The external one passes up and out to the junction of the third cartilage with its rib, where it becomes attached to the pectoralis major by fascia. It is a flat muscle about ¼ inch broad, and is tendinous only at its origin, being fleshy from the fourth intercostal space to its insertion.

(Signature of observers) JAMES CONNER.
ROBERT W. EDDIE.

Date of observation, December, 1904.
Sex, Male.

Abnormal course of the right phrenic nerve.

After passing obliquely inwards across the anterior surface of the scalenus anticus muscle to reach the anterior surface of the carotid sheath, the nerve coursed downwards in front of the internal jugular vein, and passed from the neck between the subclavian vein and the clavicle.

(Signature of observer) ALEX. HORN.

Date of observation, December, 1904.
Sex, Female.

Abnormal insertion of pectoralis minor (left).

The tendon of insertion passed over the coracoid process in a well-defined groove, giving a slip to the process as it passed to be inserted into the capsule of the shoulder-joint. The outer margin of the tendon was very clearly defined, and lay on a line drawn from the posterior border of the greater tuberosity to the middle of the coracoid process. In such cases the coraco-humeral ligament is said to be weak or absent, but in this case it was very strong and well marked.

(Signature of observer) W. Wilson Jameson.

Date of observation, November, 1904.
Sex, Male.

Occurrence of a "Meckel's diverticulum".

In this subject it was found free in the middle line of the abdomen, its apex pointing downwards. It was attached to the bowel 4 feet 7½ inches from the ileo-caecal junction. It came off from the side opposite the mesenteric attachment. In the collapsed state it measured 5·5 cm. from base to apex; diameter at the base, 1·5 cm.; diameter at the widest part, 2 cm. On distension, it measured 5·5 cm. from base to apex; diameter at the base, 2 cm.; diameter at the widest part, 2·3 cm.; circumference at the widest part, 6·5 cm.

(Signature of observer) J. E. Kesson.

Date of observation, November, 1904.
Sex, Female.

Aberrant branch from the brachial artery (right).

This branch came off the brachial near its commencement, passed down in front and a little to the inner side of the brachial, then below the bicipital fascia into the forearm, at which point it crossed the brachial to get to its outer side. About an inch below the elbow-

joint it joined the radial, which came off in a peculiar manner. The radial came as a branch from the brachial opposite the elbow-joint, formed a small loop with its convexity outwards, and ended by joining this aberrant branch. The further course of the radial was normal.

(Signature of observer) BENJAMIN KNOWLES.

ORDINARY MEETING.

28TH JANUARY, 1905.

Professor R. W. REID, M.D., F.R.C.S., President,
in the Chair.

The Minutes of the last meeting were read and approved.

The President introduced Captain A. W. Cook Young, Indian Medical Service, who described his experiences "With the Tibet Mission Force to Lhassa, 1903-4".

Captain Young showed and explained a large number of curios. The lecture was illustrated by many lantern slides made from photographs taken by Captain Young during the expedition.

Dr. G. A. Maconachie, University Lecturer on Tropical Medicine, proposed a very hearty vote of thanks to Captain Young.

Professor MacWilliam also spoke.

"WITH THE TIBET MISSION FORCE TO LHASSA."

By Captain A. W. Cook Young, M.B., I.M.S.

(Read 28th January, 1905.)

Geography and Physical Features.—Tibet is on the north-east frontier of India, bounded on the south by the Himalaya ranges and the Yun Nan ranges. To the east are the Yun Ling mountains of China. To the north, towards Mongolia and Turkestan, are the Kuan Lun ranges. To the west the tableland narrows considerably and merges into the Pamir tablelands.

Extreme length from east to west is 1,600 miles.

Extreme breadth from north to south is 150 miles in the west to an average of 700 miles in the east. The area of Tibet is 700,000 square miles.

There are two parts, *viz.*, the Lake region in the west and north-west and the River region on the east, south and west. The former region is the Northern Plateau, 700 miles broad, very arid, flat valleys, surrounded and traversed by mountain ranges, with salt or alkaline lakes, intersected with streams, soil very boggy—saline, dotted with tussocks of grass, average altitude 16,000 feet, no trees, and vegetation very scanty. The tree line ceases at an altitude of about 13,000 feet, and the scrub at a height between 15,000 and 16,000 feet. Above this grass barely grows. Aconite grows freely at the higher elevations and caused the loss of many of our animals from poisoning. The native animals, the ponies and Yaks of Tibet, do not eat aconite.

The river region is on a lower elevation and consists of narrow valleys surrounded by mountains. Cultivation is excellent, especially from 12,000 feet downwards, while barley and turnips are the only

products of the higher valleys. Wheat, potatoes, peas, apricots, oranges and nuts are cultivated freely in the lower valleys. The water is as a rule excellent and plentiful. It is taken from streams and rivers and is frequently muddy in appearance as the streams are in most cases glacier fed.

Flowers grow in abundance in the upper valleys—wild violets, anemones and whole fields of purple wild forget-me-nots, etc., are met with.

In the higher valleys—15,000 to 16,000 feet—Goa or Tibetan gazelle are very common. Burrhel on the high, bare hills abound, with Ovis ammon, and, more rarely, Ovis polli. A very rare Tibetan deer—the Shao—is also found at 12,000 to 14,000 feet. The Kyang, or wild ass, is common on the 15,000 feet valleys, and very many are seen on the "Meadow of Wild Asses" round Lhassa. The Yak is the beast of burden and agriculture. It cannot work and exist below 14,000 feet. Donkeys are very commonly used in carrying loads and for trading.

The Climate is Healthy.—The air as one ascends becomes very rarefied, and unless one's heart is sound one could not exist. The cold is intense in January, February and March, as much sometimes as 23° of frost being registered, one's breath condensing and freezing to ice on one's pillow at night. Terrible hurricanes of wind are experienced on the upper tablelands, as a rule commencing about 10 A.M. and falling towards 5 P.M., but sometimes continuing for days. There is no really hot weather; the best month is July, when it is quite warm and pleasant. Snowstorms are worst in March, April and May. We had our first snowstorm in February, but it was slight. It is very dry in the upper tables, but from 13,000 feet down, there are very heavy rains in August, with violent thunderstorms, and the hills are all enveloped in mist for days.

Route taken by the Tibet Mission Force.—From Siliguri in India one passes up through Sikkim across the Teesta bridge, where the road from Darjeeling joins, up to Rangpo, from which one road leads up to Gangtok, the headquarters of the Political Officer of Sikkim,

over the Nathula (15,000 feet) and down to Chumbi. The other road leads up to Gnatong (13,000 feet), the frontier post of Tibet, over the Jelap La (15,000 feet), a very stiff ascent, by a very bad road, indeed many places a mere goat's track. The latter road was taken by the main column of the Mission Force. While ascending from Gnatong over the Jelap La mountain sickness was frequently experienced. The symptoms of this complaint are intense headache, aching eyes, perhaps blindness, severe nausea and heart weakness, greatly aggravated by the intense cold. Descending the other side of the Jelap one passes through Yatung Gate, the entrance to Tibet proper. Here are situated the Chinese customs. At Yatung the valley narrows, and a strong loop-holed wall is built right across it, and one passes through a gate and archway in the wall into Yatung village, inhabited by Chinese and Tibetans. Here one first met men using prayer-wheels. All the trees and bushes along the road are covered with prayers written on scraps of rice-paper and there are also great poles here and there bearing prayer-flags. We pass through a few Chinese villages across the Amo Chu by a Tibetan cantilever bridge into Chumbi, a very fertile and pleasant valley with the hillsides wooded with firs. Chumbi is 11,000 to 12,000 feet high, 105 miles from Siliguri, and was the headquarters of the Mission Escort during the winter. From Chumbi to Phari the road is at first very bad and steep rising over 15,000 feet on to Phari plain—a great icy plain absolutely treeless, with Phari fort standing in the middle of it. The fort or Jong is a large stone, English-like building, very old and broken-down in places, and one passes through a big gateway into the outer court-yard, with low buildings all round for animals, then through another big gate into an inner court-yard, and so into the fort building, which is many roomed, very thick walled and very dark. There are three or four very steep stairs, or rather ladders, leading up to the roof. There is one large room in the fort—the Temple—containing a few images of Buddha and a very large number of books. Other rooms contain armour and arms—guns, swords, bows and arrows, large quantities of powder and bullets. There are always

two Jong pöns in charge of the Tibetan forts under the Lhassa Government—one Jong pön is a Lama, the other is a layman. They collect all the taxes of that district, are responsible for the levy of troops and the good behaviour of the district, and under them are the village headmen or Tsopön, who are directly responsible for each individual village. From Phari one passes over the frightful wind-swept icy plain to Tuna. As there is no wood here, our fires were all of yak dung collected from the plain. From Tuna we pass through a loopholed Tibetan wall to Guru. Here the plain was very boggy and saline, as the lake had receded during the last ten years. From Guru one passes along the Bam Tso lake to Kala Tso, another large lake, ten miles from the former gradually descending to Kangma, where one comes once again into the tree line about ninety miles from Chumbi. From Kangma we pass through the Red Idol Gorge by a very bad road over boulders and across streams. Many of the rocks here have large images of Buddha carved on them and painted red. Passing through Niani village and monastery into the Gyantse valley, which is very pretty and fertile, we cross the Nyang Chu, on which Gyantse is situated, by an old Tibetan bridge into Gyantse. Here there is a large fort dominating the town. It is like Phari Jong, the only difference being that it is built on a rock and is much larger. It maintains 50 Chinese and 200 Tibetans, and is governed by one Dapön or Tibetan general. Gyantse is the mart for Bhutan. It is a fine town with houses built of stone and wood and flat roofed. The streets are narrow, dirty, rough and unpaved. In the centre of the town is the Golden Monastery, one of the finest monasteries in Tibet, with a nine-storeyed pagoda attached to it. The town is famous for its carpets and cloths, there being some large carpet factories in the town and neighbouring villages. From Gyantse the road is at first good and along a fine open valley, then it leads through various gorges and streams ascending steadily to the Karo La, 16,000 feet high, forty-five miles from Gyantse. Here the Tibetans had built a strong loop-holed wall half a mile long across the road. The elevation here was very trying, and though we were here from the 17th to 19th July

the cold was intense at night. Crossing the Karo Pass, one descends to Nangartse, another Jong on the Yamduk Tso or Turquoise lake, which is two to three miles wide and thirty-five miles in circumference. The valley here is smiling and fertile, and passing many flourishing villages along the lake, one comes to the Pete Jong, fifteen miles from Nangartse. We soon leave the lake and cross the Kamba La (15,000 feet), a very stiff climb and very difficult descent to the Yara Tsangpo or Brahmaputra valley. On reaching the river at Chaksam Ferry, one again is in the midst of a very fertile and flourishing country, and we are now 105 miles from Gyantse. The river Tsangpo is difficult and dangerous to cross owing to many whirlpools. We crossed it by two Tibetan junks and Tibetan skin-boats made out of yak skins, and four Berthon boats which we brought with us. It took us six days to cross it: the breadth of the river at the crossing being about 400 yards. On crossing this river, we are within forty miles of Lhassa by a road which runs along the right bank of the Ki Chu, on which Lhassa stands, passing through big villages and many woods and good cultivated land. If the river is high after the rain the most of the road is under water, and in some places is over very bad ground, along the edge of rocks leading to Toölung on the Toölung Chu river which joins the stream of the Ki Chu here. There are very fine houses here, surrounded by gardens and groves of trees, belonging to civil officials of Lhassa, which is six miles farther on. Crossing the Toölung Chu by a fine strong bridge, and then through a fine flourishing wooded country past the old fort of Lhassa, we come a little farther on to Daipung Monastery, the largest monastery in the world, containing 7,000 monks and situated on the face of a mountain. It is a very fine building, and has beside it the temple of Nachung Choskyung, where the astrologer, who discovers each Dalai Lama, lives. It is a fine golden-roofed building in a grove of trees, with a large marble court-yard surrounded by fine roses and flowers. Passing on one crosses the "Meadow of Wild Asses," a very marshy plain, along the bank of the Ki Chu up to the circular road surrounding Lhassa city, and through the gateway under the shadow of the Potala

and so into Lhassa, 140 miles from Gyantse and 360 miles from Siliguri.

Nothing is seen of Lhassa in the distance except the Potala on the left and the Medical College, on a hill, on the right side. The city lies in a hollow surrounded by woods and fields, and the whole place is dominated by the Potala, which is a long high building of red stone, tapering towards the top. Its base is surrounded by walled-in paved paths and winding steps of white stone up to doors in the building. The place looks very dilapidated on closer inspection, with an extraordinary amount of rubbish and refuse all round it.

The circular road is very good and well-made. It runs round Lhassa, and on it pilgrims are constantly moving in procession following the sun, manipulating their prayer-wheels and chanting their prayers, and every now and then measuring their length in the dust. Passing along the road one sees the Chinese temple and houses near the entrance-gate of Lhassa. On passing through this archway or gate, surmounted and flanked by chortens, with the Potala to the left and the Medical College to the right, we get within the confines of the city, and to our left at the base of the Potala are seen a large number of prison buildings. The roads are very bad, muddy and unpaved. A large sleepy but cheerful crowd, poorly dressed and very dirty, throng the streets, which are also full of dogs and pigs. The houses in the streets are high and narrow, built of stone and wood. They appear very old and rather dilapidated. The windows are of glazed rice-paper, and the rooms on the ground floor are used mainly as shops, where skins, china, cloths and cloisonné work, etc., mostly of Chinese manufacture, are sold ; but no great desire is shown by the seller to sell anything. Other places on the ground floor house animals, and serve as store-rooms for grain, etc. The upper rooms are used to live in, and the windows of these are crowded with women and children gazing on us as we pass. To gain the upper rooms one passes up a steep ladder. The fuel burned by the better class of people is wood, and yak dung by the poorer classes. There are no chimneys, a hole in the roof or the windows serving as such.

The Chinese Amban's house is in the centre of the city, surrounded by high walls and many old trees, and approached through four court-yards.

Physical Appearance and Disposition of the Tibetan.—He is very courteous in manner. On meeting you he takes off his hat and bows, and, as a mark of great respect, protrudes his tongue. If very servile he also puts his thumbs up. On nearing a friendly village the headman would meet us with bowls of milk and eggs, and, before offering the milk to us, they would drink a little of it first to show it was not poisoned. He is exceedingly grateful for anything done for him, and when treated for wounds, etc., is quite pleased to submit to operation and treatment, and placed great trust in us. After being discharged from hospital, he often sent eggs and chickens to the medical officers. He is, as a rule, tall, strong and muscular, with legs and arms well developed, and complexion fair as compared with that of a native of India. Many, especially of the better class, have pigtails. Where the hair is cut it is wavy. The beard is generally very sparse; the type of face is Mongolian, and mostly very ugly; cheek bones are high; the nose is thick and depressed at the root; nostrils broad; mouth generally rather thick-lipped; teeth strong, but irregular; small slit-like eyes; the ears stand out from the head, rather far back; the voice is full, deep and powerful. They are a kind and simple people, very cheerful, but lacking in enterprise. They seem also a very healthy people. The woman is, as a rule, ugly, small and squat; many smear their faces with pig's blood, apparently to repel the attractions of the men. The married women wear on their heads a cage-like tiara of wire or whalebone covered with cloth, and studded with turquoises and coloured beads. They are very averse to being photographed, and it was most difficult to get a snapshot of them. They are very strong, and carry enormous loads on their backs, held on by flat straw ropes round the forehead or shoulders. Very few of them are pretty. The men and women dress practically alike, the only difference being that the men wear a small round cap and the women are bareheaded. The dress is a thick cloth robe with very wide sleeves,

open at the neck, crossed at the waist, and tied so. The robe reaches to the knees; they have short trousers tucked into bright-coloured cloth, "top" boots with thick rope or hide soles. The monk or lama is always bareheaded and clean shaven; his robe is red, with a hood, and reaches to his heels; the higher priests wear yellow robes. Their names change with the seasons of the year every four months, but they appear to have one permanent name, a name of the day of the week, presumably the day on which they were born, *e.g.*, Parsong, meaning Friday, is a common name, also Tsring, meaning Sunday.

Mode of Life of the Tibetan.—This is very simple. The ordinary Tibetan house is a square stone building, three sides of which are occupied as living rooms, while the fourth is the gateway leading into the court-yard. Just outside the house is the threshing floor, a clean, hard-baked square, where all the grain is threshed with a flail. From the court-yard low doorways lead into the rooms on each of the three sides. The interiors of the rooms are lined with wood; the lower rooms are generally used for housing animals and for storerooms; a ladder-like stair leads up to the next floor where the people live. The cooking, washing, etc., are done in the court-yard. Tibetans dispense with beds altogether, and lie on rugs spread on the floor. Here and there one sees mills driven by water; these are for grinding the grain. The staple diet of Tibet is tsampo, or barley meal, which is eaten mixed with either hot or cold water. A Tibetan on a journey generally carries a little bag of tsampo attached by a string to his waist. Another common food is dried mutton eaten raw either with or without tsampo, and is torn off in strips. A Tibetan always keeps his cow or goat, for he is fond of milk.

Both men and women are inveterate smokers of cigarettes, which they make themselves, or which are brought from Darjeeling or China. Some smoke long Chinese pipes. The men are very intemperate and frequently get intoxicated on rice beer or chang; these they make themselves, and they are sold in various houses along the road. Tea can also be obtained there, the Tibetan being inordinately fond of his tea, which he prefers buttered. This is an acquired taste. The women

are exceedingly fond of jewellery, and are loaded with cheap turquoise and coloured bead necklaces. Charm boxes of silver or brass containing a small image of some god and a few grains of barley are hung from their necks. They wear numerous bangles of every description, made of silver, lead or anything they can get. The Tibet man as well as his Scottish brother is very fond of a pinch of snuff, which he carries in a leather pouch attached to his waist.

Industries.—In the lower valleys, where the soil is very fertile, agriculture is carried on to a large extent, but in a very primitive manner, the woman going in front sowing the seed and her lord and master following with a plough and yak turning up the soil and covering in the seed all at the one time. Carpet making is one of the chief industries and extensively followed in Gyantse. The carpets are in various designs and colours, and a hearthrug may be purchased for seven rupees. Here also are made the prayer mats, which are about one yard square, heavily fringed and with a sacred device in the centre. A spinning wheel similar to those in this country is practically found in every house, the wool from their ordinary sheep being woven into cloth. After being made the cloth is dyed various colours, the dye being obtained from native plants and flowers growing on the hills. Stone carving of a rough nature is largely practised, the designs usually being of a sacred character.

Amusements.—Tibet is not a country given over to wild enjoyment; the people do not play cricket, football, or any of the games so familiar to us. Trials of strength, such as weight-lifting and wrestling, appeal to them principally. Horse riding is much practised, as most of them own some kind of a quadruped, be it good or otherwise, but it is generally otherwise. Tibetans are very fond of music, and the usual instrument is something like a mandoline, and to this the women and children dance. They are very fond of dancing and music, and generally their voices can be heard in song as they pursue their domestic avocations. On specially sacred occasions they dance the devil dance, dressed fantastically with a devil mask, necklace, bracelets, and apron of human bones, and a devil dancing robe and

dagger made of wood or brass. They perform this as a sacred rite.

Punishments.—The Tibetans do not directly take life, but they make the victim's life a burden to him till he longs for death. Flogging is common and very severe, and solitary confinement in dark dungeons is often resorted to. Thieves have their eyes burned out with hot plates, and thus there are many blind beggars in Tibet. Traitors and spies undergo a very horrible punishment, which consists in the skin of the abdomen being cut and pulled over the head, the poor wretch being left while vultures and other birds of prey feed on him till he dies.

Marriage Customs.—Polyandry is the custom of the country. The brothers of one family as a rule, but not always, have one wife in common. They appear to live very happily together, and the women and children are well treated.

Funeral Customs.—The Tibetans do not bury their dead. The high funeral custom is a great festival held at night under the direction of the chief lama, toms-toms are sounded, bells ring, gongs are beaten, horns blown till the noise attracts all the dogs of the neighbourhood. The head lama cuts up the body into small pieces, throws these to the four winds chanting some prayers while the dogs eat the pieces. This being done the officiating lama has a bowl of tsampo and water brought to him, he mixes this with his hands, and washes off the last remnant of the corpse from his hands and knives, so that nothing may be lost. This mixture is given to the dogs. On some occasions, as in the case of the funeral of a high lama, the thigh bone and skull of the corpse is preserved. The former is made into a horn, the latter into either a drinking vessel or tom-tom. Another method of disposing of the dead is by feeding fish with the fragments. This appears to be reserved for the more sacred bodies of chief lamas, and there are many pools round Lhassa containing enormous fish, which are sacred and supposed to contain the souls of these lamas. I once saw the body of a child brought down to a river, and after a few prayers being said over it, it was cast into the

river. This I believe is the method followed by the poorer class who cannot afford to pay for the services of a priest. In Gyantse and Lhassa I saw a certain class of beggar called Rhagubias, which, in times of famine, are fed on corpses.

After an action, when *we* buried their dead, the Tibetans always came and dug them up again, and left them for the animals and birds of prey.

Weapons.—The sword is *the* weapon of Tibet. It is long and heavy, and wielded with both hands, and always kept sharpened and ready for use. A dagger or kukri is almost invariably carried in the folds of his dress by a Tibetan, a matchlock gun fitted with prongs for resting on the ground, and a bandolier and powder-horn slung round the neck. Jingals are their artillery; these are a large kind of matchlock, firing a bullet as large or larger than a man's fist. Through our glasses we could see the Tibetan soldier firing them by running from one to another with a lighted torch. A Martini-Henry pattern rifle called a "Lhassa rifle" is used by the soldiers. The bullet is explosive, composed of clay encased in soft lead and made by the soldiers. Bows, arrows and shields are found in the old forts, but never used in warfare. Sometimes the bows and arrows are used for killing animals for the sake of their skins. A disagreeable feature of their offensive operations against us was the poisoning of the running streams by aconite. This was done by tying bundles of aconite roots loosely together, and laying them in the water. We did not lose many men from this, as fish lying dead in the river warned us.

Diseases.—Small-pox is the disease of Tibet; every other Tibetan is deeply pitted and marked by this dread disease. Syphilis is very common. Much congenital syphilis is met with, and deformities resulting therefrom. On the whole, the Tibetans appear a very healthy race, their lungs and hearts seem very sound. They have wonderful recuperative powers, and stood operations after injuries where no European or Indian could have survived; wounds even with the smallest amount of attention rarely suppurated. A case came under my notice of a Tibetan who had been wounded three months before

with a bullet through the groin and right side injuring the bowel also. The wound had been left severely alone, and the man, very much emaciated, was still alive, although living in a filthy condition, with much suppuration from the wounds. Native doctors' methods seem *nil.* There is a medical college in Lhassa, which is a downright farce. We could discover nothing that was taught there, or perhaps it was that they would not "give anything away". When asked what their treatment for dysentery was, a man went out, and, bringing in a handful of grass from the hillside, told us that was their treatment.

Religion and Monasteries.—Of their religion I know nothing but that they are Buddhists. There are numerous monasteries, which are always large buildings, and the largest of all, which is also the largest in the world, is Daipung, containing 7,000 monks. These monasteries are invariably built on the face of a mountain; the chief abbot's house is built higher up on the mountain above the monastery, which is a detached building or buildings, usually about ten. The main one is usually of red brick or stone painted red, sometimes red and yellow; the better ones have gilded roofs, and are two or three storeys high. The main building is the temple and the chief room is long and spacious. Over the ceiling and from it hang rich tapestries, but these are only in the grand rooms; the walls and pillars are covered with silk or other scrolls; the room is very dark, excepting round the altar, which is in the middle of one side and which has hundreds of small oil lamps burning night and day. Here are also all kinds of vessels, images, etc. Behind the altar is a curtained recess containing a large image of Buddha. Long rows of benches round the altar, covered with thick mats, accommodate the sentinel monks. Out of this large room is an idol room full of idols of all shapes and sizes. There are altogether many rooms, both up and down stairs, containing books bound in wood, trumpets, gongs, bells, etc. In one room, "The Devil Dancing Room," are all the materials for the devil dance; the walls are painted with hideous figures of the devil in every imaginable shape and form. There are robes and masks of fearful visage, daggers of wood and brass, human bone aprons, light

armour and swords, bows and arrows; all for use in the devil dance.

Government.—The supreme control is by high Chinese officials at Lhassa. There are two distinct administrations, one under the Dalai Lama and the other under local kings and chiefs. A native chief's name is Pombo. Under the Dalai Lama are five Shapés or ministers of State, who manage all secular affairs under the supervision of the Chinese Amban. The army is under the Amban, a Tibetan generalissimo or magpon, six depons or generals, and six rupons or majors, with large numbers of smaller officers. The army is nominally 6,000 men on active service for three years, and at home on half-pay for three years. After this the men are placed on the reserve. Taxes are mostly paid in kind, sheep, ponies, wool, butter, clothes, etc. The usual coin is a tankar, value about 6d. When smaller sums are required, this coin, which is silver, is broken into pieces according to the value required.

ORDINARY MEETING.

18th February, 1905.

Professor R. W. Reid, M.D., F.R.C.S., President, in the Chair.

The Minutes of the last meeting were read and approved.

Anatomical variations found in the course of practical work in the Anatomy Department of the University were described by several members of the Society.

Mr. James Clark, M.B., Ch.B., Junior Assistant to the Professor of Anatomy, exhibited and described the distorted feet of a Chinese female. These along with the shoes which had been worn during life by the individual had been presented to the Anatomical Museum by Mr. R. W. C. Middleton, M.B., D.P.H., Aberd.; Medical Officer of Health for Singapore. Mr. Clark had carefully dissected one of the feet and illustrated his paper by casts of the feet and ankles and by a series of photographs and skiagrams, prepared in the Anatomy Department of the University. Mr. Clark was heartily thanked for his paper.

RECORD OF ANATOMICAL VARIATIONS.

Date of observation, February, 1905.
Sex, Male.

High radial artery (right).

Here the radial artery came off at the insertion of the coraco-brachialis. It passed down the inner side of the artery, crossing it in the anticubital space. The course was then normal. This high radial

gave off the inferior profunda just below its origin from the brachial. The left arm was normal.

(Signatures of observers) A. J. D. CAMERON.
H. G. R. JAMIESON.

Date of Observation, February, 1905.
Sex, Male.

Additional head to biceps flexor cubiti (right).

This head arises from the humerus close to the insertion of the coraco-brachialis. It then crosses under the brachial and high radial arteries—this subject having a high radial—passing down on their outer side to become inserted into the semilunar fascia. The abnormality was absent in the other arm.

(Signature of observers) A. J. D. CAMERON.
H. G. R. JAMIESON.

Date of observation, February, 1905.
Sex, Male.

Abnormal bifurcation of the brachial artery.

The artery here divided into an internal and an external division about an inch and a half below its commencement. The internal division descended for about an inch, and after doing so it crossed the external division and the median nerve giving off at the same time the inferior profunda. It passed beneath the bicipital fascia to become the radial. The external division followed the usual course of the brachial artery, becoming ultimately the ulnar.

(Signature of observer) ALEX. A. BISSET.

Date of observation, February, 1905.
Sex, Male.

Abnormal muscular slip in the thigh.

A ribbon-like muscle about ½ inch broad runs down the back of the thigh and through the popliteal space to the back of the leg. It

arises from the middle of the inner border of the biceps, and passing down and in, is applied to the outer border of the semitendinosus. Opposite the popliteal space, it sends a fascial process to the deep fascia there. It then ends in a round slender tendon, which is inserted into the inner head of the gastrocnemius about a quarter of an inch above the commencement of the tendo Achillis.

(Signature of observer) J. Elder.

Date of observation, February, 1905.
Sex, Male.

Cervical ribs.

The left rib articulates with the seventh cervical vertebra behind, passing downwards and forwards to articulate with the first rib proper, just behind the groove for the subclavian vein. The groove for the artery is absent, owing to the latter passing over the articulation. It is placed so as to have superior and inferior borders, and internal and external surfaces. It measures 6·2 cm. in length, and 7·5 mm. in width at the centre but expands at the ends. These measurements differ slightly from those of the right side. Following the curvature of the first rib, the anterior articulation is about 12 cm. from the centre of the suprasternal notch. The rib has practically no curvature.

The relations are as follows:—arching from within outwards over the superior border, and in order from before backwards are the subclavian artery which crosses the articulation, the suprascapular artery and the cords of the brachial plexus.

The phrenic nerve is separated from it by the cords of the plexus, while the transversalis colli artery is separated from it by the scalenus anticus muscle. The latter muscle is internal to the rib, and is just in apposition with it at its lower and inner end. The subclavian vein crosses the first rib in front of the articulation.

Internally pleura is attached to the lower half of the inner surface. Externally the rib is covered on its outer surface by the fibres of

the scalenus anticus, whose fibres are inserted into the upper border of the cervical rib at its posterior part. These are fibres continued across the outer surface of the rib, and slope forwards to be inserted into the first rib, completely filling up the space between the two bones. On the inside one or two fibres slope in the same direction as the internal intercostal muscle, so that this part of the muscle between the ribs may be described as an extra intercostal muscle. Behind the rib is in relation with the deep muscles of the back of the neck.

The rib occurred also on the right side, the differences being mostly in size, thus:—

Length 11·2 cm. outside measurement.
7·7 cm. from outside angle to first dorsal rib articulation.
3·5 cm. from angle to body of seventh cervical vertebra.

(Signature of observers) J. B. Cruickshank.
R. F. Twort.

Date of observation, February, 1905.

A preauricular appendage to the right pinna of a foetus of the later months of gestation.

This is a cylindrical process which arises between and immediately in front of the tragus and the crus helicis. It first passes outwards and a little downwards, and then downwards and slightly forwards, and terminates in a pointed extremity which is covered by five or six hairs. The length is one centimètre, and the circumference is ·9 centimètre, but at what one might call its neck there is a slight constriction. The relative proportion of its length to that of the pinna is as two is to five. The pinna seems otherwise normal.

On section it was found to consist microscopically of a rod of yellow cartilage covered by skin.

As to the cause, the process may have become in some way fixed to the amnion, and thus, as development proceeded, got pulled outwards, or the tubercles forming the tragus and the crus helicis

may not have joined together. This theory is supported by the fact that in the development of the face, if the nasal and the maxillary processes do not join, polypoid projections are formed. In the pinna the commonest sites of non-union of the tubercles is the position of this auricular appendage, *i.e.*, between the tragus and the crus helicis, or between the helix and the antihelix. During development, the tubercle forming the tragus becomes slightly constricted into three tubercles lying vertically above each other. The highest can often be felt in the adult ear, and it seems to me possible that over-development of this could produce such an auricular appendage.

(Signature of observer) R. W. A. Salmond.

DESCRIPTION OF THE DISTORTED FEET OF A CHINESE FEMALE.

By James Clark, M.B., Ch.B., Second Assistant to the Professor of Anatomy, Aberdeen University.

(Read 18th February, 1905.)

The distorted feet of a Chinese female were presented recently to Professor Reid for the Anatomical Museum by Mr. W. R. C. Middleton, Medical Officer of Health, Singapore, and by the kind permission of Professor Reid I have dissected one of them, and have the privilege of exhibiting them to the Society.

Owing to the peculiar superstitions of the Chinese these specimens are very hard to get, and we are the more indebted to Mr. Middleton on this account for giving us the opportunity of seeing such fine examples. Enclosed with the specimens were the shoes worn during life, which are of the usual Chinese variety, made of brightly coloured cloth with canvas soles and long wooden heels shod with leather.

Mr. Middleton has furnished us with the following interesting particulars of the subject from which the feet were taken: "The woman's age was thirty-one. She was a full-grown, stout woman, weighing about 11 stones and 5 feet 5 inches in height. The circumference of the leg at the calf was 10¾ inches, and there was at least ½ inch of fat under the skin, so that the calf muscles showed a good deal of atrophy."

The legs have been sawn through below the calf, somewhat below the mid point between the malleoli and the knee. The upper end of each specimen shows a considerable layer of subcutaneous fat, but

the lower part of the leg and foot is hard and shrivelled. The foot is short and shows excessive plantar flexion, the sharpest bend being at the medio-tarsal joint, but the bend is also shared by the tarso-metatarsal and ankle joints (Plate I.). So great is the bending that the shafts of the metatarsal bones approach the vertical plane, and are almost in the same vertical line as the anterior border of the tibia. In consequence of this plantar flexion the heads of the metatarsal bones project far below the heel, and immediately in front of the heel there is a deep sulcus corresponding to the arch of the instep, the anterior or metatarsal fold of skin and the heel skin being quite in apposition in the sulcus.

The heel is very much flattened on its lower surface, and the skin is thick owing to the weight of the body being supported on this portion by means of the long heel to the shoe. Owing to the vertical direction of the metatarsal bones the plane of the heel makes little more than a right angle with the metatarsus. The great and the second toe are extended almost to a right angle upon the metatarsal bones, and show callosities upon their under surface from pressure when walking. The inner toes are flexed and crushed under the great toe, little of them being seen from the dorsal aspect, even the nails being on the plantar surface. These toes also show callosities from pressure.

The following are measurements of the left foot :—

Circumference at upper end - - - - - -	22 cm.
Circumference at internal malleolus - - - - -	18·7 cm.
Circumference round heel and foot at tarso-metatarsal joint -	23 cm.
Circumference at head of first metatarsal bone - - -	13·5 cm.
Total length of foot from tip of great toe to back of heel -	13 cm.
Length from back of heel to base of second metatarsal bone	8·7 cm.
Great toe projects below plane of heel - - - -	6·3 cm.
Breadth of foot across heads of metatarsal bones - -	5·3 cm.
Depth of sulcus in front of heel - - - - - - -	2·3 cm.
Heel pad is roughly circular with a diameter of - - -	5 cm.

On removing the skin, which was very hard and dry, a consider-

able layer of subcutaneous fat was found all over, except on the front of the foot where the skin was thinner, and between it and the tendons only some loose areolar tissue intervened. Over the heel the depth of the pad of fat varied from ½ inch at the circumference to ¼ inch at the centre. In the fat were found the superficial veins, but these were quite normal in every way. The cutaneous nerves were of very large size, probably due to the preservative used in the preparation of the specimen. The external saphenous nerve took the place of the outer branch of the musculo-cutaneous nerve, and supplied the outer two and a half toes, but the other nerve showed no departure from the normal. The deep nerves and arteries are normal in their distribution. The annular ligaments are poorly marked, especially the anterior. The vertical portion of the latter ligament could not be defined, and only the upper part of the horizontal portion could be demonstrated. The internal and external annular ligaments have their usual attachments. The plantar fascia is very poorly marked and somewhat fragmentary, only the central portion over the flexor brevis digitorum being made out. Tibialis anticus shows a very strong tendon, and at the upper part a few muscle fibres are seen joining its posterior surface. The insertion is quite normal. Extensor proprius hallucis and extensor longus digitorum likewise are represented in the specimen (Fig. 1) by tendons only, which are of fair average size and normal in insertion. Each tendon is joined by a few muscle fibres in its upper part. Almost the whole of peroneous tertius is shown, and it is a fairly large muscle with the usual origin and insertion. Extensor brevis digitorum is of average size, and shows no abnormality in its origin. The tendon and muscle belly going to the great toe is considerably separated from the rest of the muscle, while an additional slip of the muscle is lying external to the rest and sends a tendon to become united to the extensor tendon of the little toe. Peroneus longus and brevis muscles, of which little but the tendons are visible, are of fair average size and appear normal in every respect. Tendo Achilles is slightly thinner than usual, but otherwise normal. It

receives muscle fibres on its anterior surface to within three inches of its lower end. Tibialis posticus, flexor longus digitorum and flexor longus hallucis muscles show no departure from their normal size and position so far as seen in the specimen. The muscles of the sole of the foot are all normal in origin and insertion, and are little diminished in size. The superficial layer may be defined, but the muscle fibres are poorly developed and are mixed up with a con-

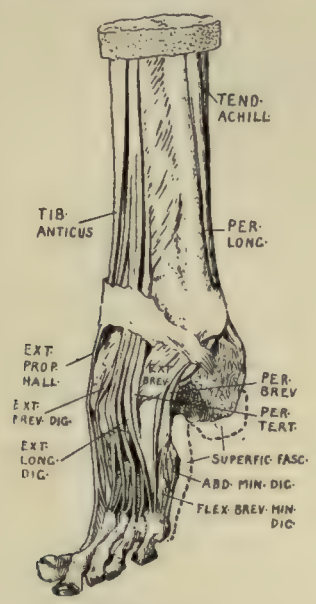


Fig. 1.

siderable amount of fat, the bellies of the muscles being very soft and friable. The deeper muscles are also infiltrated with fat and are much matted, so that it is almost impossible to define them accurately.

The bones of the foot as shown by the skiagram (Plate I.) are very little changed. Every individual bone seems almost perfect in every detail, so far as can be made out, and even the phalanges of the curled-up toes are all present. The deformity seems to be brought about by the excessive bending which has occurred at the various joints. The tuberosity of the os calcis is much depressed, and consequently the bone lies in a sloping position. The astragalus appears to be fairly

well in place, and so far as one can judge pretty normal in shape. The scaphoid is displaced backwarks well under the head of the astragalus, and the cuneiform bones are also turned under the scaphoid, with the result that the metatarsal bones are almost vertical in their long axes. The metatarsal bones themselves are pretty normal in length and shape, and are only changed in position. The phalanges of the great and second toes articulate with the heads of the metatarsal bones on their dorsal aspect, and thus the toes make little more than a right angle with the metatarsus.

Now let us consider how this distortion is brought about. There is very little reliable information to be had with regard to the custom. All that I have been able to get has been from such unreliable sources as the writings of globe trotters and stray references in the writings of missionaries. The process begins when the girl is from five to eight years of age, and is attended with excruciating pain. Long strips of calico about two inches wide are prepared, and the process starts by turning in the four outer toes under the great one, and bending the whole back towards the heel, the bandages holding the foot in position. The bandages are gradually tightened every day in spite of the agony of the poor girl, and the instep becomes more and more convex, and a chasm is formed between the heel and the front of the foot. This is persisted in until the foot has been sufficiently compressed to be put within the narrow confines of the shoe. Even after this, the feet must be kept constantly bound else they would gradually expand to their natural proportions.

The feet which we have here have expanded very considerably since having been removed from the body, as the shoes worn during life cannot now be put on. While the process of shaping the feet is going on the girl is unable to move about, and it may be two years before she can walk. Even after that, the walking cannot be called elegant, as owing to the rigidity of the foot the person walks as if on stilts, but in spite of that, she can get along the badly paved streets with wonderful rapidity.

One asks, why is this cruel custom practised? At present it is

Skiagram of distorted foot of Chinese female.
Right foot viewed from inner aspect.

practised for the same reason that we do many absurd things, *i.e.*, because it is the fashion. The origin of this absurd custom is a little uncertain. It is an old one, and some date it back to the favourite wife of an emperor who bound her feet till they were the shape of the new moon. Another theory is that it arose from the fact that the favourite concubine of another emperor had club feet and that the ladies of the court set themselves to imitate them. The true reason according to Professor Giles, Professor of Chinese in Cambridge University, is a sexual one. This view is pretty well borne out by the well-known retort of the Chinese woman when a lady missionary was remonstrating with her for being a victim of such a horrible custom; "me squeezy foot," she said, "you squeezy waist, both for same reason, get husband".

ORDINARY MEETING.

10th June, 1905.

Professor R. W. Reid, M.D., F.R.C.S., President,
in the Chair.

The Minutes of the last meeting were read and approved.

The President exhibited and explained a photograph of a Hausa barber-doctor wet-cupping a native for rheumatism. The photograph had been taken by Dr. Gordon Grant, Johannesburg, who has travelled extensively in Hausaland.

A paper on "The Dissecting Instruments of the Greek and Roman Anatomists," by Dr. J. S. Milne, Hartlepool, was read by the Secretary in the absence of Dr. Milne. The paper was illustrated by lantern slides and actual specimens. Dr. Milne was thanked for his paper.

Mr. Alex. Low next described two short stone cists, recently found, one in the parish of Aberdour, and the other in the parish of Skene. Their contents had been very kindly handed over to the Anatomical Museum, in the one case by Mr. Dingwall Fordyce, of Brucklay, and in the other by Mrs. Proctor and the Trustees of the Kirkville estate.

The President exhibited a series of skulls from New Guinea, which had been presented to the Anatomical Museum by Dr. Craigen, Chief Medical Officer and Member of the Executive and Legislative Councils, British New Guinea.

THE DISSECTING INSTRUMENTS OF THE GREEK AND ROMAN ANATOMISTS.

By J. S. Milne, M.A., M.D., Hartlepool.

(Read 10th June, 1905.)

The information we possess about the instruments in use by the Græco-Roman anatomists is entirely contained in the work by Galen, entitled ΠΕΡΙ ΑΝΑΤΟΜΙΚΩΝ ΕΓΧΕΙΡΗΣΕΩΝ, *i.e.*, "On Practical Anatomy". The other extant works on anatomy are purely descriptive or theoretical, and contain no references to instruments. Galen lived from A.D. 130-200. He was a most voluminous writer on surgery and anatomy, and knew far more about these subjects than most people at the present day would give him credit for. The most accessible edition of his works is one by Kuchon, in twenty volumes, containing the Greek text, with a Latin translation. The work on dissection consists of nine books. Mention is made of dissection of human bodies by other persons, but Galen himself only advocates dissection of various animals, such as apes and piglings; and, as the dissection of animals was sometimes of the nature of vivisection, it is natural that surgical instruments were used, just as at the present day some of the instruments we use are common to the dissecting-room and operating theatre. In several cases, however, a description is given of special instruments for dissection, such as special knives for laying open the vertebral canal. For the coarser manipulations in dissecting animals, domestic and artisan's implements were used.

Scalpels.

The handle of the typical scalpel consisted of bronze, the steel blade being inserted into a slot at the end and fixed by winding a

thread round the handle (Fig. 1). Very often at the top of the handle there are two holes through which to pass the thread, thus preventing it from slipping off (Fig. 2). In most of the instruments the steel has entirely disappeared, except the part let into the bronze. Still a considerable number of blades survive. The other end of the handle ends in a leaf-shaped blade of bronze, which Celsus calls the manubriolus, and which was largely used for blunt dissection. The various forms of blade used by ancient surgeons comprise practically every form of knife used by surgeons at the present day. A marble votive tablet depicting a box of scalpels discovered in the temple of Æsculapius on the Acropolis at Athens shows several forms, and probably indicates the varieties in most common use (Plate II.). The scalpels, it will be noted, lie head and tail in a box of the same general appearance as one of our boxes for mathematical instruments, and all except one have the typical leaf-shaped termination to the handle. The exception is one which ends in a curved hook. This was used

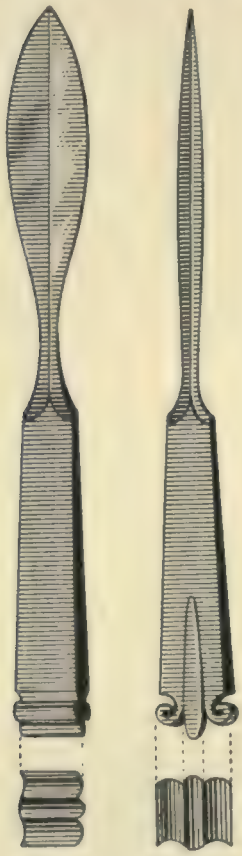


Fig. 1.—Two views of a bronze scalpel handle of typical shape, showing dissecting manubriolus at one end and slot with remains of steel blade at the other. It belonged to an oculist named Solemnis of the third century (*Annales de la Société d'Agriculture, etc., du Puy*, 1864-5).

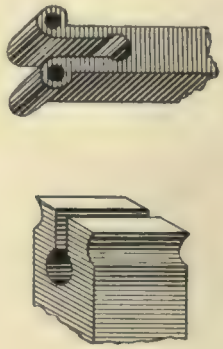


Fig. 2.—Diagrams to show different methods of fixing blades.

as a blunt hook, and also, as we know from Rufus of Ephesus, for extracting the calculus in lithotomy. The prevailing type of scalpel, be it noted, is a bellied scalpel, of a form not in use at the present day, but really a most serviceable instrument, and, judging also by the large proportion in which it figures among the scalpels excavated in Pompeii, it seems to have been almost the typical form. This form of blade is referred to by Hippocrates as the "chest-like" snipe (στηθοειδής), because it is like the chest on antero-posterior section. Galen calls it the bellied scalpel in another work, but he does not mention it specially by name in his anatomical writings.

Blades of the general form of the manubriolus described, *i.e.*, with the edges running together at the tip, are called by the Greeks μυρσινοειδής—shaped like a myrtle—and Galen mentions scalpels of this shape as used in dissection.

In Book viii., in describing the dissection of the thorax, he mentions a scalpel with the curved part forged so that the edges on either side are sharp, but concave on one side and convex on the other.

A scalpel with the tip curving slightly inwards was called σκολοπομαχαίριον, scolopomachærion (σκολόπαξ, a snipe; μαχαίριον, scalpel), and this knife is mentioned in the dissection of the vertebral canal. He divides the arches by a knife invented by himself, shaped like a scolopomachærion, and made of the best steel, such as is made in Norica, so that it may neither blunt quickly, nor bend nor break, but larger than the surgical instrument, so that it may go ahead quickly (Book viii., c. 6). The above passage is interesting as showing in actual words the quality of the steel at the disposal of the ancient anatomist, although we have plenty of outside evidence to show that good steel was quite plentiful.

He goes on to describe another special knife used in the further opening up of the canal—the "long knife" (προμήκες μαχαίριον). "This," he says, "I call the one which has two sharp edges running into one at the tip." Galen himself describes exactly what he means by "προμήκες" as applied to an instrument in another place.

Hippocrates uses the word in describing certain cauteries, and Galen, in a note on this passage in Hippocrates, says that the word is applied to instruments long in proportion to their breadth. This knife, then, had a long, sharp-pointed blade, with both edges cutting.

In Book ix. he describes the dissection of the brain of an ox. These ox brains, he says, are sold in many cities with the skull removed, but if you wish to remove it yourself you may do it with a butcher's knife (μάχαιρα). These butchers' knives are of the general form known as "culter" or "cultellus" by the Romans. Fig. 5, Plate III., shows a typical butcher's knife of steel from a camp at Sandy in Bedfordshire. They very often had a "heel," and were, therefore, unsuited for purely surgical work. The Latin surgeons are careful not to use the word "culter" or "cultellus" in describing surgical knives, but always use the word "scalpellus".

Probes.

In one single passage, in describing the dissection of the veins about the Torcular Herophili, Galen names three varieties of the surgical probe.

1. The spathomele.
2. Ear probes.
3. Probes with an olivary enlargement at either end.

In another passage he mentions the plain probe without enlargement at either end. These probes, he says, may be of bronze, iron or silver; but he prefers them made of some dense wood, like boxwood, so that when used as directors to cut on they do not chip the scalpel. There should be several sizes of each. Numerous probes of all these varieties mentioned by Galen are known, many in bronze but a few in silver, and also a few in steel. I shall now give a short description of each in turn.

1. Spathomele or spatula probe. This derives its name from σπάθη, an oar blade; and μήλη, the general word for probe.

It is mentioned so frequently in surgical works that we have no difficulty in recognising it in the numerous specimens which are

Marble votive tablet from the Temple of Aesculapius on the Acropolis. (Athens Museum.)

extant. It was a probe of about seven inches long, with an oar-shaped spatula at one end, and an olivary enlargement at the other. Its main use was pharmaceutical—for mixing and spreading medicaments. It was also used by sculptors for modelling. The olive bulb is large, averaging nearly two-eighths of an inch in diameter and over half an inch long. The specimen shown in Fig. 6, Plate III., is a typical representative. It was, as will be seen from its size, too large an instrument to be used for searching ordinary wounds, but was used for large wounds and as a uterine sound. It is one of the commonest instruments to be seen in museums.

2. The ear probe, mentioned in the last passage from Galen and in innumerable other places, is the most frequently-named instrument we have. It consisted of a narrow scoop at one end and a plain point at the other (Fig. 8, Plate III.). Its use in all sorts of manipulations is described. Galen, in one passage, says: "If a bean, stone, etc., fall into the ear, remove it with the small narrow scoop of the ear probe (*μικρῷ στενῷ κυαθίσκῳ μηλοτρίδι*)". This suffices to fix the shape of one end of it. In his dictionary he shows that the other end was plain without olivary enlargement, for in explaining the word *ἀπυροσμήλη* (probe without olivary enlargement) used by Hippocrates, Galen says that this means the ear probe. The innumerable uses to which an instrument of this handy shape could be put can easily be imagined, and it was an instrument of universal use in surgery from removing a calculus in the urethra to searching sinuses. In ear work the scoop was used in removing foreign bodies, the other end to instil medicaments into the ear. A ball of wool, soaked in oil or whatever was to be applied, was placed round the middle of the probe and the oil allowed to run down the point and drop into the ear.

3. The amphismele (*ἀμφίς*, at both ends, *μήλη*, probe), otherwise named the dipyrene (*δίς*, double, *πύρην*, olive kernel), was a probe with an olivary enlargement at each end (Fig. 7, Plate III.). It is very frequently mentioned by Galen. Thus in dissection of the brain he says: "Put in from both sides one of the small instruments, a double-ended probe (*ἀμφισμήλη*) or double olive (*διπυρήνη*), if you

prefer to call it so, or if something smaller be necessary, even an ear probe". This passage gives the two names for the instrument in juxtaposition. Extant specimens are not uncommon.

4. The probe named ἀπυρομήλη (Fig. 9, Plate III.) is a plain rod of metal without olivary enlargement at either end, and was used for searching wounds and also as a director for cutting upon.

Needles carrying lint thread are mentioned in several places. These needles are very common, and vary from huge bodkins to eyed probes and surgical needles. Three-cornered surgical needles were known to the Hindoos from very ancient times, and were used by the Romans, but actual existing specimens are very rare. I believe there is only one in the Naples Museum, though there are hundreds of round needles classed as implements of surgery. Fig. 10, Plate III., shows a typical specimen in bronze from Rome.

Chisels.

In describing the dissection of the chest in Book viii., Galen, at one stage of the proceedings, describes the division of the rib by two chisels opposed to each other. This manipulation is often described by ancient surgeons in similar circumstances, *e.g.*, in excising a piece of the clavicle one chisel was held below as a sort of anvil, and the other was struck. Galen compares the under one to a butcher's block (ἐπίκοπος). There are several specimens of the surgical chisel in the Naples Museum. They are much of the same shape as those of the present day.

Meningo-phalax.

In describing the division of the rib in the above passage, Galen directs us to place under the rib the instrument known as the meningo-phalax, so as to guard the pleura. The meningo-phalax was an instrument used in operations on the brain to prevent the meninges getting injured in the removal of bone in depressed fracture of the skull and similar operations. The description of it given by Celsus is quite full

and plain. It had a blade of bronze firm enough to support the piece of bone being operated on, and to catch the angle of the chisel if it chanced to slip. Vidus Vidius gives a picture of it (Fig. 3).

Forceps.

Curiously there is no actual mention of the dissecting forceps by Galen in his book on Practical Anatomy. Of the manipulations which nowadays we perform in dissection by means of a dissecting forceps, Galen does many with a small sharp hook. At the same time, forceps, of the dissecting forceps type, are so frequently found and are so frequently mentioned in surgical works (and in none more so than in Galen's), that I cannot doubt the forceps was used in anatomical dissection. There are two varieties of this type of forceps—the untoothed form (τριχολαβίς) or epilation forceps, and the myza (μύζα), the toothed vulsella or tumour forceps (Fig. 11, Plate III.). There are numerous forceps of both types in the Naples Museum of various breadths and lengths, some with sliding catches, most without. I was particularly struck with the inordinate length of some of the Pompeian specimens in the Naples Museum, nearly 9 inches long. They had probably been used for operations on the uterus, as described by Celsus, Soranus and others.

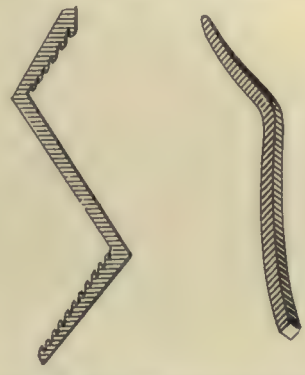


Fig. 3.—Representations by Vidus Vidius (fifteenth century) of the ancient meningo-phalax.

Hooks, Blunt and Sharp.

Galen makes frequent use of the hook in dissecting. He frequently uses it where we would use the forceps.

Numerous sharp hooks from Pompeii are to be seen in the Naples Museum. I have one which has a sharp hook at one end and a blunt dissector at the other (Fig. 12, Plate III.). The blunt hook is frequently mentioned in surgery, and also by Galen in dissection. Most existing specimens are of the same shape as the sharp hooks with the

same small curvature. The curved manubriolus of scalpel No. 6 in the Ex-Voto scalpel box already described, is also intended for use as a blunt hook. A special variety is also mentioned in dissecting the nerves of the thorax. Galen bids us place under the nerve the hook which we use in varicose veins. He says it should be "half sharp," so as to make its way, but not acutely sharp so as to pierce the sheath. In the eighth book Galen mentions an eyed hook. Is the aneurism needle still one of the contents of the modern dissecting box? It used to be in my student days.

ORDINARY MEETING.

24TH JUNE, 1905.

Professor R. W. REID, M.D., F.R.C.S., President,
in the Chair.

The Minutes of the last meeting were read and approved.

Anatomical variations found in the course of practical work in the Anatomy Department of the University were described by several members of the Society.

A paper on "The Development of the Lower Jaw in Man," by Mr. Alex. Low, M.B., was taken as read.

The treasurer's report for the past year was read and adopted.

The following were elected office-bearers for the coming year :—

President—

PROFESSOR R. W. REID, M.D., F.R.C.S. (Eng.).

Vice-Presidents—

ALEX. LOW, M.A., M.B., C.M.; ROBERT H. SPITTAL, M.B., Ch.B.;
R. W. A. SALMOND.

Secretary—T. C. BOYD, M.A.

Recording Secretary—JAMES WATT, M.A.

Treasurer—JOHN BROWN.

The retiring office-bearers were heartily thanked for their services.

RECORD OF ANATOMICAL VARIATIONS.

Date of observation, May, 1905.
Sex, Female.

Branch from the nerve to the subclavius entering the thorax (left).

A small nerve came off the upper trunk of the brachial plexus, just as this trunk emerged from beneath the scalenus anticus muscle. It then passed downwards over the other trunks of the plexus, to where the subclavian artery is crossed by the external jugular vein. Here it lay between this vein and the artery. It then hooked round in front of the external jugular vein, and, running down and in, crossed the subclavian vein, just before this vein joined the internal jugular. It then entered the thorax, lying between the internal mammary artery and the left innominate vein. Its termination could not be followed. As it crossed the external jugular vein, it gave off a muscular branch to the subclavius.

(Signature of observer) DAVID S. GARDEN.

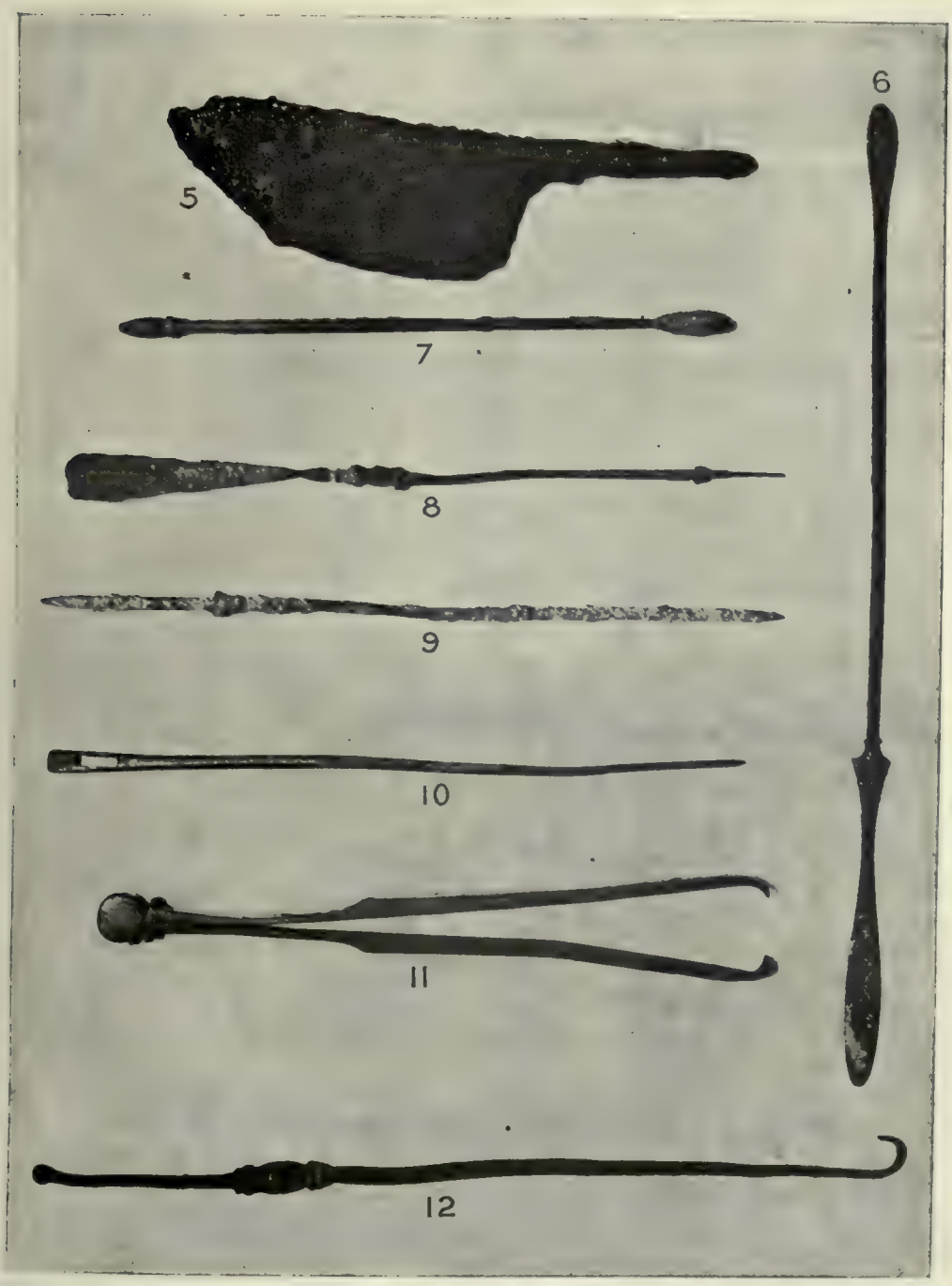
Date of observation, May, 1905.
Sex, Male.

Abnormalities in the branches of the arch of the aorta.

There is no innominate artery. The right subclavian artery arises separately as the last branch from the arch. The two common carotids arise by a short common trunk, and the left vertebral arises from the arch of the aorta, instead of from the subclavian.

The arrangement of these branches is as follows :—

The first branch arises from the upper and front part of the arch in front of the trachea. It is about $\frac{1}{4}$ inch long, dividing almost immediately into right and left common carotids. Close to the left of this a branch arises slightly smaller than the left common carotid, parallel to which it runs up into the neck. This is the left vertebral. To the left of this arises the left subclavian. Lastly a large branch—the right subclavian—arises from the upper and back part of the arch



Instruments of various *provenance*. The knife blade (5) and forceps (11) are from a Roman camp at Sandy, Bedfordshire; the others are from the neighbourhood of Rome.

of the aorta, behind and to the left of the former. It runs obliquely across the vertebral column to the upper border of the first rib on the right side, and has in front of it: the trachea and œsophagus, the two common carotids, the left vertebral and the left subclavian arteries; the left innominate and the right internal jugular veins; the right and the left vagi, the left recurrent laryngeal, and the right phrenic, nerves. Behind, it lies in close contact with the vertebral column.

(Signature of observer) ALFRED J. W. STEPHEN.

Date of observation, June, 1905.
Sex, Female.

Abnormal tibial arteries.

The anterior tibial artery was very small, and ended in muscular branches to the muscles in the front of the leg. The posterior tibial was also very small, and seemed a branch of the peroneal, which was much enlarged. The latter followed its normal course, but its anterior peroneal branch, much enlarged, pierced the interosseous membrane about two inches above the ankle, descending to the front of the ankle joint, giving off the external malleolar branch and a branch corresponding to the normal anterior peroneal, and, at the upper border of the Y-shaped ligament, passed obliquely inwards to the space between the tendon of the extensor proprius hallucis and the innermost tendon of the extensor longus digitorum, taking the place of the dorsalis pedis from the anterior tibial. As the posterior tibial was very small, the plantar arch was formed mainly by the communicating branch from the dorsalis pedis.

(Signature of observers) JOHN A. BEATTIE.
WILLIAM ANDERSON.

Date of observation, May, 1905.
Sex, Male.

Occurrence of a Meckel's diverticulum.

It is given off the free border of the ileum $6\frac{1}{2}$ feet (198 cm.) from the ileo-caecal junction. It communicates directly with the lumen of

the ileum. It is 9 cm. long; diameter at ileum 2·5 cm., expanding at its extremity to about 3 cm. Its termination presents a lobulated appearance. It has a mesentery of its own which is attached to the part of the ileum next the caecum and contained a small blood vessel. The great distance of its origin from the ileo-caecal junction may be explained by the length of the small intestine, which was 29 feet 5 inches. The large intestine was 7 feet long.

In the same subject there was an ascending mesocolon and the duodenum came up to, but did not cross, the middle line.

The attachment of the mesentery was confined to the right side of the body.

(Signature of observers) JOHN BROWN.
JOHN RENNIE.

THE DEVELOPMENT OF THE LOWER JAW IN MAN.[1]

By Alexander Low, M.A., M.B., Senior Assistant to the Professor of Anatomy and Lecturer on Embryology, University of Aberdeen.

(Presented 24th June, 1905.)

The developing mammalian lower jaw has frequently been a subject of research, both by histologists and anatomists. Histologists have found in the developing lower jaw various types of ossification—intra-membranous, endochondral and the so-called metaplastic type of Strelzoff. Anatomists have mostly regarded the mammalian lower jaw as a compound bone, and have attempted to find homologies for its component parts in the jaw of lower vertebrates.

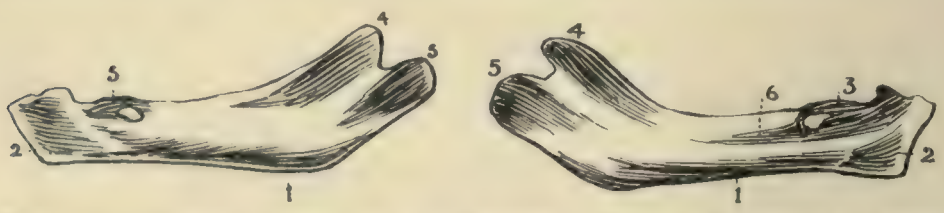
But although much research has been done on the subject of lower jaw development, there are still points regarding the ossification of the human lower jaw about which there is doubt. This is seen on examining the various descriptions of the ossification of the lower jaw given in text-books of human anatomy. Thus two standard text-books—namely, Quain's and Testut's—give different accounts of lower jaw development.

In Quain's *Anatomy* (15) it is said that "the process of ossification commences very early, being preceded only by the clavicle, and proceeds rapidly; it takes place from several centres, which are united by the fourth month. The largest part of each half is formed from a deposit (*dentary*) in the membrane on the outer side of Meckel's cartilage, and to this there is added a second smaller plate (*splenial*),

[1] I have to thank the Carnegie Trustees for a grant towards the cost of the illustration of this paper.

which forms the inner wall of the tooth-sockets, terminating behind in the lingula. A small part of the body by the side of the symphysis results from the direct ossification of the anterior end of Meckel's cartilage; and, posteriorly, the condyle and a portion of the ramus, including the angle, are developed from another ossification in cartilage."

On the other hand, Testut (22) says that each half of the lower jaw is developed on the outer surface of Meckel's cartilage after the manner of the membrane bones of the skull. Kölliker, he says, holds that the bony condyle is preceded by a cartilaginous condyle, and that the anterior part of Meckel's cartilage is ossified along with the lower jaw. Testut admits that the method of development of the mandible, particularly that of the condyle, demands further investigation.



Figs. 1 and 2.—Scheme of the ossification of the lower jaw according to Rambaud and Renault (figured by Testut).

Fig. 1 viewed from the outer and Fig. 2 from the inner aspect. 1. Inferior centre; 2. incisive centre; 3. supplementary centre of the mental foramen; 4. coronoid centre; 5. condyloid centre; 6. centre of Spix or splenial.

Finally, he states that according to Rambaud and Renault, each half maxilla has six points of ossification visible from the fiftieth day of intra-uterine life :—

1. The *inferior* centre, which is visible at the thirtieth to the thirty-fifth day as a series of bony granules at the lower border of the bone.
2. The *incisive* centre, situated on each side of the symphysis in the space which later the incisors will occupy.
3. The *supplementary* centre of the mental foramen, a small lamella which helps by its lower border to form the mental foramen.

4. The *condyloid* centre, which will form the condyle and part of the ramus.
5. The *coronoid* centre, giving rise to the coronoid process and the part of the ramus which forms its base.
6. Lastly, the *splenial centre* of Spix, situated on the inner face of the bone and extending from the orifice of the future dental canal to the incisive piece.

For a number of years I have worked at the development of the lower jaw in man and mammals. In the present paper I review the literature of lower jaw development and then record the results of my own researches regarding the development of the lower jaw in *man*.

Review of Literature.

There is an extensive literature on the subject of lower jaw development, giving the results of research done, especially by workers abroad. In recent work some of these researches seem to have been overlooked, and hence I propose to review briefly the work done on and views held regarding the development of the lower jaw in man and mammals.

Spix (18), in 1815, in his *Cephalogenesis*, described the lower jaw as arising from five separate centres, *viz.*, for the body, condyle, coronoid, angle and the "piece of Spix" or splenial—this last, he says, remains as a separate piece up to the fourth month of fœtal life.

Meckel (13), in 1820, described the cartilage of the lower jaw—hence "Meckel's cartilage". He denies the presence of a separate splenial element. He says that one or two ossicles may be found at the symphysis between the two halves of the mandible.

Magitot and Robin (10), in 1862, gave a detailed description of Meckel's cartilage in man. They hold that it takes no part in lower jaw formation, and that after the sixth month of fœtal life the cartilage atrophies, the malleus being the only part which persists.

Rambaud and Renault (16), 1864, described the lower jaw as arising from six centres, visible at the beginning of the eighth week.

Testut follows the description of lower jaw development given by these authors.

Callender (4), in 1869, published a good account of the development of lower jaw in man. He shows that the bone is partly developed from Meckel's cartilage, partly from the membrane which covers it. He describes four centres of ossification, *viz.*, a condyloid appearing in cartilage; a centre in membrane on the outside of Meckel's cartilage; an ossification of the anterior extremity of Meckel's cartilage, forming a triangular piece below the incisor teeth, and remaining separate up to the fourth month of fœtal life; finally deposits of bone in the perichondrium of the cartilage, giving rise to the plate of bone which completes the dental canal.

Strelzoff (20), in 1873, in a research on the histogenesis of bone, states that Meckel's cartilage does not ossify or take part in lower jaw formation.

W. K. Parker (14), in 1874, in a paper on the development of the skull in the pig, figures the angle and the condyle as one piece of cartilage, and the rest of the mandible as membrane bone.

Brock (3), in 1876, says that the lower jaw of the pig is laid down as a slender periosteal lamella, in which no separate parts are to be seen. Later, a cartilaginous nucleus appears in the position of the angle, and this extends to form the hinder border of the ramus and the condyle. He denies that any trace of Meckel's cartilage enters into the formation of the lower jaw.

Baumüller (2), in 1879, gives an account of the development of the lower jaw and the fate of Meckel's cartilage in the pig. He says that the anterior part of Meckel's cartilage undergoes ossification. The main part of the body of the jaw, he shows, is developed as membrane bone.

Mr. J. Bland-Sutton (21), in 1883, in a paper on the development of the inferior maxilla, describes six centres of ossification (Fig. 3). His conclusions are based on macroscopic preparations of developing lower jaw, and on the comparative anatomy of the jaw. He says

"the order of events may be arranged in stages for the sake of clearness thus :—

1. Meckel's cartilage appears.
2. Dentary is seen below.
3. Centres for condyle, coronoid, angle and mento-Meckelian.
4. Network of osseous tissue connects them together.
5. Splenial appears as a ledge of bone supporting the teeth.
6. Disappearance of Meckel's cartilage from jaw, and fusion of splenial."

All that part of lower jaw in front of the mental foramen is an ossification of Meckel's cartilage. He describes the inferior dental nerve and splenial as lying below Meckel's cartilage, and says that after the fourth month Meckel's cartilage atrophies and the splenial passes down to enclose the nerve.

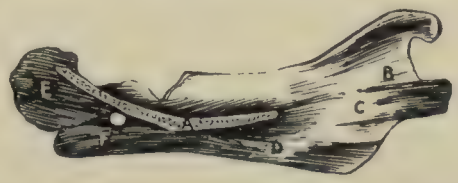


Fig. 3.—Represents the lower jaw of a human fœtus at about the tenth week of intra-uterine life (after Mr. J. Bland-Sutton).

B. Coronoid. E. Mento-Meckelian.
C. Condyle. F. Dentary.
A. Splenial. D. Angular.

Schaffer (17) in 1888 made a careful histological examination of the developing lower jaw in the sheep. He describes the lower jaw as being formed as a membrane bone with independent cartilages for the condyle and for the angle.

Henneberg (6), in 1894 in an inaugural dissertation for the doctor's degree presented to the University of Berlin, deals with the development of the lower jaw in man. He carefully describes the appearances presented by the developing lower jaw in a series of human fœtuses. I became acquainted with his paper only after I had completed my own research on human lower jaw development, and I find that his descriptions correspond exactly to the appearances presented by my own material. He treats of the appearances presented by the developing lower jaw in human fœtuses of from 40 mm. to 240 mm. crown-rump measurement. Henneberg's is

undoubtedly one of the most important recent works on the subject and seems to me to merit greater consideration.

Professor E. Fawcett (5) in 1904, in the *Proceedings of the Anatomical Society of Great Britain and Ireland*, states that Meckel's cartilage ossifies from the mental foramen to the middle line, but that the dentary ossification covers it in front. He describes a cartilaginous mass in the condyle and is doubtful if any splenial centre exists, and says that probably the whole membranous jaw arises from one centre.

Professor Karl von Bardeleben (1) in February, 1905, in the *Anatomischer Anzeiger*, argues that the chin in man and mammals is a special skeletal element—the os mentale—and that there are also found in the lower jaw, condyloid, coronoid, angular, marginal and dentale as separate elements. His views are based largely on the macroscopic appearances presented by young and adult jaws. The only fœtal jaws he has examined are human in the later months of fœtal life—for the rest he accepts the researches of previous workers.

At a meeting of the Anatomical Society of Great Britain and Ireland in May of this year (9) I gave a demonstration on the development of the lower jaw in man, and showed by slides and specimens that the human lower jaw is developed in membrane as a single skeletal element; that in connection with the condyle and coronoid process cartilaginous pieces are developed, but that these do not indicate separate elements; and that Meckel's cartilage towards its anterior extremity becomes ossified and helps to form the lower jaw in the region of the incisor teeth.

The present paper is a detailed account of the research on which my former paper was based.

Present Research.

The quite different and opposing views expressed regarding the ossification of the lower jaw seem to me to arise largely from imperfect methods of research. One cannot form a correct picture of the process by selecting a developing jaw here and there from different

mammalian orders and making a few microscopic sections of different regions of these. To understand lower jaw ossification it is necessary to obtain a complete series of embryos of any one mammal, and to make and mount *complete serial sections* of the head or lower jaw of these embryos. Further, it is necessary, especially in the earlier stages where the changes are very rapid, to make sections in different planes, *i.e.*, coronal, sagittal and horizontal. After this manner I have examined the developing lower jaw of man and various mammals, *e.g.*, pig, rabbit, mouse, mole and bat. I have a fairly complete series showing human fœtal lower jaw in its different stages, and in the present paper I describe the development of the *human* lower jaw.

In sections of the mandibular arch of a human *embryo* 10 *mm. in length*,[1] there is no indication of Meckel's cartilage.

Fig. 4.

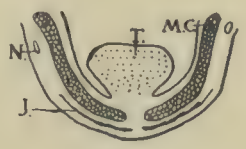


Fig. 5.

Figs. 4 and 5.—Horizontal sections of the lower jaw of a human embryo 18 mm. in length (× 8). Fig. 4 shows the lamella of membrane bone, J., lying to the outer side of the inferior dental nerve, N. Fig. 5 at a lower level shows the relation of the membrane bone, J., to Meckel's cartilage, M.C.

In *an embryo* 15 *mm. in length* Meckel's cartilage is already well formed and passes forwards towards the middle line, almost meeting but not fusing with its fellow of the opposite side.

In *an embryo* 18 *mm. in length* ossification is present as a very delicate lamella of bone developed in the mesoderm on the outer aspect of Meckel's cartilage (Figs. 4 and 5). This lamella extends forwards almost to the middle line. The inferior dental nerve lies between this lamella and Meckel's cartilage, and its dental branch passes over a notch on the upper border of the lamella.

In *an embryo* 28 *mm. in length* ossification has extended so that

[1] The crown-rump measurement has been adopted in taking the length of all embryos and fœtuses mentioned in the present paper.

each half of the lower jaw is mapped out as one complete membrane bone, and from its mesial aspect a dental shelf has commenced to grow inwards so as to overhang Meckel's cartilage from the outer side.

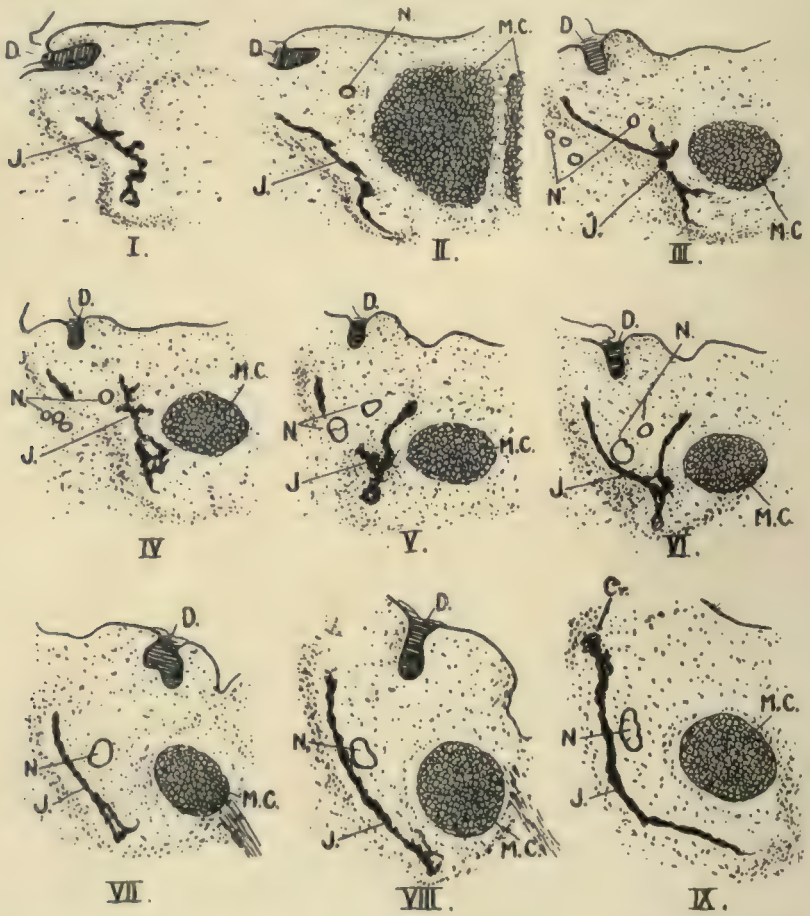


Fig. 6.—Coronal sections of the right half of the lower jaw of a human fœtus, 28 mm. in length (× 38). I. shows the membrane bone in front of Meckel's cartilage; II. is through the enlarged anterior extremity of Meckel's cartilage; III. is a section in front of the mental foramen; IV. is near the anterior margin of the mental foramen; V. near the posterior margin of the mental foramen; VI. through middle of body of jaw; VII. and VIII. through posterior part of body; IX. through the coronoid process. J., lower jaw, a continuous sheet of membrane bone; D., dental lamina; N., inferior dental nerve; M.C., Meckel's cartilage.

The varying appearances presented by coronal sections at different levels are represented in Fig. 6.

At this stage the shape and relations of Meckel's cartilage are

well seen. As the cartilage passes forwards its anterior part bends sharply round towards the middle line—this bend takes place at a point opposite the interval between the germs of the lateral incisor and canine teeth. The cartilage is enlarged and club-shaped at its anterior end, but becomes rapidly less when traced back towards the mental foramen, while behind this point its diameter increases somewhat (Fig. 6). The anterior ends of Meckel's cartilages, while they approach each other closely, are distinctly separated by a layer of mesodermic cells. There is no indication of commencing ossification in the cartilage. The membrane bone of the jaw lies on the outer side of the cartilage, and, following the bend described by it at its anterior end, comes to lie in front of the cartilage, so that coronal sections here (Fig. 6) show only the membrane bone. In front the membrane bone approaches the bone of the opposite half, almost meeting in the middle line. Tracing the membrane bone from behind forwards, it first of all forms a simple lamella in which the coronoid process and angle are already distinctly outlined. Still more forwards in the region of the last milk molar tooth germ a distinct tooth gutter begins to be formed, a coronal section of jaw a little in front of this having a Y-shaped appearance, with lateral and mesial walls. A lateral and mesial wall to the tooth gutter can be traced as far forward as the canine tooth, where the mesial wall disappears, the lateral only being continued forward. The mental foramen is represented as a much-elongated slit in the lateral wall, with the mental branch of the inferior dental nerve passing out in close relation with the posterior border of the foramen.

In *an embryo* 31 *mm. in length* coronal sections of lower jaw present much the same appearances as in the embryo of 28 mm. The anterior extremities of Meckel's cartilage are more flattened from before back, and where they touch the membrane bone, just opposite the interval between the lateral incisor tooth germ and that of the canine, the cartilage cells are becoming somewhat enlarged preparatory to ossification.

In *an embryo* 36 *mm. in length* the anterior extremity of Meckel's

cartilage opposite the lateral incisor tooth begins to be surrounded above and below by bone developed in the perichondrium, the upper lamella now forming a distinct inner alveolar margin (Fig. 7). The cells of the cartilage in contact with the bone are enlarged and vacuolated, but so far there is no actual ossification of the cartilage.

In *a fœtus* 43 *mm. in length* ossification in membrane has now extended so that the form of the adult jaw can readily be recognised. The two halves of membrane bone extend forward so as to nearly meet in the middle line. The bone no longer forms a simple lamella but shows a lattice-like structure. The inner alveolar margin at the incisor teeth is formed by a lamella which has grown over in the perichondrium above Meckel's cartilage (Fig. 8). The mental foramen is still relatively very much elongated, with the mental nerve closely applied to its posterior margin. The mesial wall of the dental gutter now arches over Meckel's cartilage. The coronoid process and angle of the jaw are both thickened, this thickening being made up of lattice-like membrane bone. There is no trace of cartilage at the coronoid process, but its apex is surrounded by condensed mesodermic tissue. The ramus of the jaw is continued backwards and upwards as a somewhat thin lamella to the condyle which is represented by condensed mesodermic tissue without any trace of bone or cartilage.

Fig. 7.—Coronal section of the lower jaw of a human fœtus, 36 mm. in length (× 7). D., lateral incisor tooth germ; J., membrane bone of jaw; M.C., Meckel's cartilage.

As to Meckel's cartilage its anterior extremity shows commencing ossification. This is taking place at a point opposite the interval between the mesial and lateral incisor tooth germs, where the cartilage is in close relation with the membrane bone. At this point the cartilage cells are much enlarged, many are vacuolated, others show two nuclei and the cells next the bone are broken down, their nuclei lying free among the osteoblastic tissue which passes in from the closely applied membrane bone (Fig. 16). These stages are preparatory to the actual ossification of the cartilage. The relation of nerves to Meckel's cartilage in the region of the ascending ramus

is well seen—here the inferior dental nerve is above the cartilage, the lingual nerve passes down on its inner side, and the mylo-hyoid nerve passes between the bone and the cartilage.

In *a fœtus* 60 *mm. in length* the relations of Meckel's cartilage

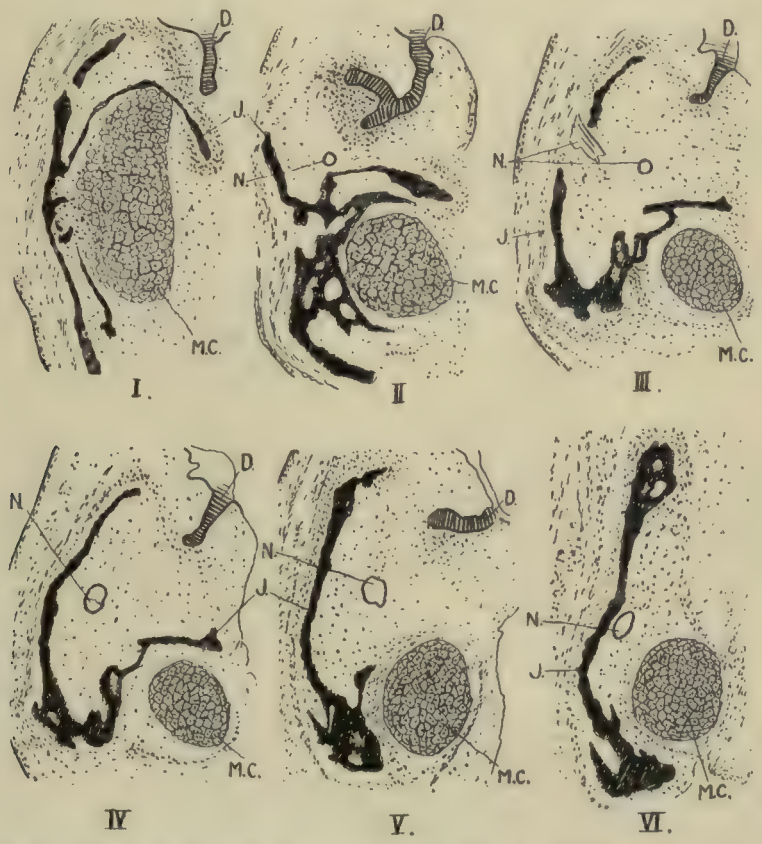


Fig. 8.—Coronal sections of the right half of the lower jaw of a human fœtus, 43 mm. in length (× 34). I. is between the central and lateral incisor tooth germs; II. through the lateral incisor tooth germ; III. at the mental foramen; IV. through middle of body of jaw; V. through posterior part of body; VI. through the coronoid process. J., lower jaw, a continuous sheet of membrane bone; D., dental lamina; N., inferior dental nerve; M.C., Meckel's cartilage. (From the *Proceed. of the Anatom. Soc. of Great Britain and Ireland*, 1905, p. 27.)

are similar to those obtaining in the last specimen, but the cartilage is undergoing resorption and ossification in the region between the lateral incisor and canine tooth germs—marrow cavities being formed by ingrowing tissue with osteoclasts and new bone formed by osteo-

blasts. The condyle is now well formed and is made of hyaline cartilage, the cells of which become flatter and smaller as they approach the perichondrium. The histological details are represented and described by Schaffer (*l.c.*, p. 371). As he points out, the formative cells no longer form bone, but a transition tissue to cartilage, and finally hyaline cartilage. This condylar cartilage extends forwards and downwards in the ramus so that sagitally it is wedge-shaped with its base at the condyle, and its apex passing forward under the coronoid process.

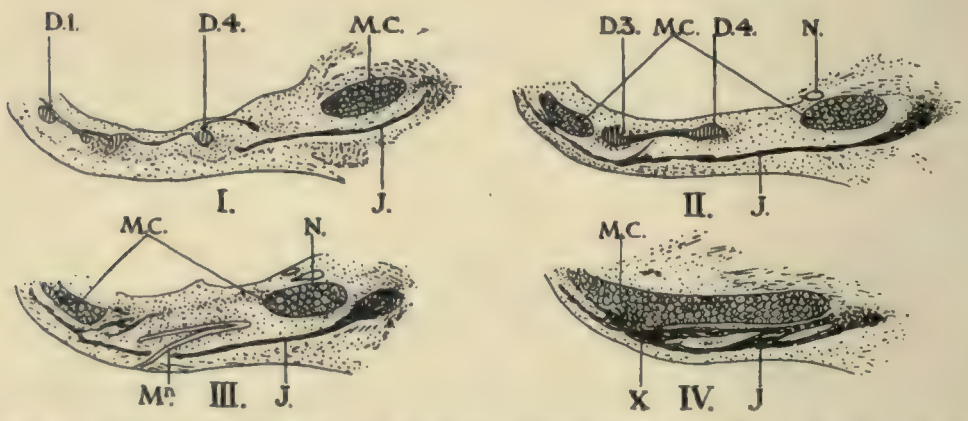


Fig. 9.—Horizontal sections of the left half of the lower jaw of a human fœtus, 43 mm. in length (× 9). The sections are made from above down, I. being at the level of the tooth germs; II. at a somewhat lower plane shows lower jaw as a continuous sheet of membrane bone; III. through the plane of the mental foramen: IV. near the lower border of the jaw, at X ossification is extending into Meckel's cartilage. D. 1.-D. 4. indicate dental germs; J., membrane bone of jaw; Mn., mental nerve; M.C., Meckel's cartilage.

In *a fœtus* 72 *mm. in length* rapid growth has taken place, the condylar cartilage has increased in length, and the coronoid process become more thickened. Horizontal sections of this stage show well the relations at the symphysis (Fig. 10). The membrane bone forms an irregular outer alveolar margin for all the tooth germs. The anterior extremities of Meckel's cartilage pass close under the germs of the central incisor teeth and meet in the middle line. At this plane immediately behind the anterior extremities of Meckel's cartilage are two small round nodules of hyaline cartilage. At a lower level Meckel's cartilage is seen below the germ of the lateral incisor

tooth, and still lower below the germ of the canine tooth which extends down almost to the lower border of the jaw. From the lateral incisor to behind the canine tooth, Meckel's cartilage is ossifying and practically enclosed by a sheath of bone. At this stage then Meckel's cartilage passes from behind forwards lying at first just inside the condyle, then descending it runs along below the inner alveolar shelf gaining the lower border of the jaw, under the canine tooth germ; at this point it passes into the jaw, becoming ossified and rising up gains the middle line just under central incisor tooth.

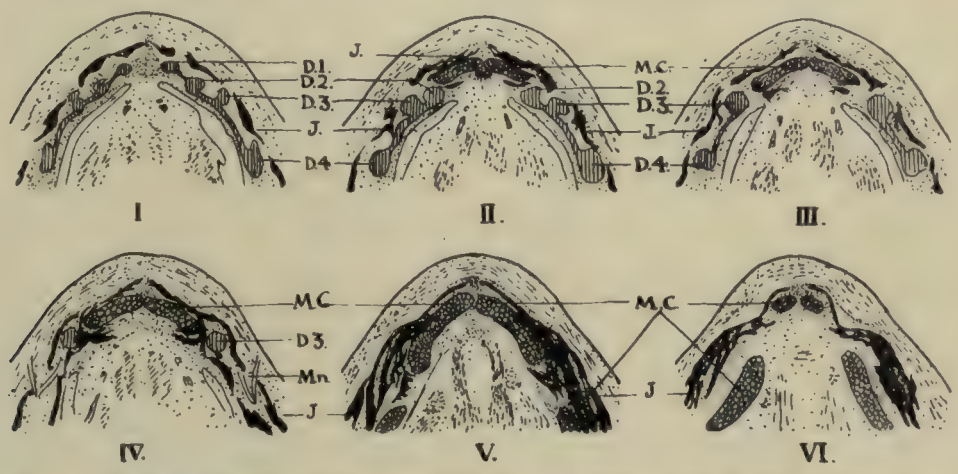


Fig. 10.—Horizontal sections through the lower jaw of a human fœtus, 72 mm. in length (× 6). I. shows the tooth germs lying to the inner side of the membrane bone of the outer alveolar wall; II. and III. show the anterior extremities of Meckel's cartilages, with membrane bone to the outer side; IV. at a still lower level shows the anterior extremities of Meckel's cartilages rising up from below the canine tooth germ; V. shows ossification extending into Meckel's cartilage; VI. Meckel's cartilage at the level of the lower border of the jaw. D. 1.-D. 4., tooth germs; J., membrane bone; M.C., Meckel's cartilage; Mn., mental nerve.

In *a fœtus* 80 *mm. in length* the main differences are in the further ossification of Meckel's cartilage, and the beginning of a cartilaginous nucleus at the anterior border of the coronoid process. A regular bony symphysis joined by connective tissue is now well developed, and behind this are the remains of the anterior extremities of Meckel's cartilages. That part of Meckel's cartilage from the central incisor to the canine tooth is wholly taken into the membrane bone of the lower jaw, and is largely resorbed and undergoing ossifi-

cation—in section its position is still indicated by clusters of cartilage cells and proliferating marrow tissue (Fig. 11). The condylar car-

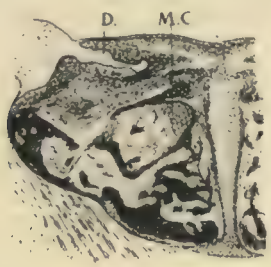


Fig. 11.

Fig. 12.

Figs. 11 and 12.—Coronal sections of the right half of the lower jaw of a human fœtus, 80 mm. in length (× 15). Fig. 11 is a section anterior to the lateral incisor tooth germ, and shows the remains of Meckel's cartilage (M.C.) surrounded by membrane bone. Fig. 12 is through the canine tooth (D. 3), and shows Meckel's cartilage passing into the lower jaw.

tilage is well-developed, and a strip of cartilage has just begun to appear, in connection with the coronoid process.

In *a fœtus* 95 *mm. in length*, the appearances are much the same except that the coronoid cartilage is more largely developed. Cartilaginous remains of Meckel's cartilage are still to be defined in the anterior part of the jaw. In this specimen both condylar and coronoid cartilages are present (Fig. 13). On sagittal section the position of the coronoid cartilage is well seen. The tip of the process is cartilaginous, and from this a band of cartilage extends along the anterior border of the process to terminate in a tapering point, just behind and below the last milk molar tooth germ. Ossification is passing into the cartilage from the membrane bone behind. In the same preparation the disposition of the wedge-shaped condylar cartilage is also seen. The condylar cartilage in its anterior part is becoming resorbed, marrow tissue and osteoblasts passing into it from the membrane bone.

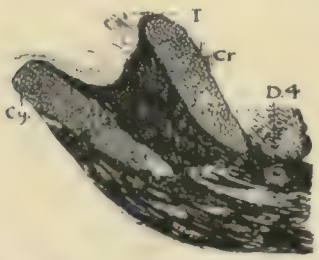


Fig. 13.—Sagittal section of the posterior part of the lower jaw of a human fœtus, 95 mm. in length (× 5½). Showing the relation of the coronoid (Cr.) and condylar (Cy.) cartilages to the membrane bone. T., temporal muscle; D. 4., last milk molar.

In *a fœtus* 103 *mm. in length,* both condylar and coronoid cartilages are perhaps at the height of their development, while the anterior ends of Meckel's cartilages are mostly resorbed. Behind the symphysis all that remain of the anterior ends of Meckel's cartilages are two small cartilaginous nodules; above these and independent of them is to be seen an unpaired cartilaginous nodule. That part of Meckel's cartilage between the central incisor tooth and the canine tooth has now become quite resorbed by osteoclasts, and invaded by the surrounding bone tissue. The varying appearances seen in coronal sections of the jaw of this fœtus are presented in Fig. 14. In the specimen there appears a strip of cartilage along the upper edge of the outer alveolar margin, and in the region of the inner alveolar margin there is a somewhat similar strip of cartilage inside the incisor tooth germs. These pieces of cartilage are not in any way connected with Meckel's cartilage, but seem to arise much in the same way as the coronoid cartilage.

In the sections the relations of the condylar cartilage can readily be traced. Its anterior extremity reaches as far forward as a point just behind the termination of the inner alveolar margin—that is, just in front of the base of the coronoid process. Traced backwards from this point, the cartilage enlarges, finally terminating in the condyle. At first the cartilage is covered by a thin lamella of bone on its outside, but, as traced backwards, it is covered on both aspects by the periostium of the jaw. The condylar cartilage, towards its anterior part, now shows regressive changes, being destroyed by giant cells, and its place taken by marrow tissue, while round it young bone tissue is being deposited. Posteriorly the cartilage is still uninjured, and the condyle is formed by hyaline cartilage covered with perichondrium.

As regards the coronoid cartilage, it consists of cartilage covered with a perichondrium continuous with the periostium of the bone; below the boundary between the bone and the cartilage, just behind the tooth gutter, there are numerous osteoclasts and marrow tissue.

Where the process runs into the mesial wall of the tooth gutter there is no cartilage. The relations of Meckel's cartilage are well seen, and it is to be noted that the origin of the mylo-hyoid muscle anteriorly is

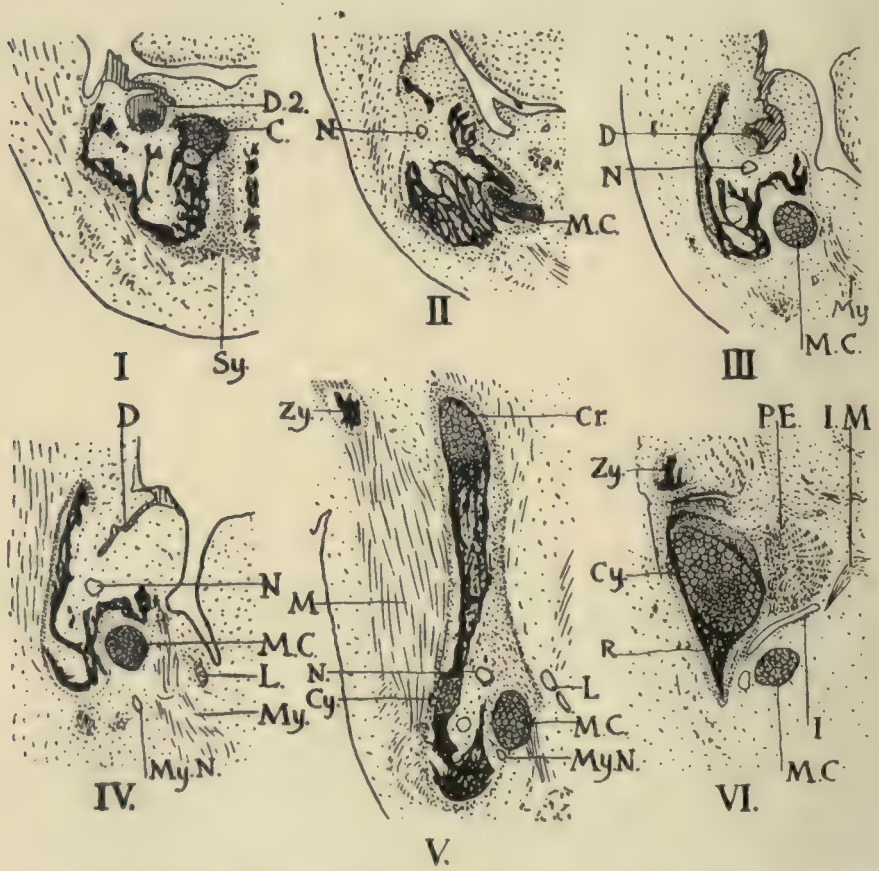


Fig. 14.—Coronal sections of the right half of the lower jaw of a human fœtus, 103 mm. in length (× 8). I. is through the lateral incisor tooth germ; II. in front of canine tooth germ; III. through first molar tooth germ; IV. through posterior part of dental lamina; V. through coronoid process; VI. through condyle. Sy., symphysis; C., cartilaginous nucleus in inner alveolar margin; N., inferior dental nerve; My., mylo-hyoid muscle; L., lingual nerve; Cr., coronoid cartilage; Cy., condylar cartilage; R., ramus; Zy., zygoma; P.E., external pterygoid muscle; M.C., Meckel's cartilage.

below the cartilage, while posteriorly it is above, and the mylo-hyoid nerve sweeps round the outside of the cartilage.

In *a fœtus* 130 *mm. in length*, the whole jaw has rapidly increased in size. In this specimen there are two pairs of carti-

laginous nodules behind the symphysis—one pair at least representing the anterior ends of Meckel's cartilages. Meckel's cartilage is still in existence from a point inside the canine milk tooth, so that no further destruction of it has taken place. There are cartilaginous nuclei along the margins of both alveolar walls in the region of the incisor milk teeth. Further, there is an additional cartilaginous nucleus along the front of the lower border of the jaw in this region. The condylar cartilage is rapidly becoming ossified towards its anterior part, trabeculæ of bone passing through it and breaking it up, only islands of cartilage cells remaining; on the trabeculæ are numerous osteoblasts. Schaffer carefully describes the mode of ossification in the condyle, and characterises it as a modified endochondral type. Thus the manner of ossification of the condylar cartilaginous pyramid differs—as has been pointed out by Henneberg—from that of the rest of the lower jaw, which grows by the deposit of lamella of bone. Its different structure is readily seen in the macerated jaw even at birth. Toldt drew attention to the porous structure of the bone here. The coronoid cartilage is still represented, but is rapidly becoming ossified.

In *a fœtus* 210 *mm. in length*, the different cartilaginous nuclei seen in the last specimen are present, but are relatively much smaller. There is one pair of cartilaginous nodules behind the symphysis, and here are also cartilage cells along the alveolar margins and along the lower margin of the bone in front. Both coronoid and condylar cartilages have undergone further ossification.

In *a fœtus* 230 *mm. in length*, there are only traces of cartilage along the edges of the alveolar walls in front, and also in the lower border of the bone (Fig. 15). These small cartilaginous nuclei are now surrounded by bone. The cartilage in the coronoid process has now practically disappeared. There are still remains of the condylar cartilage, its position being indicated by small islands of cartilage, and large marrow spaces. Meckel's cartilage extends as far forward as the canine tooth, and in the sections can be seen closely applied to the inner aspect of the bone to which it is bound by the periosteum; the cartilage is now relatively very much smaller (Fig. 15, III.). In

the lower jaw of a six months' fœtus, Meckel's cartilage can readily be seen with the naked eye. The cartilage shows up as a greyish white elevated line along the inner surface of the jaw. The cartilage lies close under the inner aspect of the condyle, and, first of all, runs almost horizontally forwards till it reaches a point below the coronoid process,

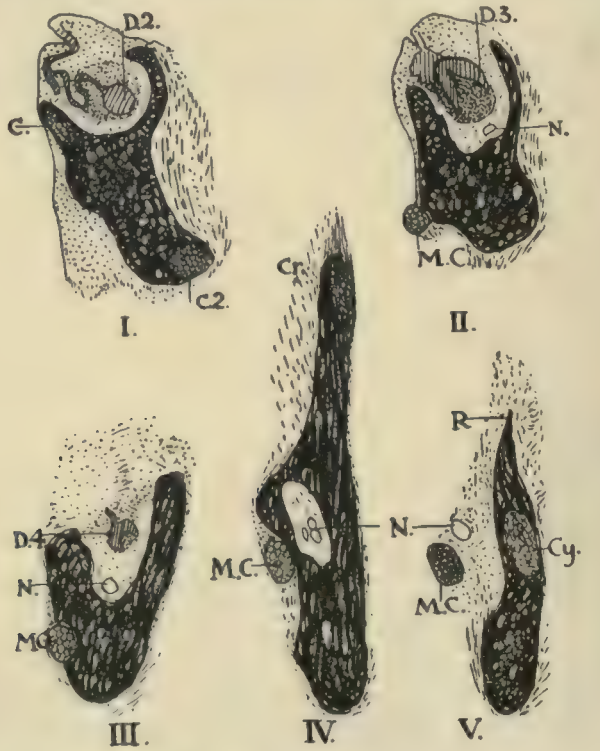


Fig. 15.—Coronal sections through the left half of the lower jaw of a human fœtus, 230 mm. in length (× 6½). I. through lateral incisor tooth germ; II. through canine tooth; III. through first molar tooth; IV. through coronoid process; V. through ramus. C., cartilage in inner alveolar margin; C. 2., cartilage in lower border of jaw; M.C., Meckel's cartilage; N., inferior dental nerve; Cr., remains of coronoid cartilage; Cy., condylar cartilage; R., ramus.

here it bends sharply down to the lower border of the bone, and then runs along just inside the lower border of the jaw to terminate in a slight knob opposite the interval between the canine and lateral incisor teeth (Fig. 15, II.). From this small knob a delicate ridge runs upwards and inwards, terminating at the symphysis just above the genial tubercle—this ridge seems to indicate the course of that

part of Meckel's cartilage which has been taken into the jaw. After this stage, Meckel's cartilage rapidly atrophies, so that at birth it is difficult to get any trace of it in connection with lower jaw. In a seven months' fœtus, horizontal sections through the symphysis do not show nodular symphysial cartilages, but again they are to be seen in sections of a fœtal jaw at the ninth month. In a fœtus at the seventh month, all trace of cartilage has disappeared from the coronoid process, but there is cartilage in the condyle and the ramus still shows the open texture of the bone; remains of the condylar cartilage persist till birth.

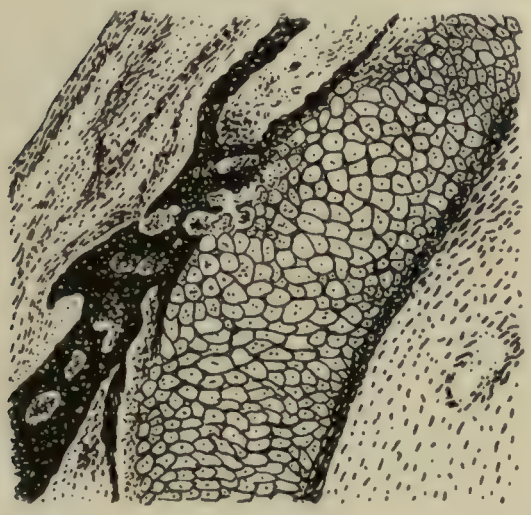


Fig. 16.—Horizontal section of the left half of the lower jaw of a human fœtus, 43 mm. in length (× 70). Shows ossification commencing to extend into Meckel's cartilage; this takes place at a point between the central and lateral incisor tooth germs.

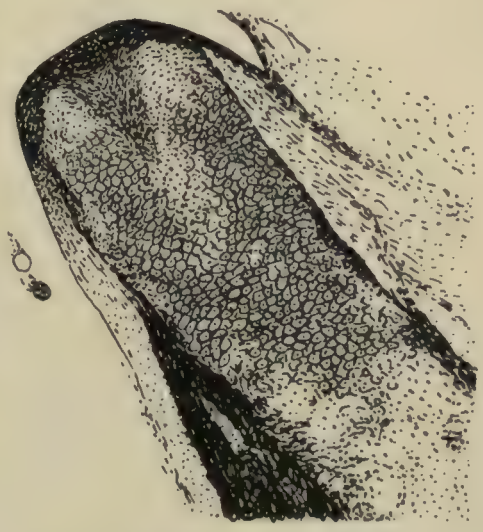


Fig. 17.—Sagittal section through the condylar cartilage of the lower jaw of a human fœtus, 95 mm. in length (× 33).

Summary.

From an examination of this series of developing *human* lower jaw we arrive at the following conclusions :—

Each half of the lower jaw is developed in membrane as a single skeletal element—the *dentary*—and the so-called *splenial* element is

simply an extension of this helping to form the inner alveolar wall and does not exist as a separate element.

Meckel's cartilage becomes ossified and incorporated with that part of the lower jaw below and inside the mesial and lateral incisor teeth. Posterior to this point Meckel's cartilage does not enter into the formation of the lower jaw. The anterior extremities of Meckel's cartilages also do not enter into the formation of the lower jaw, but

Fig. 18.—Sagittal section through the coronoid cartilage of the lower jaw of a human fœtus, 95 mm. in length (× 33).

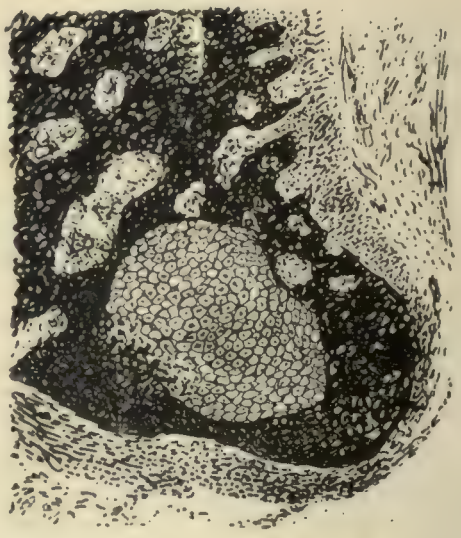


Fig. 19.—Coronal section through the lower border of the left half of the lower jaw of a human fœtus, 230 mm. in length (× 50). The section is made in the region of the lateral incisor tooth, and shows an accessory cartilaginous nucleus surrounded by bone.

usually persist throughout fœtal life as one or two cartilaginous nodules behind the symphysis. The comparative anatomy of Meckel's cartilage and the extent to which it enters into the formation of the lower jaw in various vertebrates is of interest, but I do not propose to go into this in the present paper. It may be noted, however, that in man at no stage do the anterior extremities of Meckel's cartilages actually fuse in the middle line, while in the jaws of other mammals which I have examined such a fusion does take place; this is the

case even in mammals in which in the adult the two halves of the lower jaw remain separate. Again, in the examination of the lower jaw of the turtle I found that there very frequently exists a calcification of Meckel's cartilage in the region corresponding to that which in man becomes ossified (Fig. 20).

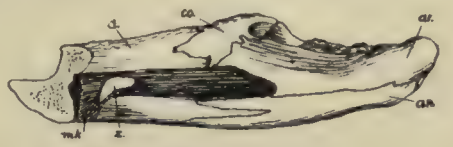


Fig. 20.—Right half of the lower jaw of turtle viewed from the inner aspect ($\frac{1}{2}$). Shows calcification (x.) in Meckel's cartilage (mk.). ar., articular; an., angular; co., coronoid; d., dentary.

At a comparatively late stage in the development of the lower jaw certain *accessory* cartilaginous nuclei appear in connection with the primary membrane bone (Figs. 21 and 22). Thus there is a well-defined, wedge-shaped *condylar* cartilage and a smaller *coronoid* cartilage. In addition to these there are also smaller cartilaginous nuclei along the margins of both alveolar walls in front as well as along the front of the lower border of the jaw. These cartilaginous nuclei have no separate centres of ossification but become resorbed and ossification extends into them from the neighbouring membrane bone. In the human lower jaw I have not observed a definite angular cartilaginous nucleus, although in

Fig. 21.

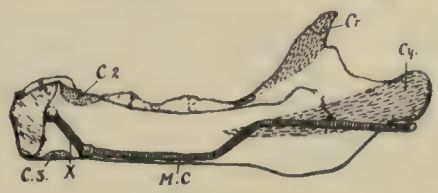


Fig. 22.

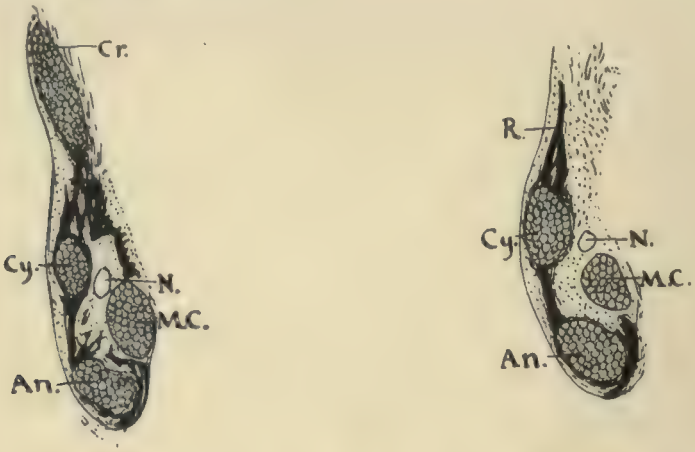
Scheme of the developing human lower jaw (right half).

Fig. 21 viewed from the outer and Fig. 22 from the inner aspect. The figures show the single membrane bone (*the dentary*) with its accessory cartilaginous nuclei. Cy., condyloid cartilage; Cr., coronoid cartilage; C. 1., cartilaginous nucleus at outer alveolar margin; C. 2., cartilaginous nucleus at inner alveolar margin; C. 3., cartilaginous nucleus at lower border; M.C., Meckel's cartilage, with X indicating the part which becomes incorporated with the lower jaw.

many other mammals a distinct and well-defined angular cartilaginous nucleus exists (Figs. 23 and 24). These various accessory cartilaginous nuclei do not indicate separate elements, but are an adaptation to the growth of the jaw.

In conclusion, I wish to express my thanks to Professor Reid for

facilities afforded to me and for his kindly interest in what has been a somewhat prolonged research.



I. II.

Figs. 23 and 24.—Coronal sections of the right half of the lower jaw of a mole embryo (*Talpa europaea*), 26 mm. in length (× 25). I. through the coronoid process; II. through the angle. Cr., coronoid cartilage; Cy., condylar cartilage; An., angular cartilage; M.C., Meckel's cartilage; R., ramus; N., inferior dental nerve.

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ORDINARY MEETING.

25TH NOVEMBER, 1905.

Professor R. W. REID, M.D., F.R.C.S., President,
in the Chair.

The Minutes of the last meeting were read and approved.

The President introduced Mr. Alex. Macdonald, M.A., Durris, who read a paper, entitled "Prehistoric Burial in Scotland". In illustration of the lecture, numerous lantern slides were exhibited.

A hearty vote of thanks was accorded to Mr. Macdonald for his paper.

PREHISTORIC BURIAL IN SCOTLAND.

By Alexander Macdonald, M.A., Durris.

(Read 25th November, 1905.)

After pointing out the far-reaching character of the Evolution Theory and its great utility as a working hypothesis in many branches of Science, the paper went on to trace its bearing on the solution of the questions of the origin and early history of mankind in general, and of the British races in particular. It enumerated the various studies that lead up to the solving of these inquiries, such as Folk-lore, Philology, Custom and the more exact branches, concerned with the measurement and structure of the human body, in which the Society is specially interested.

The value of burial customs in this connection was mentioned, as these customs were fairly fixed in the different races. A review of the whole series of these rites was given in the order in which they are supposed to have succeeded each other. The first point to be noted is the fact that very soon the habit of burning the bodies of the dead came into partial use, and brought about a lessening of the size of the sepulchres.

The unburnt body was placed in a chamber of stone, usually with a cairn built over it or a mound of earth. Dug-out coffins were occasionally used, and cases occur where the body was placed in the bare earth, with no external sign to mark the spot.

When the corpse was cremated, the ashes were usually placed in an urn, and deposited in a cist or in the bare earth in a little heap. Cairns sometimes of great size were raised over chambered graves. The chambers were made of slabs, and were divided into two or three

compartments, varying in height and breadth. The over-built cairns sometimes reach enormous dimensions—75 feet in diameter and 15 feet in height are the measurements of one of the smaller of them —and may be surrounded by ditches or stone circles.

A curious series of sepulchral cairns, designated "horned cairns," were thoroughly investigated by Dr. Joseph Anderson. These occur chiefly in Caithness and Orkney, and usually present four curved horn-like projections from the body of the stones of which the cairns are composed, falling gradually to the level of the ground.

Stone circles present a few new features with their concentric rings of monoliths. They always contain burials, either under a central cairn—chambered or not—or near the uprights inside the circle, or exceptionally outside the circle. Cremation is frequent, especially in certain areas. Our own district is peculiarly rich in this kind of monument, and here is found that peculiar type which exhibits the feature known as the recumbent stone or altar and pillars. Those three huge stones are invariably seen on the south or south-west verge of the circle. They have given rise to much conjecture, from the old "altar" theory to the more recent "gateway" hypothesis.

Short cists have received special attention from this Society, and require but to be enumerated as among early methods of burial. Though evidently constructed for the reception of the whole human frame in a doubled-up condition, they sometimes contain comminuted remains and urns of the drinking vessel type, ornaments and flints.

Questions about the races that used these successive modes of burial are still very much debated, but from the measurements of the skulls and other bones, it has been pretty well established that the dolichocephalic people were shorter in stature and feebler in build than the brachycephalic tribes that succeeded them at what interval we dare not yet venture to say. Many things lead us to conclude that the two races were for long co-existent, and that their characteristics and customs were blended together. It is of interest to mention that Dr. Beddoe thinks he has found in the west of England a race corresponding to the Silures of Tacitus—black-haired, shorter in stature,

and feebler in development than the fair races, while their skull form remains dolichocephalic. Professor Boyd-Dawkins designates them Iberians, and looks upon them as related to that puzzling people, the Basques of the Pyrenees. The palæolithic or Old Stone Age was distinguished by a low race, whose skill in making stone implements was so poor as to make it often hard to tell whether a weapon is fabricated or not. Yet this savage in some artistic instances could draw.

After this came the New Stone Age, in which our interest mainly centres, when a gradually improving and in the end highly finished article might be manufactured, usually of flint or bone, when the art of knitting—if not weaving—was known, and that of fashioning pottery and of cultivating some plants, cereals among them. Neolithic man possessed domestic animals, the sheep, the goat, the dog, the horse and very probably the ox. Towards the end of this period, we find a slight knowledge of metals as evidenced by a few bronze pins and small ornaments.

With the Celt came a great step forward, when the knowledge of metals reached a practically useful and important stage.

All this must be taken as an impressionist picture of many ages, that overlapped each other, and even lapsed backward at certain points, and intermingled and shaded off, one into the other, like the colours of the rainbow.

There are bones in some of those prehistoric tombs that indicate men of powerful build and large endurance, with crania of great capacity. For example, one of the Oban cave skulls was capable of containing not less than 1730 c.c., "a fact," says Sir W. Turner, "which places it on a level with some of the most capacious skulls of modern Scotsmen which I have measured".

The paper concluded with an inventory of the grave-goods found in the various kinds of sepulchres. These consist of three different kinds—pottery, personal ornaments and weapons. Of pottery the most frequent objects are urns of various shapes, generally designated

"cinerary urns," "food vessels," "drinking cups," and the much rarer and smaller "incense cups". Beads, pins, brooches and necklaces are the chief ornaments found. Among weapons and tools the most noteworthy are arrowheads, knives, scrapers, stone hammers, bracers, and whetstones.

ORDINARY MEETING.

9TH DECEMBER, 1905.

Professor R. W. REID, M.D., F.R.C.S., President,
in the Chair.

The Minutes of the last meeting were read and approved.

Mr. R. H. Spittal, M.B., Ch.B., read a paper describing a series of New Guinea skulls, presented to the Anatomical Museum by Mr. Craigen, Chief Medical Officer in British New Guinea.

Descriptions of several anatomical variations found in the course of practical work in the Anatomy Department of the University were given by several members of the Society.

OBSERVATIONS ON FOURTEEN NEW GUINEA SKULLS.

By R. H. Spittal, M.B., Ch.B., Junior Assistant to the Professor of Anatomy, University of Aberdeen.

(Read 9th December, 1905.)

These skulls were presented to the Anatomy Museum of the University by Mr. Allan Jas. Craigen, M.B., Ch.B., Port Moresby, New Guinea, a graduate of this University, recently Chief Medical Officer and Member of the Executive and Legislative Councils, British New Guinea. I desire to thank Professor Reid for permitting me to examine them and to make these observations.

Of the fourteen skulls the three elaborately decorated ones came from the region of the Bamu River, other nine from Goaribari Island, one from Orokoio, one from the Fly River, and all were obtained by Mr. Robinson, when Acting-Governor of British New Guinea. In a letter to Professor Reid, written in June of this year, Mr. Craigen says, "I will not be able to give you much information regarding them (*i.e.*, the skulls), as the village on the Bamu River, where the decorated ones were got from, has only been visited twice, once by Sir Wm. MacGregor, and again by Judge Robinson with a Government party last year, when these were obtained".

New Guinea is a large island situated to the north of Australia, and the portion nearest that continent is under British rule. On the south coast there is a large bay, the Gulf of Papua, and the Bamu and Fly Rivers flow into the western part of this gulf near each other. The island of Goaribari lies a little further east, close to the coast, and it was in a village on this island that James Chalmers,

a famous missionary, was murdered, and, it is believed, eaten by the natives, in the year 1901.

Even at the present day New Guinea has not been fully explored, and there is still much to learn about the inhabitants. The latter are inclined to be hostile to strangers, and cannibalism still flourishes in many parts. They have a practice of collecting human skulls, both of friends and of enemies, and they preserve these skulls in their warhouses or "dobus," and also in their dwellings. As a people, they are classed as Melanesians, in the subdivision of Papuans. Their chief characteristic is that they are negroes of a comparatively light colour.

We will consider first the chief features presented by these skulls from an anthropometric point of view. Owing to the amount of decoration on some of them and to deficiencies in others, the series of cranial measurements is necessarily very incomplete. So far as possible, however, the various indices have been worked out, and the results compared with those obtained by certain other observers. From measurements supplied by Professor Flower, in the Osteological Catalogue of specimens contained in the museum of the Royal College of Surgeons, England, we find that a typical Papuan skull is—

Dolichocephalic.
Metriocephalic.
Prognathous.
Platyrhine.
Microseme.
Microcephalic.
Horizontal circumference about 490 mm.

Professor Turner, in the Proceedings of the Royal Society of Edinburgh, 1898-99, gets practically the same result from the examination of a series of ten skulls, there being only a slight difference in the nasal and in the orbital indices. The measurements of four other skulls in the museum of this Department, examined by Dr. C. T. Andrew, and published in the Proceedings of this Society, 1899-1900, also agree fairly closely with Professor Turner's results, but again there is some difference in the nasal and in the orbital indices. From

TABLE OF DETAILED MEASUREMENTS OF SKULLS.

Number	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
Age	Young Adult.	Young Adult.	Adult.	Child.	Adult.	Adult.	Child.	Adult.	Adult.	Adult.	Adult.	Adult.	Child.	Adult.
Sex	F.	M.	—	—	—	—	—	—	—	—	—	—	—	M.
Cubic capacity	1100	1396	1172	—	1108	1192	—	—	1030	—	—	—	1080	1240
Glabello-occipital length	159	168	—	156	—	—	—	173	161	—	183	145	—	168
Ophryo-occipital length	159	167	—	160	—	—	—	—	—	—	—	—	—	170
Basi-bregmatic height	128	142	128	—	115	136	—	—	129	—	—	—	123	144
Vertical index	80·5	84·5	—	—	—	—	—	—	80·1	—	—	—	—	85·7
Minimum frontal diameter	84	92	93	80	—	—	85	90	91	—	96	—	—	97
Stephanic diameter	104	111	109	93	107	106	105	104	107	—	102	98	—	107
Asterionic diameter	97	108	106	93	98	96	94	110	97	106	100	101	92	101
Maximum breadth	130	136	134	118	133	131	133	130	127	139	129	127	118	125
Cranial index	81·8	81·0	—	75·6	—	—	—	75·1	78·9	—	70·5	87·6	—	74·4
Horizontal circumference	453	481	—	440	—	—	—	—	—	—	—	—	—	481
Frontal longitudinal arc	110	129	—	111	—	—	115	—	—	—	—	—	—	—
Parietal longitudinal arc	115	125	123	119	124	121	121	126	119	120	119	—	125	—
Occipital longitudinal arc	100	110	95	105	95	105	—	—	107	—	—	—	96	115
Nasio-inional longitudinal arc	273	311	290	285	—	—	—	—	—	—	—	—	—	310
Total longitudinal arc	325	364	—	335	—	—	—	—	—	—	—	—	—	369
Base line	125	128	—	—	—	—	—	—	119	—	—	—	—	128
Proportion of vault to base	2·6	2·8	2·9	—	—	—	—	—	—	—	—	—	—	2·9
Sagittal circumference	455	499	467	—	—	—	—	—	—	—	—	—	—	500
Vertical transverse arc	284	317	300	—	284	301	293	—	297	—	—	—	282	326
Biauricular diameter	98	103	104	—	99	100	82	—	93	—	—	—	91	103
Transverse circumference	382	420	404	—	383	401	375	—	390	—	—	—	373	429
Foramen magnum length	35	42	34	—	37	32	—	—	29	—	—	—	35	35
Basi-nasal length	95	93	—	—	—	—	—	—	92	—	—	—	—	96
Basi-alveolar length	99	80	89	—	—	103	—	—	98	—	—	—	87	110
Gnathic index	104·2	86·0	84·8	—	—	—	—	—	106·1	—	—	—	—	114·6
Inter-zygomatic breadth	117	121	—	89	115	118	84	—	109	—	—	—	105	—
Inter-malar breadth	99	96	108	78	108	100	83	—	97	—	—	—	—	114
Inter-dachryonic breadth	22	—	—	19	—	—	19	—	20	—	—	—	—	23
Nasio-mental length	114	—	—	—	—	—	81	—	—	—	—	—	—	110
Complete facial index	98·3	—	—	—	—	—	96·4	—	—	—	—	—	—	—
Nasio-alveolar length	65	64	—	47	—	—	50	—	55	—	—	—	—	71
Upper facial index	55·5	52·9	—	—	—	—	59·4	—	50·5	—	—	—	—	—
Nasal height	48	51	—	37	—	—	36	—	—	—	—	—	—	50
Nasal width	22	26	—	20	—	—	20	—	—	—	—	—	—	25
Nasal index	45·8	50·9	—	54·1	—	—	55·5	—	—	—	—	—	—	50
Orbital width	34	—	—	30	—	—	33	—	36	—	38	—	—	45
Orbital height	32	36	—	32	—	—	35	—	29	—	37	—	—	35
Orbital index	94·1	—	—	106·6	—	—	106·1	—	80·6	—	97·4	—	—	77·8
Palato-alveolar length	55	43	51	50	—	—	39	—	53	—	—	—	44	60
Palato-alveolar breadth	60	56	50	39	—	—	51	—	—	—	—	—	55	65
Palatal index	109·1	130·2	98·0	78·0	—	—	130·7	—	—	—	—	—	125·0	108·3

the series of skulls before us, so far as one can judge from the few indices obtainable with accuracy, we find that :—

Breadth index	= variable; two of each class.
Height index	= Akrocephalic.
Alveolar index	= Prognathous.
Nasal index	= variable.
Orbital index	= Megaseme.
Capacity	= Microcephalic.
Horizontal circumference	= 450 to 480 mm.

These results differ materially from those recorded by the authorities quoted. The principal difference is with regard to the height of the skulls which are extremely high. The orbits are rather square, and the horizontal circumference is small.

However, as our figures are so few, it would not be very wise to speculate about the reason of these differences. We can only say that these skulls belong to a people of a low type, as evidenced by the small cranial capacity and prognathism, and of a mixed race. One of our specimens, No. 2, stands apart from the others on account of its comparatively large cranial capacity and orthognathism. As the natives are cannibals, one might account for this fact by suggesting that it is the skull of a stranger belonging to a different tribe or race, who had been unfortunate enough to fall into the enemies' hands.

As regards other anatomical characteristics of the skulls, Wormian bones are present in all but two, and in ten cases these are situated in the lambdoidal suture. At the pterion, where the frontal bone usually articulates with the great wing of the sphenoid for about half an inch, there is a tendency for this short suture to be reduced in length, and in two cases, Nos. 1 and 8, it is absent altogether, the temporal bone articulating directly with the frontal. One skull, No. 11, possesses a frontal or metopic suture. It was not found possible to ascertain the sex, because in most of them the sexual features have been obscured by decoration. Three of them are the skulls of children; two of them, Nos. 4 and 7, about six years of age; and the other, No. 13, about seven or eight, judging by the

teeth. The lower jaw is absent in all but four of them, and in only one case was it possible to obtain measurements, so that no information of any value could be got from this source.

No less than eight of these fourteen skulls show distinct signs of having been artificially moulded to a greater or less extent. The nature of the deformity varies :—

(*a*) Flattening in the lambdoidal region, involving both the parietal and occipital bones—Nos. 3 and 6.

(*b*) Flattening in the parieto-occipital region of one side, with a corresponding bulging on the other, giving the skull a lop-sided appearance when viewed from behind. This is especially marked in No. 5, slightly so in Nos. 2 and 12.

(*c*) A shallow transverse constriction in the region of the coronal suture—Nos. 8 and 11.

(*d*) No. 14 (Plate V., Fig. 1) shows a broad, fairly deep groove, running transversely across the forehead immediately above the orbits. The frontal region is thus rendered very prominent. According to a note by Mr. Craigen as to this skull, " the natives about Orokoio go in for moulding the child's head, hence the peculiar shape ". In this case the moulding had evidently taken the form of a tight bandage passing across the forehead. A constriction in the coronal region would be readily produced by a band passing across the skull and round the lower jaw. In the case of the other varieties of deformity, however, the method of moulding is not evident. Moulding of the child's head is a practice of many savage tribes. Some of you will remember that Dr. Moir, when giving a lecture on the Hausa people to the Society last session, noted a similar practice amongst them.

Seven of these skulls, Nos. 4, 6, 9, 10, 11, 12 and 14, show patterns carved on the bone. The frontal region is selected for decoration, except in the case of No. 6, where the carving is limited to the floors of both temporal fossæ. The various patterns are very simple, while the workmanship is very rude : individually they are as follows :—

(*a*) A transverse row of short oblique parallel lines enclosed between two transverse lines (Plate IV., Fig. 1); skull No. 4.

(*b*) Cross-hatching (Plate IV., Figs. 2 and 3); skull No. 6.

(*c*) A row of chevrons enclosed between two parallel lines (Plate IV., Fig. 4); skull No. 9.

(*d*) Two transverse undulating bands carved in low relief (Plate IV., Fig. 5); skull No. 10.

(*e*) Two transverse zig-zag bands carved in low relief (Plate IV., Fig. 6); skull No. 11.

(*f*) Two transverse undulating bands separated by one straight band, and enclosed between two others: also carved in low relief (Plate IV., Fig. 7); skull No. 12.

(*g*) Two narrow sickle-shaped spaces placed vertically, enclosing a downward-pointed horse-shoe pattern, within which is contained an elongated oval figure (Plate IV., Fig. 8); skull No. 14.

It is doubtful what this form of decoration signifies, some considering that it has reference to the mythology of the people, but Mr. Craigen says that his belief is that it denotes relationship to the head of the house. Considered as works of art the specimens before us are of a decidedly primitive character. The Papuans can, however, produce much more elaborate work as seen in many decorated articles belonging to the New Guinea collection, deposited in the Anthropological Museum of the University.

Five of these skulls have evidently been kept suspended in native huts or some other such place. The method of suspension is by means of a cane-loop passing through the nasal fossæ and round the hard palate, in this way forming a ring round the upper jaw. When the lower jaw is present it is included as well (Plate V., Fig. 2). From this loop there projects in front a central stem of the same material usually over a foot long, with another loop at the far end. By means of this handle the skull could be suspended or carried in the hand. Many of the skulls have the appearance of having been kept in this way in a smoky atmosphere as evidenced by their blackened appearance especially in the occipital and basal regions. Nos. 2, 3, 6 and 8 show this loop intact, but in No. 5 the part encircling the upper jaw only remains.

Five skulls are further decorated in a curious way—Nos. 3, 5, 6, 8 and 13. They have been fashioned so as to represent a very grotesque human face (Plate V., Fig. 2), the facial region being covered with a substance consisting of a mixture of hardened clay and resinous material. The orbits are filled up with this material and eyes are indicated by embedding something in their position; in a few cases, a ring of white siliceous seeds. A straight nose, four to five inches long, is formed on a framework, consisting of a cane loop, secured in the nasal aperture. In addition, these faces are smeared with bands of red and black paint. All our specimens are incomplete in some of these details.

Five of the skulls (Nos. 1, 9, 10, 11 and 12) have a plaited fibrous band over a yard long attached by its ends to the zygomatic arches. In No. 1 this band is studded with cowrie shells arranged in a zigzag fashion (Plate V., Fig. 3), and in No. 9 it consists of a strip of bark.

Three of the skulls are distinguished from the others by their very elaborate ornamentation. These are the three that were obtained at the Bamu river—Nos. 10, 11 and 12 (Plates VI., VII.). In the case of these, the base of the skull, both temporal fossæ and the facial region are covered with the same claylike substance. From each orbit protrudes a hornlike body, five to six inches long, rounded, averaging over one inch in thickness, diverging from the one on the opposite side, and having a large flat red seed embedded on its blunt apex. These protrusions obviously give the appearance of stalked eyes; they have fallen out from skull No. 11.

A wooden ring flattened laterally is attached to the front of the face by a projection thrust into the anterior nasal aperture. A similar ring is present in skull No. 9. In No. 10 it has evidently been present but has fallen out. These rings are elliptical in shape and vary in size. In No. 12, which possesses the largest one, it measures 9 inches in its longest diameter. More or less simple geometrical designs are carved on the flat sides of the rings. In No. 12 the ring is further decorated, several greyish feathers being inserted by their

FIG. 1

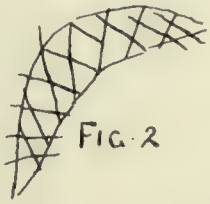


FIG. 2

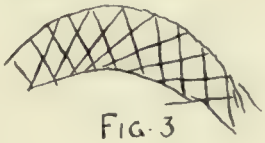


FIG. 3

FIG. 4

FIG. 5.

FIG 6

FIG. 7.

FIG 8.

2/3 NAT. SIZE.

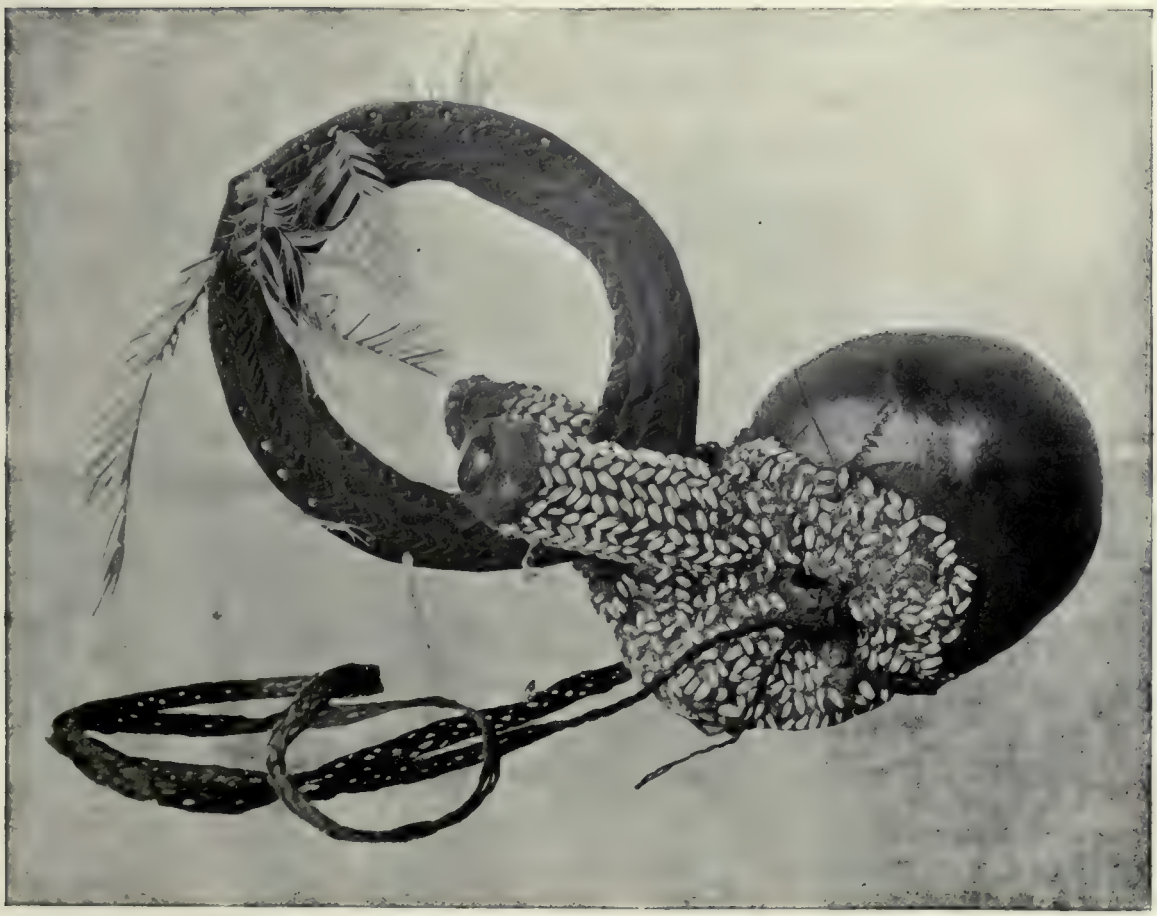
Carved patterns on New Guinea skulls.

Fig. 1.

Fig. 2.

Fig. 3.

Skulls from New Guinea.
Fig. 1 showing deformity. Figs. 2 and 3 showing different kinds of decoration.



Decorated skull from New Guinea.
Side view.

Decorated skull from New Guinea.
Front view.

quills into holes along the outer margin of the rim. Numbers of the barbs of these feathers have been removed from the quills at short intervals with the result that the chevron pattern of the feathers is much more pronounced. The whole of the resinous surface on the base of the skulls, on the face and orbital protrusions is studded in these three specimens with white siliceous seeds, which are set obliquely and in such a way as to form rows, each pair of rows being composed of a series of chevrons. A large number of these seeds have fallen out, but their impressions remain. In skull No. 13 jequirity seeds have been used instead of these white ones.

With regard to the significance of all this ornamentation I will simply quote Mr. Craigen's letter: "As regards the meaning of the nasal and orbital projections, I am unable to give any explanation unless they refer to some totem, but I doubt that, as all the skulls were similarly decorated, and a tribe as a rule has a number of totems. It is a seed at the end of the orbital protrusion, but I do not know the name of the plant. I have always heard that the marks on the frontal bone denote either rank or relationship. As a rule one considers highly decorated skulls to be those of chiefs or men of renown. They do not bother about ornamenting the skulls of prisoners or of enemies killed in warfare. This refers to tribes about eighty miles east, but of the upper Bamu river we are at present still ignorant."

In conclusion, I have to express my indebtedness to Professor Reid for his aid in making these observations and also for many helpful suggestions.

RECORD OF ANATOMICAL VARIATIONS.

Date of observation, November, 1905.
Sex, Female.

An additional head to the biceps flexor cubiti.

This consists of a slip of muscle, 14 cm. long and 5 cm. broad, arising by a thin aponeurosis from the middle of the inner surface of

the humerus between the insertion of the coraco-brachialis and the origin of the brachialis anticus. From this origin the muscle passes downwards on the anterior surface of the latter muscle to be inserted by a thin aponeurosis into the inner part of the upper margin of the bicipital fascia.

Superficial to the muscle there are the fascia of the arm and the basilic vein. Deep to it there is the brachialis anticus, and in its lower part the brachial artery passes underneath it about 2 cm. above the bicipital fascia, in an oblique direction downwards and outwards. External to it lies the triceps muscle. Internal to it are the brachial artery and median nerve.

(Signature of observer) JOHN GEDDES.

Date of observation, November, 1905.
Sex, Female.

Tendinous slip between latissimus dorsi and triceps.

This is a tendinous slip joining the tendon of insertion of the latissimus dorsi muscle to the tendinous part of the origin of the long head of the triceps. The slip is 1·5 cm. long and ·25 cm. broad. It is attached to the lower border of the tendon of latissimus dorsi 3·5 cm. from its insertion into the humerus, and joins the long head of triceps on its inner surface 6 cm. from its origin below the glenoid cavity. The slip of tendon is flat and twisted spirally, so that its inner border becomes anterior, and its outer border posterior, tracing from above downwards.

(Signature of observer) JOHN GEDDES.

Date of observation, November, 1905.
Sex, Male.

Two fissures in left lung.

This abnormality consists in the left lung having two distinct and complete fissures. The great fissure is normal in position, but there is a strong adhesion of the visceral pleura of the lower edge of

the middle lobe to the inner surface of the eighth rib and upper surface of the diaphragm, extending for about an inch and a half along the eighth rib from the mid axillary line.

The other fissure, which is the smaller, extends from the mid-axillary line at the level of the sixth rib to the fourth chondro-sternal articulation, when the lung is partially inflated. Both edges of the fissure are completely enveloped in visceral pleura.

(Signature of observer) ALEXANDER WILSON.

Date of observation, November, 1905.
Sex, Male.

Abnormal position of a right subclavian artery.

On the right side of this subject the subclavian artery passes in front of the scalenus anticus muscle instead of behind. From its origin the artery runs upwards and outwards to about $3\frac{1}{2}$ cm. above the first rib. It then turns downwards and outwards at an angle of 90°, and passes in front of the scalenus anticus.

The thyroid axis is given off at the highest part of the subclavian artery, and a posterior scapular artery is given off from the thyroid axis near its origin and passes back between the upper and middle cords of the brachial plexus.

All the branches of the subclavian are given off to the inner side of the scalenus anticus except the internal mammary, which has its origin in front of the muscle.

The phrenic nerve passes in front of the subclavian and posterior scapular arteries.

The insertion of the right scalenus anticus muscle is more posterior than the left one, the former being $8\frac{1}{2}$ cm. and the latter 7 cm. from the middle of the upper border of the sternum.

(Signature of observer) ALFRED J. W. STEPHEN.

Date of observation, November, 1905.
Sex, Male.

Abnormal subscapular artery.

The subscapular artery comes off the axillary artery higher up than normally. It runs downwards and backwards and about an inch from its origin it gives off a branch, the posterior circumflex artery, which descends through the quadrangular space. About an inch further on in its course it gives off the dorsalis scapulæ, which descends to the triangular space. The artery itself then proceeds to distribute branches to the neighbouring muscles in the normal fashion.

(Signature of observer) D. Craig.

Date of observation, December, 1905.
Sexes, two Males and one Female.

Abnormalities in branches of aorta.

In three subjects a similar abnormality existed with regard to the branches from the arch of the aorta. In all three the abnormality consisted in the branches of the arch being two in number—a large innominate trunk, from which arose the right subclavian artery along with the right and left common carotid arteries, and a left subclavian artery.

In No. 1—a male—the left common carotid came from the innominate just above the origin of the latter artery. The innominate itself then passed vertically upwards in front of the trachea and bifurcated at the level of the third cartilage of the trachea.

In No. 2—a male—the large innominate artery came off at the right extremity of the arch, at the upper part of the ascending aorta. This artery gave off the three branches above mentioned.

In No. 3—a female—the large innominate artery gave off three branches as above mentioned, right subclavian, right and left common carotid.

(Signatures of observers) G. A. Grant.
D. M. Spring.
J. G. Muterer.

Date of observation, November, 1905.
Sex, Female.

High division of brachial artery (right).

In this subject the radial artery comes off from the brachial opposite the lower border of the subscapularis muscle. It runs parallel to and in close contact with the brachial artery under the deep fascia. It gives off no recurrent branch at the elbow, but a recurrent artery arises from the brachial just above the insertion of the biceps muscle. This high radial was not found in the left arm of the subject.

(Signature of observer) JAMES GARBUTT.

Date of observation, November, 1905.
Sex, Male.

Occurrence of a duodenal fossa.

At the duodeno-jejunal junction or the fourth part of the duodenum, a diverticulum of the intestine occurred. It protruded backwards, upwards and outwards from the back of the intestine, lying in a small fossa. When not distended, its size was that of a small walnut. The diverticulum lay in a fossa, which had definite boundaries on all sides. Above it was the middle colic artery; on the left, a branch from the middle colic artery passed down to anastomose with the colica sinistra; on the right side lay the superior mesenteric artery and vein. The left renal vein was in relation with the diverticulum behind, lying between it and the vertebral column. In front it had a covering of peritoneum. The diverticulum lay entirely behind the intestine, which, in the natural position, concealed it from view.

On distension, the characters of the diverticulum were more evident. In shape it appeared globular, and measured about two inches in its long diameter and one inch in its transverse diameter.

(Signature of observer) W. J. CRUICKSHANK, M.A.

Date of observation, November, 1905.
Sex, Male.

Accessory or detached slip of trapezius muscle (both sides).

This slip lay along the anterior border of the trapezius, and was distinctly separated from it by a narrow cellular interval, which was least marked below. The slip was about $\frac{3}{8}$ inch broad, and was enclosed in the common sheath of fascia of the trapezius. The origin of the trapezius, from the superior curved line of the occipital bone, was only $\frac{1}{2}$ inch wide. Beyond this, externally, at an interval of $\frac{1}{4}$ inch, was the tendinous origin of the slip, which was $\frac{1}{2}$ inch wide. The insertion of the slip was by tendinous fibres into the posterior border of the clavicle just internal to the insertion of the rest of the muscle—the whole occupying not more than the outer third of the posterior border.

About 3 inches from the origin of the slip, the small occipital nerve hooked round between the slip and the rest of the trapezius.

Both sides were exactly alike, except that on the left side, the tendinous origin was adherent to the underlying splenius capitis muscle.

(Signature of observer) JAMES WATT, M.A.

Date of observation, November, 1905.
Sex, Male.

High division of the brachial artery (left).

In this subject the brachial artery divides into radial and ulnar arteries at the lower border of the teres major muscle. These arteries pass down the arm together, and, accompanied by the median nerve, pass under the bicipital fascia, and are distributed normally.

(Signature of observer) H. BRAYSHAW.

Date of observation, November, 1905.
Sex, Female.

Presence of rectus sternalis muscle.

This muscle is placed at the lateral border of the sternum, superficial to the pectoralis major, underneath the skin and fascia. The muscle is a small band of fibres about 6 inches long, and half an inch broad at its origin, narrowing to about $\frac{1}{8}$ inch at its insertion. It is fleshy for nearly its whole length.

The muscle is a continuation upwards of the rectus abdominis, and is inserted into the tendon of the sterno-mastoid, a little above the sternal origin of that muscle.

(Signature of observer) H. G. Bruce.

ORDINARY MEETING.

27TH JANUARY, 1906.

Professor R. W. REID, M.D., F.R.C.S., President,
in the Chair.

The Minutes of last meeting were read and approved.

Mr. F. S. Maxwell, B.A., a Hausa from Sierra Leone, read a paper on "Hausaland and its People," and demonstrated lantern slides descriptive of the customs of the people.

At the conclusion Mr. Maxwell was heartily thanked for his paper.

NOTES ON HAUSALAND AND ITS PEOPLE.

By F. S. Maxwell, B.A., Sierra Leone.

(Read 27th January, 1906.)

1. Geographical.

Hausaland is included within your Protectorate of Northern Nigeria, which, next to India, is the largest dependency of the British Crown. Nigeria, be it known, is not a place name, and cannot be found on any map of Africa made out more than twelve years ago. It is applied to a number of self-governing native states, in the Western Sûdan and the valley of the Niger, which within recent years have accepted the protection of Great Britain. The portion known as Southern Nigeria, which now forms with Lagos one political entity, and which first accepted British protection and suzerainty, was, for a long time before the name Nigeria was coined, known as the Oil Rivers Protectorate. Before the union with Lagos its seat of government was Old Calabar. The portion known as Northern Nigeria corresponds to the region which was formerly the sphere of operations of the Royal Niger Company. This company was in regard to this portion of West Africa what the East India Company was to India. It controlled its own armies, maintained its own police, and exercised jurisdiction and a sort of protection within the sphere of its operations. It practically enjoyed the monopoly of the trade, and it was from it that the British Government ultimately took over the protection of these states from the aggression of other white powers and the tender mercies of one another. Northern Nigeria includes a portion of the area known to moderns as the Sûdan and to the ancients by various names, such as Nigritia,

Ethiopia, Tekrour and Genewah or Genowah, all of which simply mean "Negroland" or the "Land of the Blacks". Northern Africa may be roughly divided into three portions running parallel to one another in a direction from east to west, *viz.* (1) an extra-tropical portion north of the desert of Sahara, (2) a desert portion, the Sahara, and (3) an intra-tropical portion, the Sûdan or Land of the Blacks, of which Hausaland forms a part.

The map of Africa shows on its western side, between the seventh and sixteenth parallels of north latitude, a loosely formed Y-shaped water system. The arms of the Y are represented by the Niger flowing from the north-west and the Benué or Bani flowing from the north-east towards each other. They meet at Lakoja, a little to the south of the eighth parallel of north latitude. From this point they flow together under the name Niger very nearly due south for a distance of about 250 miles to the Gulf of Guinea. This river represents the stem of the Y. The eastern arm of the Y, the Bani, is somewhat shorter than the western, and is completed by the southern portion of Lake Tchad lying north of its sources. The area contained within the arms of this Y-shaped water system north of the tenth parallel and extending as far north as the fourteenth parallel of north latitude corresponds to Bornou and Hausaland proper. The addition of the adjective "proper" to the name Hausaland becomes necessary in view of the present-day practice of including within the limits of Hausaland a state called Borgu, which was not one of the original seven Hausa states. The effect of this inclusion is to extend the Hausaland of to-day, roughly, as far south as the ninth parallel of north latitude. For Borgu, which lies on the left bank of the Niger and outside the Y-shaped water system, extends about as far south. Hausaland lies between the fourth and eleventh meridians of east longitude.

2. General Remarks on the Hausa People.

The population of the area thus roughly indicated has not, as far as I know, been accurately ascertained. It is very roughly estimated

at present at about ten millions. The people are generally acknowledged to be peaceful and industrious. In common with the other nations of the Sûdan, especially those professing Islam, they give evidences of an advance in civilisation and culture not generally observed among the nations further south. This, however, does not appear surprising seeing the countries of the Sûdan were in touch with the countries in the north of Africa from which civilisation and culture and learning came to Europe. To go fully into this question would involve too lengthy a discussion of the history of the Sûdan and its relations with the States of the North. As a general principle, however, it is likely to be accepted that places abutting on the world's highways, whether they be sea-ports or places on caravan routes, acquire a higher civilisation and a higher culture than places more remote. The Sûdan was a commercial highway, and it is, therefore, no matter of surprise that its towns should have shown a greater advance in culture than remoter regions. The inhabitants of these Sûdanese countries, in general, have always been well spoken of in ancient literature. Thus we find the "Father of History" describing them as "the tallest, the most beautiful and long-lived of the human race," and the "Blind Bard of Thebes" celebrating them as "the most just of men," "the favourites of the gods," "the blameless Ethiopians". The references to them in ancient literature, which are too many to be mentioned within the time at my disposal, leave no room for doubt, that in some period of hoary antiquity, the leading race of the western world was a black race, and, further, that that black race was the one inhabiting the Sûdan, of which Hausaland forms a part. Serious white writers of to-day consider it an open question, whether in the matter of civilisation it was North Africa that gave the impulse to the Sûdan or the Sûdan that gave the impulse to the north. Says Lady Lugard (to whom belongs the credit of being about the only writer who has not written foolishly on Africa or the African): "When the history of Negroland comes to be written in detail, it may be found that the kingdoms lying to the eastern end of the Sûdan were the home of races who inspired, rather than of races who

received the traditions of civilisation associated for us with the name of ancient Egypt. For they cover on either side of the Upper Nile, between the latitudes of 10° and 17°, territories in which are found monuments more ancient than the oldest Egyptian monuments. If this should prove to be the case, and the civilised world be forced to recognise in a black people the fount of its original enlightenment, it may happen that we shall have to revise entirely our view of the black races, and regard those who now exist as the decadent representatives of an almost forgotten era, rather than as the embryonic possibility of an era yet to come." In these circumstances what excites surprise is the evident standstill in the development of these nations, which seems to give the lie to their former brilliant history. Edris, king of Bornou, was making gunpowder for the use of his armies at a period contemporary with Queen Elizabeth, and by a formula upon which Waltham Abbey has scarcely been able to improve, and yet to-day his descendants are compelled to accept the protection of hers—a protection which being forced upon them must be unpalatable to them—because the superiority of the lethal weapons of the Protector more than compensates the superiority of the animal spirits and physical courage of the Protected! It may be shown that this backwardness or want of progress has been due to three signal disasters which affected the nations of the Sûdan and, through them, all the Africa of the blacks, and which effectively blocked the Sûdan, and closed it to the outside world. These disasters were the Moorish Conquest of the Eastern Sûdan in the sixteenth century, the African Slave Trade into which the English were initiated by Sir John Hawkins, who in one of his voyages visited Sierra Leone, and the Fulani Conquest of the Western Sûdan in the early years of last century.

3. Origin of the Hausas.

The state of civilisation exhibited by the Hausa States has led to all sorts of theories being advanced as to the origin of the Hausa people. The general principle on which these theories are based is that no good thing can come out of Blackland, and the object with

which they are advanced is to prove that because the Hausas exhibit a measure of civilisation they cannot be Negraic. Without entering into a detailed academic discussion of any of these theories, it may be remarked, in a general way, that there are differences in physical characters among negro as among European nations. Even in the matter of colour there are degrees of blackness among negroes, even of the same nation or the same family, just as there are degrees of whiteness among Caucasians, even of the same nation or the same family. The degree of a negro's blackness is purely a question of the amount of the melanin deposit in the layers of his skin. As to one nation of a race being more advanced than another, that is so ordinary a phenomenon, even in Europe, that one wonders at the extravagant, if not irrelevant, conclusions that anthropology attempts to draw from it when it appears in Africa. Do not Great Britain, France, Germany and the United States to-day lead the white world? Does not Japan lead the yellow world? And why should not Songhay, Hausa and Bornou have led the black world in the long ago without it being therefore assumed that they were of some different stock? Nations and countries that abut on the world's highways benefit from contact with other nations and countries, and nations in contact reflect the culture of the nations with which they have been in contact. Roman culture is reflected in these islands still. What wonder if North African culture be reflected in Hausa?

4. The Eastern Origin Theory.

The point is often strained that the Hausas themselves have a tradition of having migrated from the East. So indeed they have. But what nation has not a similar tradition? Nearly every West African nation has it. This claim to an Eastern origin made in the Hausa tradition, considered along with other similar claims made by nearly every nation on earth, should be regarded as furnishing another consideration (that of universal consent) strongly favouring the truth of the great law of the migrations of peoples which draws them from the land of the rising to that of the setting sun. Discarding mere

tradition we have left us this much of certainty, that from time immemorial the Hausas have been present in the Western Sûdan, somewhat north of their present territory. There is no reason which can be considered cogent or incontrovertible for regarding them as aught else but Negraic.

5. The Hausa in History.

Within historic times the Hausas have been known as divided into seven States which were independent of one another generally. The military predominance of one or another at various times, however, resulted in a sort of unwilling confederation. These States were named Biram, Gober, Katsena, Dawra, Kano, Rano and Zaria. Lungern, a town in the last-named State, is the headquarters of the British Administration. Other States were subsequently added to the number, such as Ilorin and Nupe, Gazawa and Zamfara, but though Hausa was spoken in them they were only Hausa States in the same sense as that in which a black country like Northern Nigeria is British. Historical records of Hausa for the last thousand years, more or less, are available, according to which these States were always independent of and hostile to one another. But their tradition refers to a time when they were confederate States. This period has been fixed by some authorities as, at the latest, only a little later than A.D. 700.

6. Sources of Hausa History.

The materials available for the study of the history of Hausaland are, unfortunately, very scanty. The Hausa records were apparently purposely destroyed by their Fulani conquerors with the object of destroying all traces of their predecessors. A few manuscripts, however, escaped the general destruction. One contains a chronicle of Katsena. Another, in possession of the Niger Company, gives the history of Kano during the reigns of forty-two kings. The Rev. C. H. Robinson, M.A., first Hausa Scholar of the Hausa Association, found one in Zaria, giving some account of the history of that State. There are also native notes on Hausa history which are, however,

believed to be from a tainted source. The Sultan Bello, the Fulani commander, compiled a history of Hausa from a previous study of the documents, the destruction of which he encouraged. This history is naturally a very much distorted narrative, reading very much like an English history of France or a French history of England. There are also oral traditions and references in the writings of contemporary Arabs. Very little trustworthy detail is preserved with reference to the Hausa's customs, laws, administration, literature or religion.

7. Administration, Laws, Industries.

That their administrative system was as nearly perfect as could be is borne out by the fact that the Fulani simply adopted it, and on the British occupation the States were considered well governed. Each State was under a supreme ruler, sultan, emir or king, who had a sort of chancellor (magi) and an advisory council. The ruler generally commanded the troops himself in war, though sometimes this duty was relegated to a military commander.

After the adoption of Islam the law was Koranic and generally administered by magistrates known as "kaids". They were learned in the Koran and conversant with the works of the leading Arabian writers on law, as well as with recorded decisions. They were often "mallams," or professors and priests.

The people were rather heavily taxed, as would appear from the following list of taxes, based apparently on the Koranic model, but much diversified in different States. Independent pagan States were raided for slaves, and conquered ones heavily taxed. In the Muslim States the principal taxes were :—

1. Zakka, a tithe on corn, limited to the two staple crops of the country. It was exigible only from Muslims and devoted to charity and religion, and perhaps to State purposes.
2. Kurdin Kasa, a land tax, the tribute of the conquered pagans.
3. A plantation tax, levied on all crops save those taxed with Zakka.
4. Jangali, a cattle tax, levied only on cattle, not on flocks.

5. Sokoto Gaisua, a tax paid to Sokoto and Gando by all other emirates under the Fulani régime.
6. Kurdin Sarauta, an accession duty paid by a chief or holder of office on appointment.
7. Every form of handicraft was separately taxed.
8. Vendors in markets, merchants, traders and brokers were taxed at different rates in different places in addition to the tolls on caravans.
9. Gado, or death duties, were collected and intestate estates lapsed to the ruler in default of a recognised heir.
10. Fines, court bribes, presents, whenever an inferior presented himself before a superior ; and other irregular levies.
11. Minor special taxes on brewers, date palms, honey, dancing girls, etc.

These taxes were collected by officials known as Jakada and Ajele, who were agents of the fief-holder under the feudal system that came in with the Fulani occupation. The Jakada was to give notice when the taxes became due, and the Ajele was entrusted with the actual collection. The whole system of taxation is being re-organised by the British Administration.

The industries of Hausaland resemble those of other Muslim countries in Africa. The people, although brave and fearless, are on the whole a peaceful and industrious people. Agriculture is keenly pursued. Among their farm products are guinea-corn, known in Africa as kûs-kûs, a leading article of diet, maize or Indian corn and wheat, sweet potatoes and yam, and the boabab or breadfruit. Indigo, which furnishes their principal dye, used to be extensively cultivated. Besides agriculture, cattle tending was also an important occupation. The Hausas and Bornuese, like the Fulani, are great herdsmen, and among them in old times, as among the patriarchs of the Bible, a man's wealth was estimated by the size of his flocks and the number of his slaves and retainers. Other industries were weaving, dyeing, brass-working, mat and basket making, and working in leather. Some of these industries have declined with the changes of

recent years, but the industries that made a centre like Kano famous are still carried on. It does not need half an eye to see, though, that it cannot be long before the weaving industry of Kano, for instance, will be destroyed by the importation of cheap cottons from the Manchester looms. All Hausaland is now, in adaptation to changed circumstances, becoming a great cotton-growing centre, furnishing the raw material for the aforesaid Manchester looms to work on. Kano is the great market of Hausaland and is the destination of caravans from all points of the compass. The tanned goat skins worked at Kano are the "Morocco" leather of commerce. About 300,000 of these are said to be exported annually to Morocco and other parts of the north, and thence to Europe. Other exports from Kano to Europe include ivory and feathers. Cloth is woven by means of hand-worked looms, in strips from three to four inches wide, several of which are sewn together to form a piece.

8. Food, Dress, Etc.

The Hausa is a man of wonderful strength, and he is proud of it. All the races of Africa exhibit a wonderful power of endurance, but even among them the Hausa is phenomenal. This fact he attributes to his feeding chiefly on the kûs-kûs or guinea corn. Butter and milk are largely consumed, the latter being preferred in the condition known as "sour". Unlike many African nations the Hausas eat flesh. They are great consumers of the kola-nut, the seed of the Herculia Acuminata, which is very rich in alkaloids and is a great sustainer of energy. It is an important article of commerce. Tobacco is used chiefly in the form of snuff, though the pipe is slowly coming into favour. Like other Muslim nations the Hausas are total abstainers from alcoholic beverages. In consequence of this abstinence for generations the Hausa constitution has become so susceptible to the toxic action of alcohol that I have known cases in which Christianised Hausa descendants have ruined themselves, body and soul, by drinking even moderately.

The dress of Hausaland consists, in the case of men, of a large

over-gown (boloma) generally white or blue, worn over a closer fitting tunic-like garment (caftan), spacious zouaves, sandals, fez and turban, cotton cap or straw hat, as the season or the occasion demands. The female costume forms a complete and decent covering for the entire body.

9. Hausaland across the Centuries.

The Sultan Bello ascribes the origin of the Hausa people to a slave. He excepts the people of Gober, who, he says, were free-born, and descended from the Copts of Egypt. In estimating the value of this dictum, it should be borne in mind that Bello was a Fulani, an hereditary enemy of the Hausas, and not likely to say anything in their favour. The Kano Chronicle, which covers a period extending from mythical times to the Fulani conquest in the early part of last century, gives the founder of Kano as one Berbushay. This word means "a man from the land of slaves". But to insist on "a man from the land of slaves" being, therefore, a slave, is to run the risk of perpetrating a *non-sequitur*. Berbushay is described as "a black, strong man," and "a lover of hunting". He played in the Sûdan the rôle of a Herakles. He is credited with having killed an elephant with his spear one day. He carried it on his head, *more Africano*, a long distance. Where he put it down was afterwards the site of Kano. A similar legend ascribes the foundation of Zaria to a strong man who killed a "dodo" or fetish lion. The mythical history of the Hausa States makes Biram wed Diggera, a Berber settlement in the desert, north of Hausaland. This union resulted in a family of three sets of twins, Katsena and Zaria, Kano and Rano, Gober and Daura. Each member of the family had duties assigned to him. Gober, the fighting man, was to see to the defence of the others, a reference no doubt to the position of this State on the northern frontier. Kano and Rano were to develop industries. Kano is to this day an industrial centre. Katsena and Daura were to trade, and Zaria to maintain the supply of labour. This it effected by raiding the defenceless country to the south. In a short time the family was increased by the addi-

tion of seven illegitimate children, *viz.*, Nupe, Ilorin, etc. This myth seems to indicate some form of confederation between the States at some early, perhaps prehistoric period. The indication is not confirmed by history. "The country of Hausa," says Sultan Bello, a writer of last century, "consists of seven provinces, to each of which a prince is appointed to superintend its affairs, and the inhabitants of the whole speak one language. The central province of this kingdom is Katsena; the most extensive is Zaria; the most warlike is Gober; and the most fertile is Kano." Kano was the first of the States to play a leading rôle in Hausa history. Its first king, Dauda, whose coming Berbushay foretold, reigned about the close of the tenth century. Islam was accepted by another of its kings, Yahya, about the middle of the thirteenth century. In the second reign after his Kano became embroiled with Zaria. It is on record that in the several battles fought, the Kano soldiery used "iron caps". Warriors of the Hausa States are said to come out to battle still in shirts of mail, which some people say are spoils of the Crusaders brought by Arab merchants from Palestine. King Edris made his own gunpowder, and the Almami Samodu, in his long struggle with the French, made his own rifles and ammunition. There is, therefore, no absurdity in supposing that these shirts of mail may quite possibly have been home-made. In the reign of another Dauda, fifteenth king of Kano, there appears to have been a *rapprochement* between Kano and Bornou. So real was the *entente cordiale* then established that we find Kalmana, king of Bornou, taking sanctuary at Kano from his rebellious subjects in 1430. During the next reign a Kano field force appears to have operated successfully in the southern provinces. A seven-year-long campaign was undertaken, one result of which was that one thousand slaves were sent up to Kano every month. About the same time there was a rupture with Bornou. The result of the war which followed was that "many towns were given to Bornou". The king of Kano evidently had not the services of a Count Witte to bluff his victorious enemy out of his due and stoutly refuse the cession of an inch of territory, or the payment of a copeck of indemnity. The

king of that time is reported to have been the first to have camels, and to drink wine, in Hausaland. In the reign of the next king, Yakoub (1402-1422), there was an exodus of Fulani from Mella, another Sûdanese state, to Hausaland. Land was given them in Kano, and some other States. With their characteristic treachery, the Fulani had begun the peaceful invasion of a country on which they had their eye. The name Fulani is synonymous in Africa with the basest treachery. A Fulani will invite to his house, and receive with every mark of friendship, the man whose destruction he has planned. He will seat him on his best rug or hide over the pit he has dug for him, and into which he intends him to fall. Among all the nations, from the Sûdan to Sierra Leone, you find them settling in small communities, paying tribute to the rulers. But for the Pax Britannica many another nation would have found out, to its cost, what Hausa has found, that to entertain the Fulani is to nurse a viper. Yakoub's reign witnessed a great revival in trade and increase in the number of foreign caravans, as well as some immigration of Arabs and Berbers. Mohammed Rimpa, the next king, 1422-1459, was one of the most famous, if not actually *the* most famous, of the rulers of Kano, and did much to improve the country. Learned men are reported to have resorted much to Kano in his day; mosques were built, and "religion became strong". He first observed the fast of Ramadan. "He gave titles to his eunuchs, and shut up his women after the manner of the East." He built the walls of Kano, with their seven gates, and also a palace. He did something towards systematising administration, for it is on record that he divided Kano into nine provinces, over each of which he appointed a viceroy. The next reign was wasted in a disastrous war with Bornou, resulting in the dethronement of the king of Kano, and the installation of his victorious enemy's slave in his place. Ahmodu Kesoke, son of the dethroned king, somehow regained the throne of his fathers, and "conquered the four corners of Hausa, east and west, and north and south," and put to flight the armies of Bornou which marched against him. His reign witnessed another revival of learning and flocking of "*Mallams*" (professors or

learned men) to Kano. The leading event of the sixteenth century was the Songhay invasion and conquest, mentioned in the Tarikh-es-Sûdan, and by Leo, the African, but not in the Kano Chronicle. Askia, king of Timbuctoo, compelled his defeated enemy to marry one of his daughters, and pay him the third part of all his tribute. Passing over nearly two centuries, we come to Al Wali, the last Hausa king of Kano, who rebuilt its walls in 1787, and ultimately had to flee to Zaria for refuge from the victorious Fulani. The other States, like Kano, had their ups and downs, their eras of prosperity and adversity, culminating in the unspeakable catastrophe of the Fulani irruption during the early part of last century. This alien domination Hausa was on the point of shaking off, when the British Government appeared on the scene. Much bloodshed was thus averted, and though the British occupation has not been bloodless, yet it is Fulani blood that has been spilt.

10. Religion.

An overwhelming majority of the 10,000,000 inhabitants of Hausaland to-day profess Islam. But Hausaland has not always been a Muslim country. Islam was accepted only during the reign of Yahya in the thirteenth century. It is generally believed, and I have heard it stated, that Islam was forced upon the Hausas by their Fulani conquerors. The statement involves an almost unpardonable anachronism. As a matter of fact the Fulani conquest followed quite six centuries after the adoption of Islam as the national religion. The latter event took place in the thirteenth century, the former in the nineteenth. The idea of force having been used to compel its acceptance is in direct contradiction to history, which tells us that this event was quite peaceful. The statement that Islam wins its way among the nations of Africa by fire and sword is a pious fraud of Christian missionaries to account for their own failures when in contact with it. Berbushay was a pagan, lived on the Hill Dalla, and is said to have inherited the customs of Dalla, which were handed down through the pagan families. He was Pontifex Maximus as well as king and officiated at religious

festivals. None but he could approach the goddess Gonkie or Shemsusu, whose shrine was a walled hill which was constantly guarded. Her festivals were celebrated twice a year when *black* animals only were sacrificed. In connection with these festivals were some mystic rites during which the worshippers divested themselves of their clothing, affording a parallel to "the pagan rites of naked worship with which Venus Erycina of the Phœnicians was once honoured in Mecca". Arising from this worship of a supreme female deity was a tradition that the Hausa States were once under the rule of a woman whose capital was at Zaria. Bello describes her as Amina, daughter of the Prince of Zaria, and states that she subdued Hausaland by force of arms. Early tradition makes her the founder of Zaria, and associates a colossal statue of her with some remarkable rocks called Almena, to the south-east of Zaria. Berbushay was a prophet and foretold the erection of mosques, a prophecy which received fulfilment when in the reign of Yahya, about the middle of the thirteenth century, Islam was accepted, having been introduced from Melle in the Eastern Sûdan. Yahya's successor was buried by the imâm, or priest of the mosque, with Muslim religious rites. His corpse is said to have been the first to be wrapped in white cloth and to have had prayers said over it. His successor is found consulting the priest of Shemsusu when in difficulties with Zaria, and by his advice attending pagan ceremonies, at which the priest "sang the song of Berbushay". Nevertheless, unlike the son of Kish in similar circumstance, he achieved success. Paganism died hard. The struggles for supremacy between it and Islam raged continuously, with alternate success, till about the fifteenth century, when Islam would appear to have triumphed. The Faith received a great impulse in the reigns of Mohammed Rimpa and Ahmodu Kesoke, his grandson. There can be no doubt that it has dignified the Hausas, as it does all its followers. Certain ceremonial rites to which the youth of both sexes are subjected prior to entering the full rights of citizenship or being recognised as Muslims and permitted to enter a mosque, are not entirely religious, but are also regarded as sanitary measures and are observed by most African

nations, even pagans. The omission of them is regarded as a social offence and the penalty is ostracism. During the period of seclusion which follows the girls receive systematic instruction in such subjects as medical botany, domestic economy, dancing and deportment. The five daily prayers, the fast of Ramadan and the feast of Bairam are all faithfully observed. Polygamy is recognised, subject to the Koranic limitation of a maximum of four wives. As Hausa sentiment requires that every marriageable woman should be married, there was not, prior to the introduction of European influence, any "sisterhood of shame". This apparently necessary concomitant of European civilisation has hitherto been heavily taxed by the native rulers of the Hausa States. Public prayers are said in Arabic, which is to Islam what Latin is to the Roman Church. The problem of labour was solved by domestic slavery, a system little understood in this country, but which was not at all the same thing as the oversea slavery.

11. Education and Literature.

Besides the historical manuscripts enumerated in a previous paragraph, the only Hausa literature surviving the destruction of the Fulani consists of religious and warlike songs.

Native schools exist throughout the country, where the children are taught to read and write. At Katsena there used to be a university similar to the other universities of the Sûdan, of which that of Sankoré was the most celebrated. These universities were generally domiciled in some extensive mosque, and may be regarded as off-shoots of the mosques, much in the same way as Durham University is an off-shoot of Durham Cathedral. The instruction imparted was based on the Koran, and embraced grammar and literature, philosophy, logic, elocution, history, biography, ethnography, and philology. References to surgery point to the Sûdanese not having been unaware of the Arabian saying, "He who studies anatomy pleases God". It is on record that a certain distinguished person went to Timbuctoo for an operation for cataract, which was entirely success-

ful. The teachers, called Mallams, are generally famous for their devotion to Islam, and their application of Koranic precepts, their knowledge of the holy writ, their learning and the dignity of their personal life. This vocation is often hereditary, and the necessary consecration to religion and learning was sustained by pilgrimages to Mecca, and sojourns in the great Arabian universities. M. Dubois says: "A cerebral refinement was thus produced among a certain proportion of the Negraic population, which had surprising results, and which gives the categorical lie to the theorists who insist on the inferiority of the black races". His reference in the expression "surprising results" is to the fact that these negroes were as good as, and, in many cases, superior to, the Arab scholars, as is proved by their being appointed to professorships in Morocco, Egypt, and the universities of Arabia, whilst the Arabs were not always found equal to the requirements of the Sûdanese universities. Teaching is absolutely free. Except in very rare instances the Mallams are unpaid, and the students have no class fees to pay. The *Taliba* or student of course learns his rudiments before coming to the university. Some small teacher has taught them to him. The schools are held out of doors for the most part, or in sheds during bad weather. The pupils sit on the ground with crossed legs, tailor-fashion, forming a circle round the schoolmaster. They repeat verses of the Koran in chorus after him, following the inflections, marking the pauses and imitating the tone he indicates. They are taught to form Arabic characters by copying verses of the Koran on wooden tablets. These are washed from time to time, and the washings kept for use as medicine, the ink being made of freshly expressed vegetable juices. The master then discusses the verse from every point of view. When the entire Koran has been learnt thus, verse by verse, the *Taliba* is ready for the university. No preliminary examination damps his enthusiasm. He studies under what masters he likes, and may shift from class to class at will. The teaching is rather of the nature of the elucidation of books than of lectures *ex professo*. Classes are generally held within the precincts of some mosque, and sometimes also on the premises of the pro-

fessor. At the completion of their course, students receive a licence or diploma, and every career in the Sûdan is open to them. The pilgrimage to Mecca secures the title *Al-hadj.* Learned men from all parts of the Sûdan flocked to the University of Katsena, including Aicha Ahmed, one of the most famous traditionists of Timbuctoo. In this town the Hausa language is said to have attained its greatest perfection in richness of form and refinement of pronunciation, whilst the manners of the place were said to be distinguished for superior politeness over the rest of Hausaland, which was itself noted for the civility of its inhabitants.

12. Language.

This is grouped with Coptic among Hamitic languages and is very widely spoken in the Western Sûdan and other parts of Africa: in places so far separated from one another as Mecca, Suakim, Tripoli, Alexandria, Tunis and Lagos. It is to the west of Africa what Swahili is to the east, and what French is to Europe. On this account it has been called the *lingua franca* of West Africa. The Hausa language, with its words rich in liquids, is far more mellifluous and melodious than even such tongues as Joloff, Fulani, Susu and M'Fautsi. It is excelled by Arabic alone, which has with truth been called "the language of the angels". Hausa has been reduced to writing for more than a century. Despite the fact that it is spoken over an area of half a million square miles, the difference between its dialects is comparatively slight.

13. Some Hausa Proverbs.

I have selected a few Hausa proverbs just to show that in spite of external differences, minds move along the same general lines:—

1. "Little knowledge is like kunkummi." "Kunkummi" is tying the hand to the neck, a dangerous thing for horsemen especially.
2. "Hurry is not strength."

3. "Faults are like a hill; you mount on your own and then see other people's."
4. "Evil is like a hill; every one gets on his own and speaks about some one else's."
5. "A man is cut by the company he does not keep."
6. "Gazing at a man who is a long way off will not bring him to you."
7. "Talking will not take a camel to Asben; only acquaintance with the nose string."
8. "Quantity makes the cotton draw the stone."
9. "The one-eyed man only thanks Allah for his eye when he sees the totally blind one."
10. "Where there is a good disposition ugliness is beauty, but where there is no disposition beauty is ugliness."
11. "A man who is falling into a well will seize even the edge of a sword."

These have been taken at random out of a book of 567 Hausa proverbs compiled by Capt. G. Merrick, R.G.A., and, in some cases, slightly corrected. Parallels in the English language readily suggest themselves.

ORDINARY MEETING.

17TH FEBRUARY, 1906.

Professor R. W. REID, M.D., F.R.C.S., President,
in the Chair.

The Minutes of the last meeting were read and approved.

The President demonstrated several vertical sections of the human body prepared in the Anatomical Department. The various sections were illustrated by lantern slides and several peculiarities noted.

Several members of the Society described anatomical variations found in the dissecting-room.

Alex. Low, M.A., M.B., C.M., described the contents of a short cist found at Tyrie, Aberdeenshire, and presented to the museum by Lord Saltoun.

At the conclusion of the meeting the various lecturers were accorded a hearty vote of thanks.

NOTES UPON A MESIAL SAGITTAL SECTION OF A FEMALE SUBJECT.

By Professor R. W. Reid, M.D., F.R.C.S., President of the Society.

This section was one of a series of four sagittal sections of the trunk of a well-developed muscular female subject, aged about thirty-five years, which was brought to the Anatomy Department of this University. The only history which I was able to obtain was that the individual was found in an outhouse in this town in an insensible and moribund condition and that she died a few hours afterwards.

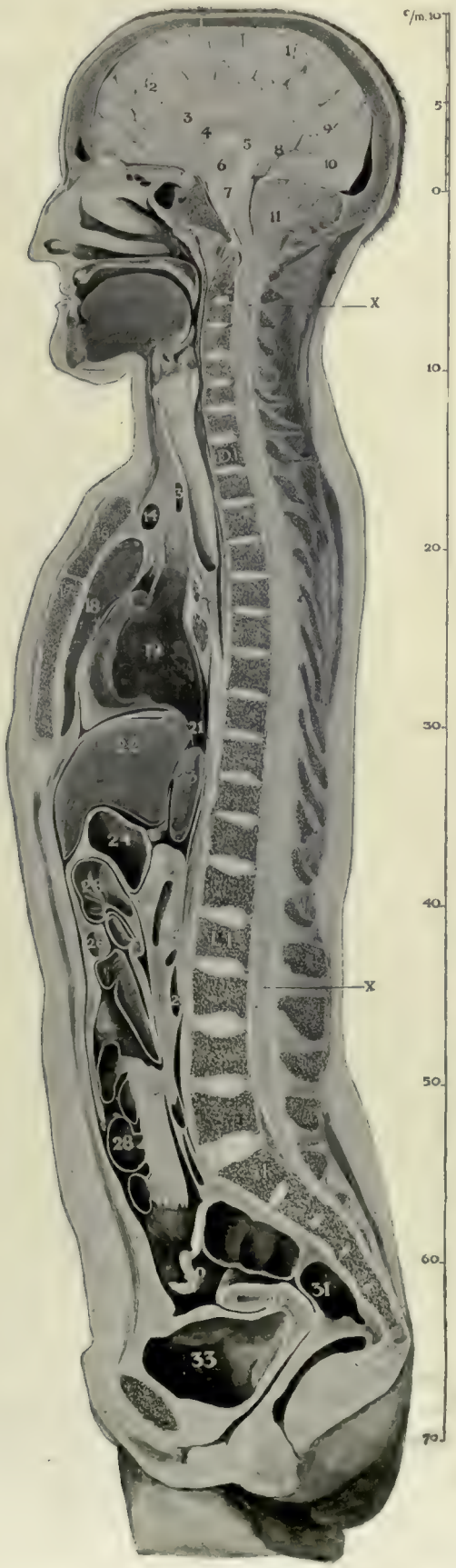
As the body seemed to be very well formed and of an age younger than that which usually obtains with regard to dissecting-room subjects, I decided to make sagittal sections of the trunk in the frozen state.

As the mesial section shows some remarkable features I think that it is desirable that they should be put on record.

On looking at the head the cranial vault is seen to be particularly thick. The internal occipital protuberance is on a higher level than usual, causing the tentorium cerbelli to assume a practically horizontal position instead of to slope downwards and backwards as it ordinarily does.

The spinal column presents twenty-three presacral, six sacral and three coccygeal vertebræ, the effect being to shorten the lumbar and lengthen the sacral region. The levels of the viscera in relation to the front of the spine are about half a vertebra higher than usual.

The contents of the spinal canal are of interest, more especially from a morbid anatomy point of view. The spinal cord, which terminates inferiorly at the usual place, is compressed antero-posteriorly



KEY TO PLATE VIII.

1. Fissure of Rolando.
2. Calloso-marginal fissure.
3. Corpus callosum.
4. Corpus striatum.
5. Internal capsule.
6. Optic thalamus.
7. Pons Varolii.
8. Dentate fissure.
9. Perpendicular fissure.
10. Calcarine fissure.
11. Cerebellum.
12. Trachea.
13. Innominate artery.
14. Right innominate vein.
15. Superior vena cava.
16. Manubrium sterni.
17. Gladiolus.
18. Right lung.
19. Blood clot in right auricle.
20. Right pulmonary veins.
21. Inferior vena cava.
22. Liver.
23. Spigelian lobe of liver.
24. Stomach.
25. Pancreas.
26. Transverse colon.
27. Duodenum.
28. Small intestine.
29. Mesentery.
30. Veriform appendix.
31. Rectum.
32. Uterus.
33. Bladder.
34. Anal canal.
X. New growth.

and laterally by a new growth extending throughout the whole length of the canal and situated between the dura mater and the pia mater and attached to the latter. This growth when traced upwards seems to surround and lose itself indefinitely in the medulla oblongata. Microscopically it has the structure of gliomatous tissue.

Whether this morbid condition is in any way associated with an attempt at the formation of a second spinal cord—an attempt which has aborted and passed into pathological formation—is a question which presents itself for consideration. Two cases of localised doubling of the spinal cord have been recorded by Dr. Alexander Bruce in vols. iii. and iv. of the *Review of Neurology and Psychiatry*, and along with this record Dr. Bruce gives a complete synopsis of thirty-six cases which had been collected by Steiner. The present case presents much similarity with examples of diffuse sarcoma of the spinal pia mater described by Dr. Sidney Coupland and Dr. William Pasteur in vol. xxxviii. of the *Transactions of the Pathological Society of London.*

RECORD OF ANATOMICAL VARIATIONS.

Date of observation, 1905-1906.

Variations in the roots of the lungs.

Fifteen subjects were examined, and of these five were found to be normal on both sides (33 per cent.), two abnormal on both sides (13 per cent.), seven abnormal on the left side alone (47 per cent.), and one abnormal on the right side alone (7 per cent.).

Thus 60 per cent. were abnormal on the left side, and 20 per cent. on the right side.

Left side—

	Above downwards.	Antero-posterior.
6 in normal position - - -	A B V	V A B
4 with A in front of B - - -	A B V	A V B
3 with B above A - - - -	B A V	V A B
2 with V highest and A lowest -	V B A	V A B

Right side—

	Above downwards.	Antero-posterior.
12 in normal position - - -	B A V	V A B
2 with A above V - - - -	B V A	V A B
1 with A above B - - - -	A B V	V A B

B = bronchus, A = artery, V = Vein.

(Signature of observer) J. W. FIDDES.

Date of observation, December, 1905.
Sex, Female.

Two ureters from a right kidney.

Measurements of kidneys—

	Right.	Left.
Length - - - -	108 mm.	106 mm.
Breadth - - - -	50 mm.	45 mm.
Thickness - - - -	36 mm.	36 mm.
Above the iliac crest - -	1½ in. (approx.)	2 in. (approx.)

Veins.—There are three veins passing from the hilum of the kidney. The first lies in front of the renal artery at the upper end of the hilum, and passes transversely across into the inferior vena cava. The second lies below the artery on the same plane, and passes out from the middle of the hilum. The third, smaller than either of the former, passes slightly downwards and inwards from the lower end of the hilum to join the ovarian vein 1½ inches below its junction with the inferior vena cava.

Ureters.—There are two ureters, superior and inferior. The superior begins at the upper end of the hilum behind the renal artery, and passes downwards and inwards in front of the second vein, and behind the third at its junction with the ovarian vein. It then descends on the inner side of the ovarian vein, and crosses the common iliac just where it divides.

The inferior ureter, which is slightly larger, arises from the lower end of the hilum just above the third vein, and, passing behind the vein, it descends on the outer side of the superior, to which it is connected by areolar tissue.

Pelves.—There are two pelves corresponding to the two ureters.

Each shows all the normal structures, the lower being slightly the larger.

Inside the Bladder.—There are three openings for the three ureters, two in the normal position, and another on the right, on a line between the right ureter opening and the urethra, and ½ inch from the opening of the ureter.

(Signature of observer) WILLIAM ANDERSON.

Date of observation, December, 1905.
Sex, Male.

High origin of ulnar artery (left).

This artery arises from the front of the brachial artery at the same level as the superior profunda artery. In the arm it lies superficially along the line of the brachial artery. In front of the elbow-joint it passes under the bicipital fascia and in the forearm lies superficial to the flexor muscles, immediately beneath the deep fascia. It passes under the anterior annular ligament of the wrist and forms a normal superficial palmar arch.

Branches.—In the arm a muscular branch is given off to the biceps muscle and muscular branches are given off to the flexor muscles of the forearm. No ulnar recurrent artery is given off. The arteries of the right upper extremity are normal.

In the left upper extremity no palmaris longus muscle exists.

(Signature of observer) JOSEPH P. CAMERON.

ON FOUR SHORT CISTS FROM ABERDEENSHIRE.

By Alexander Low, M.A., M.B., Senior Assistant to the Professor of Anatomy and Lecturer on Embryology, University of Aberdeen.

(Read 17th February, 1906.)

In a previous paper[1] I described the contents of a series of short cists preserved in the Anatomical Museum of the University. In the present paper I describe four additional cists which have been recovered in Aberdeenshire since the date of my former paper. In the case of three of the cists, I was fortunate in having the opportunity of examining the cists and their contents soon after their discovery.

I now give a detailed description of each cist and its contents.

Auchlin Short Cist.

On 14th November, 1904, while workmen were excavating gravel from rising ground in the corner of a cultivated field on the farm of Auchlin, Aberdour, they discovered a short cist. Through the intelligent interest of Mr. George Fowlie, the tenant of the farm, the cist and its contents were carefully preserved. I examined and photographed the cist with its contents soon after its discovery.

The cist had been opened into by the removal of a flat, upright stone which formed its north end—the long axis of the cist running north and south. The depth of soil covering the cist is about eighteen inches. As examined from the interior, the sides of the cist are built of flat stones set on edge, while the floor is formed by gravel. The inside measurements of the cist are 3 feet 8 inches long, 18 inches wide, and 16 inches deep. The south end of the cist is formed by a large

[1] *Proc. of the Anatom. and Anthrop. Soc. of the Univ. of Aberdeen*, 1902-1904.

flat stone set on edge with the ends of two smaller stones projecting inwards for three or four inches over its upper border. Each of the east and west sides of the cist is made by two large flat stones set on edge, but these stop short of the roof and over their upper borders projects a series of smaller stones. These smaller stones project inwards and in this way narrow the cist towards its roof for the better support of the single large flat roofing stone.

Contents of the Cist.—The cist contains many pieces of broken bones, the remains of the skeleton of a young child and small pieces of charcoal.

The pieces of bone lie in a small heap in the north-east corner of the cist. A large proportion of these pieces of bone have a splintered appearance and show evidence of having been calcined. Some of the pieces of bone can be identified as human, *e.g.*, the lower end of a femur, a piece of the lower jaw and a part of a temporal bone.

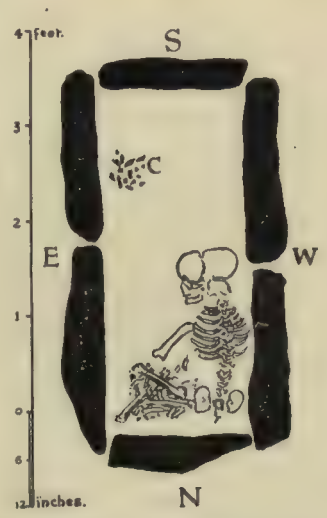


Fig. 1.—Short cist at Auchlin, Aberdour. C., pieces of charcoal.

To one side of this heap of broken pieces of bone lie the remains of the skeleton of a young child. Of this skeleton are fairly well preserved the left frontal, parietal and temporal bones, a part of the lower jaw with milk teeth, also the neural arches of twelve vertebræ. These arches had not united with the bodies of their vertebræ, a fact which shows that the skeleton is that of a child about five or six years of age. There are also a number of incomplete ribs and the diaphysis of a left humerus. The bones of this skeleton show no evidence of having been calcined.

In the south-west corner of the cist is blackened humus, among which are scattered small pieces of charcoal. The cist thus contains :—

1. The remains of the bones of two human skeletons, *viz.* :—
   (*a*) The skeleton of an adult the bones of which are much broken and show evidence of having been calcined.
   (*b*) The skeleton of a child about five or six years of age.
2. Pieces of charcoal.

In conclusion I may say that steps have been taken to preserve the cist, while the proprietor of the estate, A. Dingwall Fordyce, Esq., of Brucklay, has presented the contents of the cist to Professor Reid for preservation in the Anatomical Museum of the University.

Whitestone Short Cist.

This cist was recovered on the farm of Whitestone, Skene, on 3rd March, 1905. On the following day Professor Reid, Mr. D. R. Thom and myself examined the cist. In the interval the cist and its contents had been carefully preserved by the tenant of the farm, Mr. R. Allan. The cist was unearthed while workmen were removing gravel in the corner of a flat cultivated field. In removing the gravel the workmen partly uncovered one side of the cist (Plate IX.).

The cist had been opened by the removal of a large flat stone at the north-west corner. The long axis of the cist runs exactly east and west. There is a depth of from 6 to 10 inches of mould over the covering stone of the cist. The inside measurements of the cist are 3 feet 10 inches long, 24 inches broad and 21 inches high. The north side of the cist is formed by two somewhat irregular flat stones set on edge. As these are only from 15 to 18 inches in depth, to complete this wall, between their upper margins and the covering stone is wedged in a series of three smaller stones. The south side of the cist is formed by a single flat stone set on edge. The east end of the cist is closed by a flat stone 24 inches wide by 18 inches high, while over its upper edge there projects inwards for some 4 inches the end of a stone 3½ inches in thickness. In the same manner the west end of the cist is formed by one flat stone 24 inches wide by 10 inches high, and over its upper margin a stone 5 inches in thickness projects inwards for 4 inches. The roof is practically formed by one large

flat stone, somewhat irregular in outline, the south-west corner being wanting and filled in by a smaller stone. Additional support is given to the roof stone by the projection inwards of the flat stones at either end of the cist.

Contents of the Cist.—The cist contained the remains of the skeleton of an adult male, two urns, three flint scrapers and a large number of small pieces of charcoal.

The skeleton lay with the skull at the east end of the cist and with the face looking towards the south. From the position of the bones the individual must have been placed in the cist on his left side with his thighs and legs flexed (Fig. 2).

Fig. 2.—Short cist at Whitestone, Skene. A. and B., urns; C., pieces of charcoal; F., flints.

Of the two urns the wider one lay to the south and in front of the face, and here numerous pieces of charcoal were found. The taller urn lay on the north side, about the middle, and near it were found two small flint scrapers.

THE SKELETON.—The bones of the skeleton are much broken, but the remains indicate an adult male of short stature.

Skull.—The skull has crumbled away at the left parietal region, but fortunately is sufficiently intact to permit of the most important measurements being recorded. The measurements are given in detail in Table I. The skull is that of an adult male. The muscular markings are feebly developed, the mastoid processes being small and there being no prominence at the inion. Synostosis has occurred in the parieto-squamous suture and in the pterion. The teeth are in excellent preservation and are not much worn. The cranium has an approximate capacity of 1,450 c.c. of mustard seed.

Norma verticalis.—In norma verticalis the skull is brachycephalic,

broadly oval in form, the zygomatic arches are concealed and the rather prominent glabella hides the root of the nose.

Norma lateralis (Fig. 3).—The nasion is depressed and the glabella and brow ridges are prominent. The frontal bone is at first

Fig. 3.—Skull from cist at Whitestone, Skene ($\frac{1}{3}$).

somewhat receding and then rises with a steep curve to the bregma; from this point there is a corresponding curve down to the obelion. The occipital pole is flattened and the inion is not prominent. The skull rests—on a plane surface—upon the molar teeth and the opisthion.

Norma occipitalis.—This view is pentagonal in outline. The sides of the cranium descend almost vertically from the parietal eminences to the mastoid processes. The maximum breadth is near the level of the parietal eminences.

Norma frontalis.—The face is broad with a total facial index of 88·7. The orbits are microseme and the nasal aperture is broad and cordate with an index of 50·9. There is subnasal prognathism.

Norma basilaris.—The palate is elliptical and the posterior palatine spine prominent and sharp. All the upper teeth are present, except the two central incisors, which have dropped out. The cusps of the molar and premolar teeth are little worn and well-formed. The lower incisor teeth are worn flush, and must have been in apposition without any over-lapping of the upper incisors. The combined length of the upper molar and premolar teeth is 43 mm., and as the basinasal length is 100 mm., the dental index is 43, that is mesodont. Both the first upper molar teeth have four cusps, while the second and third upper molars have each three cusps, and the crown of the third molar tooth is exactly of the same size and appearance as that of the second molar.

The right half of the lower jaw with the chin is intact, its angle is 115°, the sigmoid notch is wide and shallow, the chin is prominent and the incisor teeth are inclined forwards. The external oblique line is well developed and more so the internal oblique line. Inside the molar teeth and above the internal oblique line, there is a marked thickening of the jaw.

The other bones of the skeleton are much broken.

The shafts of both femora are complete, but the heads are detached. The length of the right femur is approximately 450 mm. In the femora the gluteal ridges are not greatly developed, but the linæ asperæ are very distinctly pilastered. The platymeric index of the right femur is 73·6, while the pilasteric index is 122·2.

The bodies of both pubic bones are intact, and show a short broad symphysial surface.

The two radii are complete, and are well marked but rather slender bones : the right radius is 233 mm. in length while the left is 235 mm. The olecranon process of the right ulna is broken off, and the lower end of the left ulna is destroyed—from both bones we obtain an approximate length of 250 mm. The olecranon and coro-

noid processes are large and well developed, while the shafts of the bones are slender.

The height of the individual as calculated from the femora would have been approximately 5 feet 4 inches.

The bones thus indicate an individual of low stature and rather delicate build with a broad skull, somewhat prominent brow ridges, narrow orbits and broad nose.

Flints.—In the cist were found three flints, which show evidence of having been worked. The largest flint measures 43 mm. by 32 mm., and is 11 mm. thick along the back, while one border has been reduced to a cutting edge by flaking. The other two flints are much smaller, but each shows a sharp cutting edge made by flaking—these seem to be of the nature of thumb scrapers.

Urns.—An uncommon feature of the cist is that it contains two urns. These two urns differ in size, shape and ornamentation. The one urn is of the shape and appearance characteristic of the "drinking cup" or "beaker" class of urn, being relatively broad with slightly constricted neck and everted lip. The other urn is tall and relatively narrow, and not of a form characteristic of the "drinking cup" class of urn. These two urns are figured on Plate X., and later in the paper are described in detail.

The cist thus contains :—

1. The skeleton of an adult brachycephalic male about 5 feet 4 inches in height.
2. Two urns—one a typical "beaker," the other of a somewhat anomalous type.
3. Three worked flints.
4. Pieces of charcoal.

The trustees of the Kirkville estate have handed over to Professor Reid the whole contents of the cist for preservation in the Anatomical Museum.

Blackhills Short Cist.

This cist was recovered at Blackhills, Tyrie, in July, 1905. The cist was unearthed while Mr. John Milne was excavating gravel. Professor Reid, Mr. J. F. Tocher and myself visited and made a careful examination of the cist which, except for being opened at one corner, had been left untouched. Thanks are due to Mr. A. G. Brown, factor to Lord Saltoun, for taking steps to have the cist and its contents kept undisturbed and for affording us facilities for the examination of the cist.

There is a depth of some two feet of soil and gravel above the covering stones of the cist. The long axis of the cist lies E.S.E.

The roof of the cist is formed by two somewhat irregular flat stones. The cist has been opened by the removal of one of the roofing stones at its south-east corner. The stone removed is triangular in shape, and measures two feet along its base and about one foot in thickness. Internally the cist is not quite rectangular, the north-west corner being obtuse (Fig. 4). The internal measurements of the cist are 3 feet in length, 2 feet in width, and 1 foot 9 inches in depth. Fig. 4 is a plan of the cist, and shows the various stones forming its walls. The stones forming the walls are not closely jointed. The floor of the cist is paved with rounded water-worn pebbles of a uniform size and appearance.

Fig. 4.—Short cist at Blackhills, Tyrie.

Contents of Cist.—The cist contains the remains of the skeleton of an adult male and an urn. The urn lay at the south-east corner, tilted against the east end of the cist and near the skull. There were no flints nor pieces of charcoal, but the greater part of the skeleton was covered by a felted substance in which on microscopic examina-

tion hairs can be identified. Probably the individual had been covered by an ox hide.

The bones of the skeleton lay undisturbed, and a photograph was taken, and from this the position of the skeleton as shown in Fig. 4 reconstructed. The vertebræ lie in a straight line along the middle line of the cist; the scapulæ lie, on either side of the vertebræ, on their posterior surfaces and with the glenoid fossæ pointing outwards. The right humerus lies on its posterior surface and parallel to the vertebral column. The right radius and ulna lie parallel to each other, with their lower extremities crossing the lumbar spine. The head and neck of the right femur have crumbled away, but the shaft of the bone lies obliquely with its great trochanter in the position of the hollow of the sacrum and its lower extremity touching the south side of the cist. The right tibia and fibula lie under the right femur, with the fibula next the trunk. The left femur lies with its head in the acetabulum, and is so far flexed as to lie almost parallel to the vertebral column, while the left tibia and fibula lie almost parallel to their corresponding femur. The shafts of the left radius and ulna lie under the left femur, with their lower ends in the venter ilii. The hand bones lie in a cluster in the left venter ilii, while the bones of the foot lie in the south-west corner of the cist. The plan, Fig. 4, shows the position of the skeleton.

Thus the individual had been placed in the cist on his back, with his hands in front of the abdomen and thighs and legs completely flexed.

The Skeleton.—The bones of the skeleton are in a fair state of preservation, and have evidently belonged to an adult male beyond middle life. Certain of the bones show distinct evidences of osteo-arthritic disease. Thus several of the vertebræ show bony nodules at and lipping of the articular margins; the same changes are seen in several of the metacarpal bones, especially in the heads of the metacarpals of both thumbs.

Skull.—The cranial part of the skull has crumbled away at parts, so that its cubic capacity cannot be taken; however, it is so far intact

as to permit of the measurements recorded being taken (Table I.). Synostosis has commenced at the obelion. The upper jaw is edentulous behind the first premolar teeth, also in the lower jaw, the left canine and second premolar teeth, and both first and third molars have been removed during life, and the alveolar process has become absorbed. The crowns of the remaining teeth are worn quite flat. The skull is that of an aged male, with its muscular ridges and crests feebly developed.

Norma verticalis.—The outline of this view is a broad oval. There is flattening at the vertex, and the breadth is relatively great, so that the length-breadth index is 83·6. The nasal bones and zygomatic arches are concealed.

Norma lateralis.—The nasion is somewhat depressed, while the glabella is faintly marked. The thickness of the skull at the level of the glabella is only 10 mm. From the glabella the frontal arc rises up with a uniform steep curve to the bregma; from the obelion to the occipital point there is flattening. There is some projection of the occipital pole. The breadth-height index is 90·5.

Norma occipitalis.—This view is square looking: the parietal eminences are well marked, and there is only very slight bulging of the lateral walls of the cranium.

Norma facialis.—There is no prognathism, the gnathic index being 95. The face is short and relatively broad, the orbital margins are fine, and the orbital index is microseme. The nasal bones are delicate and slender, while the nasal aperture is somewhat narrow and pyriform, with an index of 46·9.

Norma basilaris.—The palate is slightly elliptical in outline. The tuberosities of the maxillæ are small, and the glenoid fossæ deep.

Lower Jaw.—The lower jaw is complete, and is a rather delicate but well-formed bone. The oblique lines are well developed, especially the inner one, which projects inwards as an overhanging shelf. The various nerve foramina are very large. The angle of the ramus is 119°.

Thus the skull is broad and relatively low. There is no pro-

minence of the glabella and no prognathism; the face is broad, without prominence of the malar bones; the orbits are narrow, and the nasal aperture of medium breadth.

Bones of Trunk and Extremities.—The dorsal and lumbar vertebræ are all intact, and the lumbar spine is of interest, in that the vertical depth of the lumbar vertebræ taken together, is greater when measured behind than in front. The respective measurements of the lumbar vertebræ are as follows:—

	L 1.	L 2.	L 3.	L 4.	L 5.		Total.
Anterior vertical diameter,	14	25	24	25	25	=	113 mm.
Posterior vertical diameter,	27	27	22	27	25	=	128 mm.

The marked wedge shape of the first lumbar vertebra may be due to disease, as several of the vertebræ show evidences of osteo-arthritis.

The bones of the upper extremities are much broken, but the parts remaining indicate delicate bones. The right clavicle is complete, and is a slender, straight and relatively long bone. The right radius is also slender and somewhat curved, and measures 232 mm. in length.

The right femur is complete, but the head of the left is broken. The upper third of the shaft of the femur shows platymeria, the small trochanter, though well developed, being obscured when the bone is viewed from the front.

The left tibia is complete, while only the lower two-thirds of the right remains; both bones are platycnemic, and retroversion of the tibial head is well marked. There is an accessory facet on the lower end of the left tibia for the neck of the astragalus. The torsion of the shaft of the tibia is so great that the articular facet for the lower end of the fibula looks much backwards, thereby throwing the external malleolus on a plane more posterior than that of the internal malleolus.

The right fibula measures 350 mm., and is a stout bone with well-marked muscular impressions. Its outer border is especially large and rounded so that the bone is much widened transversely.

Both astragali are preserved entire. They are bones of average size, but each shows the following peculiarities: as regards the neck of the bone on its upper surface there is a well-marked internal flexion facet and also a less distinct one along the external border of this surface. Again the angle of the neck is large and the internal pyriform facet is prolonged far forward on the neck.

The first metatarsal bones are relatively long and stout bones with large impressions for the insertion of the peronei muscles. The head of the bone is large and globular and its articular surface is prolonged on to the dorsal aspect.

The skeleton is thus that of an aged male of medium height and build with a broad, relatively low skull, and a low broad face with no overhanging eye ridges.

Urn.—The cist also contained an urn, not of the usual "beaker" type, but of the "food-vessel" type (Plate X., Fig. 3).

The cist thus contains :—

1. The skeleton of an aged brachycephalic male about 5 feet 4 inches in height.
2. An urn of the "food-vessel" type.
3. The remains of an ox hide.

There are no pieces of charcoal and no implements of any kind. The floor of the cist is paved with water-worn pebbles.

Lord Saltoun has presented the skeletal remains to Professor Reid for preservation in the Anatomical Museum.

Tifty Short Cist.

This cist was recovered in a cultivated field at Tifty, Fyvie, in October, 1905. The covering stone of the cist was tilted up by the plough and the cist opened by Mr. Alexander Rennie, farmer. The covering stone of the cist was only about 10 inches below the surface of the ground. The cist measured 22 inches in length and in breadth measured 13 inches at one end and 11 inches at the other; its depth was 10 inches. The only contents of the cist were some "ashes" and an urn of the "drinking cup" type. The urn was quite empty. I

had an opportunity of examining and photographing the urn, and give a detailed description later while the urn itself is figured on Plate X., Fig. 4.

Remarks on Skeletal Remains.

I now review the chief features presented by the bones of the two skeletons recovered from the Whitestone and Blackhills cists.

Table I.

DETAILED MEASUREMENT OF SKULLS.

	Whitestone.	Blackhills.		Whitestone.	Blackhills.
Sex	Male.	Male.	Inter-malar breadth	120 *ap.*	116 *ap.*
Cubic capacity	1450 *ap.*	—	Inter-dachryonic breadth	25	15
Glabello-occipital length	181	189	Nasio-mental length	119	112 *ap.*
Ophyro-occipital length	175	188	*Complete facial index*	88·7	86·1
Nasio-inional length	169	170	Nasio-alveolar length	72	70
Basi-bregmatic height	135	143	*Upper facial index*	53·7	53·8
Length-height index	74·5	75·6	Nasal height	51	49
Minimum frontal diameter	112 *ap.*	100	Nasal width	26	23
Stephanic diameter	110 *ap.*	—	*Nasal index*	50·9	46·9
Maximum breadth	156 *ap.*	158 *ap.*	Orbital width	41	44
Cephalic index	86·1	83·6	Orbital height	32	34
Breadth-height index	86·5	90·5	*Orbital index*	78	77·3
Horizontal circumference	512 *ap.*	524 *ap.*	Palato-alveolar length	58	51
Frontal longitudinal arc	130	130 *ap.*	Palato-alveolar breadth	63	57
Parietal longitudinal arc	132	130	*Palatal index*	108·6	110·9
Occipital longitudinal arc	113 *ap.*	125	Dental length	43	—
Nasio-inional longitudinal arc	311	345	*Dental index*	43	—
Total longitudinal arc	375	385			
Base line	137	136	Measurements of lower jaw: Symphysial height	33	34
Proportion of vault to base	2·7	2·8	Coronoid height	63	64
Sagittal circumference	511	526	Condyloid height	—	62
Vertical transverse arc	324	330 *ap.*	Gonio-symphysial length	74	68
Biauricular diameter	136 *ap.*	124	Bicondyloid width	—	130
Transverse circumference	460	454	Bigonial width	—	98
Foramen magnum length	36	41	Breadth of ascending ramus	33	29
Basi-nasal length	100	100	Condylo-symphysial length	—	104
Basi-alveolar length	101	95	Condylo-coronoid width	—	40
Gnathic index	101	95	*Mandibular index*	—	80
Inter-zygomatic breadth	134 *ap.*	130 *ap.*	*Coronoid index*	—	38·5

Skulls.—The various measurements of the two skulls are given in Table I. As the crania are somewhat broken the cubic capacity cannot be accurately taken. The cubic capacity of the Whitestone skull is rather small, being only about 1,450 c.c. of mustard seed. The height of the skulls as compared with the length is relatively great, both skulls being practically *hypsicephalic.* On the other hand, on comparing the relation of the breadth and height to each other we get a breadth-height index less than 100, both skulls being *platychamæcephalic, i.e.,* wide and low skulls. Comparing the breadth with the length both skulls are broad, the Whitestone skull being *hyperbrachycephalic,* with a cephalic index of 86·5.

TABLE II.

Measurement.	Whitestone Skull	Blackhills Skull.	Measurement.	Whitestone Skull.	Blackhills Skull.
Basi-occipital radius - -	98	115	Basi - occipito - sphenoidal axis - - - -	59	62
Basi-lambdoidal radius -	105	125	Cibriform axis - - -	34	37
Perpendicular radius - -	135	140	Spheno-ethmoidal angle -	136°	130°
Basi-bregmatic radius -	135	143	Spheno-maxillary line -	88	88
Basi-glabellar radius - -	112	112	Spheno-maxillary angle -	86°	76°
Basi-nasal radius - -	100	100	Base-line - - - -	137	136
Basi-alveolar radius - -	101	95	Distance of perpendicular behind bregma - -	43	44
Most ant. point from perpendicular - - -	106	104			
Most post. point from perpendicular - - -	73	87			

Both skulls being somewhat broken in their lateral walls it was possible to examine and take measurements of the interior aspect of each cranium. With these measurements and with the help of tracings from strips of lead, Figs. 5 and 6 were reconstructed. The various radii and angles were taken according to the method of Sir William Turner,[1] and are recorded in Table II.

It is seen that in each skull the distance from the perpendicular radius to the anterior curve of the cranial cavity is longer than to the

[1] *Trans. Roy. Soc. Edin.,* vol. xl., part 3 (No. 24).

corresponding point behind; this is especially so in the case of the Whitestone skull, the occipital pole being poorly developed.

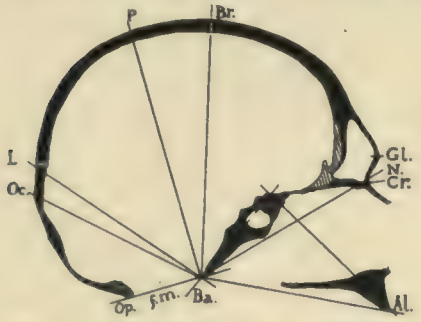


Fig. 5.—Tracing of skull from Whitestone short cist ($\frac{1}{3}$).

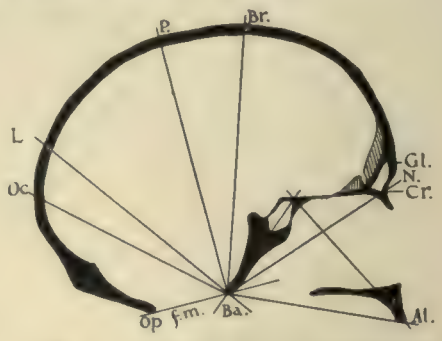


Fig. 6.—Tracing of skull from Blackhills short cist ($\frac{1}{3}$).

The face in both skulls is low and broad, and the orbits are distinctly *microseme*. In the Whitestone skull the nasal aperture is rather broad, the index being *mesorhine*, while in the Blackhills skull the index is *leptorhine*.

Lower Jaw.—Both lower jaws show characteristic thickening of the alveolar process inside the molar teeth in the region of the internal oblique line. This thickening is most developed in the case of the Whitestone skull, the lower jaw at the level of the second molar tooth being 19 mm. in thickness. This thickening is largely due to an overhanging ledge, on the inner side of the alveolar process of the jaw, for the support of the two last molar teeth.

Teeth.—The teeth in both upper and lower jaw of the Whitestone skull are beautifully preserved. The molar teeth have large, well-formed crowns. The second and third upper molars have each three cusps. The crown of the third molar or "wisdom" tooth is as large and well developed as that of the second molar. The combined length of the three upper molar teeth on each side is 29 mm., and the combined length of the upper molars and premolars is 43. Comparing this with the basi-nasal length, we obtain a *dental index* of 43 (Flower). Thus as regards the teeth the skull is mesodont, the crowns of the molar and premolar teeth being relatively larger than in the modern Scottish skull.

Bones of Extremities.—The clavicles of both skeletons are relatively long, straight and slender bones. The forearm bones are also slender and somewhat more curved than usual.

TABLE III.

MEASUREMENTS IN MM. OF BONES OF EXTREMITIES.

	Whitestone.		Blackhills.	
Sex	Male.		Male.	
Side	R.	L.	R.	L.
Radius	232	235	—	—
Femur :—				
Maximum length	450 *ap.*	—	458	—
Below small trochanter :—				
Ant. post. diam.	28	—	26	28
Trans. diam.	38	—	37	38
Middle of shaft :—				
Ant. post. diam.	33	33	31	32
Trans. diam.	27	27	27	27

	Whitestone.		Blackhills.	
Sex	Male.		Male.	
Side	R.	L.	R.	L.
Platymeric index	73·6	—	70·2	73·6
Pilasteric index	122·2	122·2	114·8	118·5
Tibia :—				
Maximum length	—	—	—	374
Condylar-astragaloid length	—	—	—	358
Ant. post. diam.	—	—	40	39
Trans. diam.	—	—	27	27
Platycnemic index	—	—	67·5	69·2
Femoro-tibial index	—	—	81·6 *ap.*	
Fibula	—	—	350	—

The femora are *platymeric* and the tibiæ *platycnemic* with torsion of the shaft and retroversion of the head.

The fibula in these short cist skeletons present characteristic appearances. It is a stout bone with its muscular impressions and ridges largely developed. The shaft differs from the modern bone in having its transverse diameter much greater than its antero-posterior; thus in the Blackhills skeleton a section across the middle of the shaft of the fibula measures 13 mm. in its antero-posterior diameter and 20 mm. in its transverse diameter. The surfaces for the attachment of the peronei muscles and for the flexor longus hallucis muscle are very extensive.

The astragalus also shows characteristic features. The astragali of the Blackhills skeleton are of an average size, but the angle of the neck is large, being 22° instead of 15°, the average angle in the modern European astragalus. Along the inner border of the upper surface of the neck is a distinct articular facet, and the internal

pyriform facet is continued far forwards, reaching within 4 mm. of the anterior articular surface. The anterior articular facet on the head of the bone is large, with its long axis almost horizontal.

Finally, the first metatarsal bone is especially large—the head is globular, with an extensive articular surface extending as far on the dorsal aspect as to the ventral aspect.

Thus in the skeleton of the lower limb torsion of the tibia is associated with marked increase of the angle of the neck of the astragalus. This increase of angle produces inversion of the anterior part of the foot, and is opposed in direction to the torsion of the tibia. Again, there is great development of the fibular surfaces for the attachment of the peroneus longus and flexor longus hallucis muscles associated with great development of the metatarsal bone of the big toe.

Structure of the Cists.

All the four cists are built of irregularly shaped flat stones, the ends being formed by one flat stone set on edge, while in the case of the side walls two flat stones are usually required. The sides of the cists are mostly contracted towards the roof, so as to better support the covering stones. In no case is clay used in the building of the cist, the stones being loosely jointed. In one example only is the floor paved. As regards the internal dimensions of the cists, the three larger cists, where burial had taken place by inhumation, vary in length from 3 feet to 3 feet 10 inches, in width from 18 inches to 2 feet, and in depth from 16 to 21 inches. The cist—where burial had taken place by incineration—is much smaller, only 22 inches in length by about 12 inches wide and 10 inches deep.

The long axis of each of the two cists, in which the adult skeletons were found, ran practically east and west, with the skull at the east end. In the other cist, where the bones had been partially calcined, the long axis ran north and south.

In no case was there any mound or external indication of the site of the cist.

Pottery.

In three of the cists sepulchral urns were present; one of the cists contained two urns, so that in all four urns were recovered in a very good state of preservation.

Two urns were present in the Whitestone cist—an unusual occurrence. The position of the urns in the cist is indicated in the plan (Fig. 2). One urn—No. 1—is short and relatively wide, while the other urn—No. 2—is tall and narrow (Plate X., Figs. 1 and 2).

Urn No. 1.—This is an example of the ovoid type of beaker with recurved rim—Thurnam's β type of drinking cup urn.[1] It measures $6\frac{1}{2}$ inches in height by $6\frac{1}{8}$ inches in diameter across the brim, and $3\frac{1}{4}$ inches in diameter at the base. The body is oval and passes with a gradual curve into the neck which is short and everted—that is subtype β 4, according to the classification adopted by the Hon. John Abercromby.[2]

The brim is slightly bevelled to the inside and the wall of the urn is fully a quarter of an inch in thickness. The paste is of a light brown colour on the exterior of the urn, but much darker on the interior surface — both surfaces are comparatively smooth. The ornamentation of the outer surface is arranged in bands passing horizontally round the vessel. Most of the ornamentation has been formed by impressions stamped in the soft clay with a narrow slip of notched wood or bone, this giving rise to lines of small rectangular impressions.

There are three main horizontal bands of ornamentation separated by horizontal lines and plain spaces. The uppermost band is $1\frac{1}{8}$ inches in width and is ornamented by parallel lines crossing each other obliquely so as to produce a lattice-like pattern. The second main ornamented band consists of sets of parallel lines running obliquely, each set being made up of about ten lines. The direction of the lines of each set alternate, so that one set of lines is inclined towards the

[1] *Archæologia*, vol. xliii., p. 392.

[2] *Journal of the Anthropological Institute*, vol. xxxii., p. 373.

left while the next is inclined towards the right. The lowest ornamented band is formed by horizontal lines enclosing a double row of a "herring-bone" pattern (Plate X., Fig. 1).

Urn No. 2.—This urn, also from the Whitestone cist, at first sight seems to differ very much from Urn No. 1. However, I think it belongs to the same type—that is Thurnam's γ type of drinking-cup urn. It measures 8 inches in height by $3\frac{1}{4}$ inches in diameter across the brim, and $2\frac{3}{4}$ inches at the base. The body is ovoid and passes up to the brim with almost straight walls ; there is no recurved rim, but it seems to me the urn belongs to the sub-type γ 1 of Abercromby's classification of beaker urns. The paste is of a dull reddish-brown colour on the surface and almost black in the interior of the urn. The ornamentation is arranged in bands passing horizontally round the vessel, and has been produced by impressions stamped on the soft clay with a notched tool. Round the neck there is a zone of parallel lines for a depth of $2\frac{1}{4}$ inches. The second ornamented band, $1\frac{1}{4}$ inches in depth, has marginal horizontal lines above and below, enclosing short vertical parallel lines which are interrupted in the middle by a double chevron pattern. The third and fourth bands of ornamentation are quite similar to the second band. Finally, the lowest inch of the urn is surrounded by a series of horizontal lines (Plate X., Fig. 2).

Urn No. 3.—This urn was recovered from the Blackhills cist associated with an unburnt burial. The urn is of the "food-vessel" form, $4\frac{7}{8}$ inches in height and $4\frac{7}{8}$ inches in diameter at the mouth, $5\frac{1}{4}$ inches in diameter at the middle from which it tapers to a flat bottom $3\frac{3}{8}$ inches in diameter. The rim is slightly bevelled towards the interior and shows a series of lines cutting it transversely and separated from each other by a distance of about $\frac{1}{4}$ inch. The exterior surface of the urn is of a light brown colour and the whole surface is covered with ornament, linear in character, evidently produced by stamping the clay while still moist with a toothed slip of wood or bone.

Round the middle of the urn there is a concave moulding, and

above and below this the method of ornamentation is similar. Immediately under the rim are three horizontal lines, and between the lowest of these horizontal lines and the concave moulding is a band of lozenge-shaped figures, each filled in with four or five parallel vertical lines. Below the concave moulding there is an almost exactly similar band of ornamentation (Plate X., Fig. 3).

Urn No. 4.—This urn was recovered from the cist at Tifty, Fyvie. It is an example of the low-brimmed type of "drinking cup" or beaker urn. Beaker urns are usually found associated with an unburnt burial; however, in this cist, incineration had been practised. The urn measures $6\frac{1}{8}$ inches in height by $4\frac{1}{8}$ inches in diameter at the brim, and $2\frac{1}{2}$ inches in diameter at the base. The urn is an example of sub-type γ 4, and as the Hon. John Abercromby has shown, this sub-type of beaker urn seems to be confined to the north-east of Scotland.

The surface of the urn is of a light brown colour, while the interior is much darker in colour and comparatively smooth.

TABLE IV.

MEASUREMENTS IN MM. OF URNS FROM SHORT CISTS.

Cist in which urn found.	Whitestone (*a*).	Whitestone (*b*).	Blackhills.	Tifty.
Height - - - - - -	165	203	124	155
Diameter at brim - - - -	155	84	124	106
Diameter at neck - - - -	135	86	—	97
Diameter at belly - - - -	150	101	132	113
Diameter at base - - - -	84	69	86	65
Thickness of wall - - - -	8	7	10	8
Thickness of base - - - -	14	14	19	14

The ornamentation is arranged in bands, passing horizontally round the urn, plain spaces alternating with these bands. There are four bands of ornamentation, the scheme of ornamentation in each band being similar in character. Each band consists of three rows of parallel lines crossing obliquely between marginal horizontal lines.

The direction of these oblique lines alternates in adjacent rows. The ornamentation has evidently been produced by impressions made in the soft clay by a toothed tool, the lines being made up of small rectangular impressions (Plate X., Fig. 4).

Conclusion.

This group of four short cists presents several features of unusual interest. They furnish us with examples of burial by inhumation and also by incineration. There is evidence to show that while burial by inhumation was the earlier practice, still inhumation and incineration were partly contemporaneous, and this is borne out by one of the cists of the present group, in which along with a burial by inhumation were also found incinerated remains.

A short cist may or may not contain a sepulchral urn, but when present, the "beaker" type of urn is usually associated with burial by inhumation, rarely—as in one of our cists—is it associated with burial by incineration. On the other hand, the "food-vessel" type of urn is usually associated with burial by incineration, and not as in our example with an unburnt skeleton.

Finally, from an examination of the skeletal remains from these short cists, we find evidence of a people of low stature. Their skulls are of a very brachycephalous type with moderately developed supra-orbital ridges, low breadth-height index, with parieto-occipital flattening, with the face low and broad, and the lower jaw not heavy or strong. The two skulls now described are of a type similar to that of the short cist skulls detailed in my former paper. In that paper I stated that as regards the origin of these short cist builders, "there seems little doubt but that they were descendants from the short, broad-headed Alpine race that occupied Central Europe about the end of the Stone Age". Since my paper was read the Hon. John Abercromby[1] has published a paper in which he demonstrates that the "beaker" class of sepulchral urn is the oldest Bronze Age ceramic, and that it is an imported, not a native type, having its centre of dis-

[1] *Journal Anthropological Institute*, vol. xxxii., 1902.

Cist at Whitestone, Skene, Aberdeenshire.

Fig. 1.—Urn from cist at Whitestone, Skene ($\frac{1}{3}$).

Fig. 2.—Urn from cist at Whitestone, Skene ($\frac{1}{3}$).

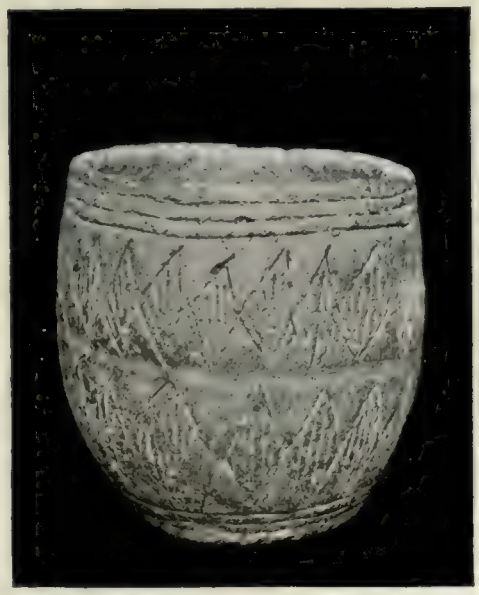


Fig. 3.—Urn from cist at Blackhills, Tyrie ($\frac{2}{3}$).

Fig. 4.—Urn from cist at Tifty, Fyvie ($\frac{1}{3}$).

persion in Central Europe at the end of the Stone Age. More recently, Dr. Thomas H. Bryce[1] in a suggestive paper, has sought to establish that there is a specific type of cranial form associated with the "beaker" class of sepulchral urn, and says that for working purposes it will be desirable in the future to arrange Bronze Age crania in terms of the fictilia. This is the seventh skull associated with a "beaker" urn which I have described, and, with five others tabulated and described by Dr. Bryce, make a practically uniform series, the type agreeing exactly. If this holds good for the "beaker" type of urn, is there evidence of a specific type of skull associated with the "food-vessel" type of urn? Unfortunately, it is very rare to find a "food-vessel" urn associated with an unburnt burial, these being usually found in cists where incineration has been practised. Hence it is difficult to obtain evidence on this point, and it would be unsafe to draw any conclusions from the single example now described. All I can say is, that on comparing these two skulls, certain slight differences are to be noted. The skull associated with the "food-vessel" urn is less brachycephalous; the breadth-height index is less low; the parieto-occipital flattening is less marked; there is an increase in the distance between the "perpendicular" and the posterior curve of the cranium, the occipital pole being distinctly more developed.

[1] *Proc. Soc. of Antiquaries of Scot.*, 1904-05, p. 425.

ORDINARY MEETING.

12th May, 1906.

Professor R. W. Reid, M.D., F.R.C.S., President,
in the Chair.

The Minutes of last meeting were read and approved.

The President introduced Mr. George Moir, M.R.C.V.S., who gave an address on "The Natives of the Malay Peninsula," with lantern illustrations and exhibition of specimens which he had presented to the Anthropological Museum of the University.

After a discussion on the paper, a hearty vote of thanks was accorded to Mr. Moir.

A paper on "The Anatomical Education of the Medical Student," by Mr. F. G. Parsons, F.R.C.S., was taken as read.

THE NATIVES OF THE MALAY PENINSULA.

By George Moir, M.R.C.V.S., Government Veterinary Surgeon, Perak, Federated Malay States.

(Read 12th May, 1906.)

The Malay Peninsula is a narrow strip of land, lying between the Straits of Malacca on the west, and the China Sea on the east. It consists of part of the colony of the Straits Settlements, *viz.*, Provence Wellesley, the Dindings and Malacca, the Federated Malay States of Perak, Selangor, Negri Sembilon and Pahang, all under British protection; Kedah, Reman, Patani, Kalantan and Trengganu, allied to Siam; and the independent native State of Johore.

Penang is an island lying about two miles to the west of the coast of Provence Wellesley, and Singapore is an island separated from the extreme southern point of the Peninsula by a comparatively narrow channel.

Penang, Malacca, Singapore, Provence Wellesley and the Dindings form the colony of the Straits Settlements.

A range of mountains runs throughout the entire length of the Peninsula, separating Pahang from the other three Federated States; the highest mountains ranging from 3,000 to 7,000 feet above sea-level. To the east and west of this mountain-range are vast alluvial plains, well watered, and covered with dense forest or jungle, only patches of which are as yet cultivated.

The positions of the different Federated States are as follows: Perak lies on the western side of the Peninsula between Provence Wellesley and Kedah on the north, and Selangor on the south. Selangor lies between Perak on the north, and Negri Sembilan on the

south. Negri Sembilan lies between Selangor on the north, and Malacca and Johore on the south. Pahang lies to the east of the other States, bounded on the north by the Siamese States, and on the south by Johore. The area of the four States is some 26,380 square miles.

The population at the last census, in 1901, was 678,595, consisting of 312,486 Malays and other natives of the Archipelago, 299,739 Chinese, 2,954 Europeans and Eurasians, and the remainder composed of Tamils, Singhalese, Siamese, Japanese and races from Northern India, Bengalis, Sikhs, Pathans, etc.

The Sakai population was put down at 7,982, but this figure is not altogether to be relied on. The Sakais are a nomadic race, the majority of them leading a roving life, in what is as yet primeval forest. The difficulty of making a correct census of them can be easily understood.

The climate of the Malay Peninsula, although hot and moist, is fairly healthy. It is insular rather than continental. The temperature varies between 75° F. at night, and 95° F. in the day. The average mean temperature in the shade is about 85° F. The nights are always sufficiently cool to permit of sleep without the assistance of a punkah. There are no seasonal changes and there are no variations in the average temperature all the year round. Foliage is perennial. The rainfall is abundant, from 100 to 200 inches per annum, depending on the district. It is distributed fairly equally throughout the year, there being no regular wet and dry seasons, although some months are, as a rule, wetter than others.

The chief products of the States are tin, rice, rubber, cocoa-nuts, pepper, sugar and coffee; the last mentioned is not so much cultivated as formerly, rubber now taking its place in many plantations. The tin mining is chiefly in the hands of the Chinese.

The history of British interference in these States is interesting and is a record of almost uninterrupted success. In 1874, owing to dissensions among the Malays themselves, riots among the Chinese employed in the mines, the consequent insecurity of trade and property

in the neighbouring British possessions, and the admitted inability on the part of the Sultans to deal with these, the then Governor of the Straits Settlements resolved to interfere, more especially as the Sultan of Perak had appealed for assistance. The result was the appointment of a British Resident, first in Perak, and soon afterwards in Selangor, each to advise the Sultan in the government of his State and to organise an efficient system of revenue collection. Mr. Birch, father of the present British Resident at Perak, was appointed the first British Resident of Perak.

The appointment of a British officer to administer the State was resented by a large number of the Malays, and in November, 1875, Mr. Birch was murdered while bathing in the Perak river at Pasir Salak. To avenge this outrage a military detachment was sent up, and after a few months' jungle fighting the murderers of Mr. Birch were captured and punished.

British Residents were subsequently appointed in Negri Sembilon and Pahang. Since that time the States have enjoyed uninterrupted prosperity, culminating in 1896 in the federation of the four and the appointment of a Resident General, to whom the Residents of the different States are directly responsible. Previous to federation the Residents were each responsible to the Governor of the Straits Settlements.

In the thirty-two years since the British interfered in the government of the States the revenue has increased manyfold. In 1876 the total revenue was $560,997. In 1904 it had risen to $22,255,268. Ten years after the appointment of the first British Resident slavery was abolished. Splendid roads have now been made in the opened-up parts of the country and a railway runs through the States from north to south. Numerous fine public buildings have been erected, and all this has been done out of the revenue. The public debt is nil. In addition, an efficient law administration has been established, so that in what was a comparatively wild country forty years ago life and property are now as safe as they are in Great Britain.

As before mentioned the bulk of the population consists of Chinese

and Malays. With the former it is not necessary to deal in this paper, but I would only state that, taking into consideration the class to which they belong—the coolie class—they are peaceful, law-abiding citizens. They are industrious, hard-working men, and without them the Federated Malay States would not have reached the advanced state they have reached at the present day.

The Malays.

I was very much surprised to see in a geography published so recently as last year, 1905 (*Tweeddale Geography*, 3), the statement: "The Malays are nearly all pirates, and are much dreaded". A short sentence more misleading would be difficult to construct, for although such a description may have applied to the Malays of forty or fifty years ago it certainly does not apply to-day. A better description and one that I have seen or heard somewhere is: "The gentlemen of the East".

The Malays are nearly related to the Mongolian type. They are brown in colour, with dark coarse hair and dark or brown eyes. They are short in stature and well built with prominent high cheek bones, flat noses and thick lips. They are lazy, and comparatively useless as workmen, but they are keen sportsmen, and will work harder when there is the prospect of something to kill than for any other reason. They are easy-going and good-tempered, kind to their children, and always anxious to please. Although they do not show much emotion they resent slights, and are not very forgetful of injuries. Although they may not show anger at the time they are apt to brood over injuries. Every now and again one hears of a Malay running amok from brooding over real or fancied injuries. When they do run amok they do not necessarily vent their anger on the evildoer, but on whoever should chance to be nearest at the time. Cases of amok are not very frequent, and they seem to be getting less frequent now than formerly.

The favourite occupation of the Malays is gossiping and day dreaming. They will sit for hours under the shade of a tree in a

semi-conscious, dreamy condition, and be quite happy. They live in kampongs, in little attap houses, surrounded by cocoanut or fruit trees. They plant their padi and then sit down to watch it grow. They allow their wives and families to do the harvesting as well as most of the work that has to be done.

They are devout Mohammedans, pray five times a day, and attend the mosque regularly. Their marriage and burial customs are in accordance with Mohammedan law.

The Malay dress consists of a jacket or baju, made of thin printed cloth, and a kind of skirt or sarong fastened round the waist, but many of the men wear Chinese trousers. The women's dress consists of the sarong, worn as a skirt, with a belt round the waist, and a long baju buttoned or pinned down the front. Another sarong is often worn over the head. For a Mohammedan race the Malay women are allowed an unusual amount of freedom ; their faces are generally fully exposed. Although the Malays are the dominant race, and although the Peninsula is named after them, they are immigrants only, or they are supposed to be descended from immigrants, who arrived in the Peninsula from Sumatra about the twelfth century. The Sakais are supposed to be the aborigines of the Peninsula.

The Malay alphabet is composed of the Arabic alphabet with six letters added. The language is mainly disyllabic and contains many words of Arabic and Sanskrit origin. The literature is very meagre.

The Sakais.

As before mentioned the Sakais are supposed to be the aborigines of the Peninsula. They are of negrito or negroid type, and are called by the Malays "Orang Utan," or "men of the woods," and that is a very good name for them, because the majority of them keep to the woods. Only a few of the bolder ones ever come near civilisation. In some of the out-stations, as Tapah and Gopeng, they may occasionally be seen having come there to dispose of jungle produce and to buy tobacco and salt, etc.

In appearance they are dark brown or black, darker than the

Malays. They are rather taller than the Malays, but not so well built. They have high cheek bones and protruding jaws with fairly well-cut features.

The men, for the most part, wear their hair in a longish, curled, tangled mass. Some of them shave their heads more or less completely. Some of the women, especially those who have come much in contact with the Malays, wear their hair neatly combed back and tied in a knot. Others appear to have pulled their hair back, but without combing, and tied it in a similar knot, while others, again, wear their hair in what can be described only as a mop. This is the usual way of wearing the hair among the women met far away among the hills.

The men's clothing consists of a sheet of bark cloth, twisted round the waist, and then pulled through between the legs. They do not as a rule wear ornaments, unless a few poisoned darts carried on the ears, or in the hair, can be called ornaments. Although the men as a rule wear this piece of bark cloth, they are occasionally met with wearing no clothing whatever. The women wear the same bark cloth twisted round their waists, and often a quantity of roots, grasses, leaves, etc., are inserted at the top of the cloth. They are very fond of ornaments, as strings of beads and bracelets. Anything that can be strung together, as bones, teeth, seeds, glass beads, coins, etc., are used as necklaces. Sometimes a dozen such necklaces will be worn, either as ordinary necklaces or, as is very frequently the case with the older women, over one shoulder and under the breast of the opposite side. They wear either a piece of bamboo or a bone, or a porcupine's quill through the septa of their noses; when they go to a wedding, a feather has to be inserted.

They wear the same kind of ornaments in their ears, the holes in the lobes of which are sometimes very large. The women also are very fond of wearing armlets, made of brass or iron rings and of ornamenting their hair with bits of bark cloth, flowers or roots. They also frequently paint their faces with a red dye; a common way is to have two red dabs on the forehead, one on each cheek and one on the chin.

The Sakai houses I have seen have for the most part consisted of a slanting attap, or plaited palm leaf roof, resting on the ground at one side, and supported at the other by two upright posts—that is with three open sides. Many have two such roofs, placed in apposition at the apex with the two ends open and occasionally one end is closed up. The beds consist of a number of fairly stout branches, about six feet in length, raised a little from the ground, but the Sakais very often sleep in the open air, on the ground.

Their food consists of rice, tapioca, monkeys, snakes, squirrels, birds or, in fact, the flesh of any animal or bird that they come in contact with ; but they never kill except for the purpose of obtaining food or for protection.

The Sakais of the interior are exceedingly bashful and timid and never travel alone, but always in parties of two or more. If they happen to meet a stranger on the road or path, and can possibly do so without being observed, they will slip into the jungle and hide till the stranger has passed. If they know that they have been seen they will walk straight ahead, looking neither to the right nor left, but keeping as far as possible from the stranger. Should it be a party of women and the stranger speaks to them, they will not reply, while if it is a party of men one of them will reply, as briefly as possible, but without halting.

They are very kindly by nature and would not willingly do any creature any harm. Mr. G. B. Cerruti, than whom there is no greater authority on the Sakais, informs me that the women will even nurse and bring up, as one of their own family, any young animal that they may find in the jungle; he gave me a photograph of two Sakai women acting as foster-mothers to young pigs.

The Sakais are quite at home in the jungle. The way that they can pass through what looks like impenetrable forest is little short of marvellous.

They are not business men in any sense of the term, and they are being constantly cheated by the Chinese traders engaged in the jungle produce trade, for whom they frequently collect jungle produce. The

system of dealing with them is by barter; beads, cheap cloth, tobacco, salt, etc., being exchanged for rattans, rubber, etc. They always allow the other party to fix the price. I bought four blowpipes and four cases of poisoned darts from Sakais for one dollar and about a dozen cigars. I would have given them more, but I was a long way from civilisation at the time and getting short of money. However, they were quite pleased with the bargain, or at any rate appeared to be so.

The men are very jealous of strangers and their women folks. Although I have met young women often, when travelling on the roads and paths, I have never yet seen one in a Sakai village or encampment. It is difficult, or almost impossible, to reach their homes without a guide. There is no path leading to a Sakai village; and on every occasion the guide has given a whoop when nearing the village, which, I presume, was to warn the people that a stranger was coming; consequently, on my arrival, only the men and a few skin-diseased old women were to be seen, the younger women having disappeared. Others, who have had dealings with the Sakais, have told me they have had similar experiences. The women, when young, are not at all bad looking, but both women and men, when they grow up, become affected with loathsome skin diseases.

The Sakais are a very dirty race and seldom or never bathe. Although I have occasionally seen Sakais on a raft on the Perak River, they are not fond of that method of transport, being essentially landsmen, and preferring to keep to the land, if that is possible. They are very honest. If you tell a Sakai to come to see you in a certain number of days, he will not make a definite promise to do so. He will say, "If I remember, I will come, but if I promise definitely to come, then I will not be able to sleep for thinking about it, and that will make me ill, and then I will probably not be able to come after all". And that is all the promise you will get from him.

According to Mr. Knocker, Curator of the Perak State Museum, the Sakais are unable to count more than a few numbers. He says, "It is never advisable to make any arrangement with him for more

than two days ahead, not that he is hopelessly forgetful of an engagement, but simply that after the first day he quickly loses count" (*Journal of Federal Malay States Museum*, ii.). It may be that the Sakais realise their inability to count the days, since they are so unwilling to give a definite promise to do anything on a certain day. They have practically no idea of distance; one man will say that a certain place is about two miles distant, while the next one will say ten miles. Distance beyond a few miles is, as a rule, spoken of as so many days or nights distant, that is, so many days' journey, but there is a curious lack of agreement among them as to how many days' journey there may be between any two given places.

The Sakais are very superstitious, but have apparently no religion. They believe in ghosts, or, as they are called in Malay, Hantus. All their diseases are attributed to winds, or rather to ghosts in the winds, and their cures for the various diseases are in different kinds of combs worn in the hair. I had a few combs in my possession, but they were evidently misplaced when packing up to come home. They are made from part of a bamboo shoot, and are curiously ornamented, like the quivers for holding darts.

Their musical instruments are a kind of drum made from bamboo stem, and played like a kettle-drum, and a peculiar kind of flute, which is played through the nose. A photograph of two Sakais playing flutes in this manner may be seen in vol. i. of the *Wide World Magazine*, page 159.

Their principal weapon is the blowpipe or sumpitan. The blowpipes vary in length from about $5\frac{1}{2}$ feet to $7\frac{1}{2}$ feet and are always ornamented more or less. The darts are from 8 to 11 inches in length, being made from the mid-rib of a palm leaf, and fitted with a hub of pitch. They are poisoned at the tips with upas or ipoh a poison, obtained by boiling down the sap of the upas tree.

The quivers or cases are made of bamboo, fitted with a close fitting cap and always ornamented, some of them very prettily. The ornamentation takes the form mostly of straight lines running in various directions, and crossing each other at various angles, or in

angular figures. The quivers are carried by means of a string round the waist, but sometimes over the shoulder or round the neck. Sometimes the quiver is simply inserted into the waist-cloth. The method of using the blowpipe is as follows. A dart is inserted, and then a little cotton, or velvety hairs found at the base of the mid-rib of some leaves. The blowpipe is then applied to the mouth like a cornet, aim is taken, and a short sharp puff will send the dart for a considerable distance. The Sakais are very expert in the use of the blowpipe, and can shoot squirrels and other animals at a distance of from thirty to fifty yards. As soon as the animal drops, the dart is withdrawn, and the wounded part immediately cut out. A sort of bird-lime, prepared by boiling down the sap of the getah tree, is used to catch small birds.

Some of the Sakais grow a little rice or tapioca in jungle clearings, but they do not readily settle down. They are too fond of roving about to settle down in one place, and should a death occur in an encampment, all the houses are burnt down, the crops are abandoned, and they move on to another place.

They have practically no written language, but they can represent some expressions by scratching marks on leaves.

Marriage Laws.—A Sakai is by custom allowed to have more than one wife. He may marry all his sisters-in-law. When a Sakai wishes to get married, the selection of a suitable partner is left to the discretion of his parents, or elders. As soon as the girl is chosen she is allowed to come in contact with her intended husband for about a month to test his habits, conduct, character, etc. If everything is found to be satisfactory, a day is fixed for the wedding. The marriage ceremony begins with a big feast or kanduri, the menu consisting of roast monkeys, boiled snakes, tapioca, etc. A sort of war dance or jantong is then performed, in which the only musical instrument used is a log of bamboo of special construction. The bamboo, one foot in length, is hollowed out at both ends and is played in the same way as a kettle-drum. Every guest is bound to play a tune. To attend the wedding all the guests must adorn their noses with birds' feathers.

After the ceremonies, which last nearly three days, the bride is made to run round an ant-hill and the bridegroom must chase her. As soon as she is caught the guests disperse, and the newly married couple go home.

Funeral Customs.—Although the Sakais have no religion they are very superstitious. When a death occurs, the dead body is wrapped up with mats or leaves, and buried on the spot where death took place. All the deceased's personal effects, such as blowpipes, spears, feathers, earthenware pots, etc., are placed in the grave. The whole family and the neighbours remove to another place.

For information regarding the marriage and burial customs, I am indebted to Mr. Mat Dahalan, who obtained the information from his father, a Penghulu or Malay headman.

ON THE ANATOMICAL EDUCATION OF THE MEDICAL STUDENT.

By F. G. Parsons, F.R.C.S., Examiner in Anatomy to the Universities of Cambridge, Aberdeen, London and Birmingham, and to the Society of Apothecaries of London; Lecturer on Anatomy at St. Thomas's Hospital and the London School of Medicine for Women; late Examiner in Anatomy for the Fellowship of the Royal College of Surgeons of England.

(Presented 12th May, 1906.)

As time goes on, and science is continually widening her bounds, the question of what a student shall be taught becomes more and more important, and more and more difficult to solve.

It is generally agreed that the man who has had an education in the scientific groundwork of his profession—the man who has learnt not only what to do but why he does it—is in a better position to surmount difficulties, and to add to the discoveries already made, than one who is a mere empiric and who does certain things under certain conditions without knowing why. This is generally the case, though we all know examples of men who unite with a consummate knowledge of the theory of their profession an utter inability to practise it successfully; while, on the other hand, many very successful practitioners are quite ignorant of the scientific reasons underlying the actions which experience has taught them to adopt. It is not, however, a question of science *versus* experience in our profession, or I have very little doubt which would win, but simply whether science, combined with experience, is a better equipment for a medical man than either alone. Unless it can be shown that either is disadvan-

tageous, there can be only one answer, the one on which all our Universities and Colleges act, that certain of the sciences are useful stepping-stones towards the art of healing and preventing disease, and cannot safely be dispensed with.

When the question arises, "How much and how many of these sciences shall the medical student be taught?" the answer usually given is, "As much as he can learn, in the time at his disposal, of chemistry, physics and biology (including physiology)," for the sciences of medicine, surgery and pathology are chiefly applications of these. I do not regard topographical anatomy as a science in the same sense that these are, but the whole position of anatomy in medical education is different to that of the others, and, I think, is worthy of special consideration.

I am not the least afraid that anatomy will ever lose its place in our curricula, but we all know that of late years its importance has diminished, and I do not feel hopeful that it will ever regain its old commanding position. A hundred years ago it was the chief educational subject of the medical student; he first acquired from it the faculty of observation and of manipulative skill, as well as a taste for research, because, in those days, dissecting manuals, telling him exactly what cut to make next, and what to see when it was made, were either unknown or of nothing approaching their present excellence.

A hundred years ago, physiology was in its infancy, and the story of what the things did was told in the anatomy lectures when the things themselves were known. This was a different state of affairs to the present, when students are often lectured to on the functions of structures which they have not yet seen.

Then, too, the dissecting-room was the central meeting place of the school, where the earliest friendships were made and where the demonstrators knew and were known by their students in a way which is impossible now when the time has to be shared with the chemical, physiological and biological laboratories, and when the dissecting manuals, excellent as they are, enable one demonstrator to

supervise easily a room where formerly three or four would not have been too many. But in noting the differences between the past and the present, I do not altogether regret the change because I hope that I am able to see and not to forget that the turning out of a good modern general practitioner is our object, and neither anatomy nor chemistry nor surgery alone will do that, neither will the mind of any man retain more than a small proportion of studies with which he is not being constantly brought into touch in practice. I quite realise that all these more modern studies must not be grudged a fair share of the student's time, even if it is taken from that formerly belonging to anatomy, and I also see that the modern student cannot hope to learn as much anatomy as his predecessors did, and, therefore, it is very important that what he does learn should be, firstly, the most suitable for him in kind; and, secondly, that it should be really his own and not merely crammed from tutorial classes, books and pictures.

Our present system is to try to teach the student as much as possible of the contents of the standard anatomical text-books, because, although every teacher would like to lay stress on the parts which to him seem most important, he dare not do it in practice lest the examiner should have a different view of what is important. Of course in a University such as this, whose own degree is a licence to practise, the matter may not be so urgent, but even here there are always the possible prejudices of an external examiner to face, and, besides, some of the brighter students find that it helps them in after life to add another diploma, such as the Fellowship of one of the Colleges of Surgeons, to their degree, and few Universities would care to have it said that their graduates were particularly ill-prepared for these examinations.

If all that is known of anatomy could be mastered in the time allotted there would be no difficulty, but what a very little the average man can learn in twelve months! At the risk of seeming egotistical, I can best instance my own case. I have been learning anatomy, and little but anatomy, for twenty years, and my ignorance is still colossal. I try to think of this in marking papers and in

examining students *viva voce.* I say to myself, "How much better than this could you have done at the end of your second anatomy session?" and the answer frequently adds a few more marks to the candidate's store. Here, I think, I may step aside for a moment to point out that, however severe or however lenient the examiner may be, the candidates themselves, in the long run, set their own standard. Whenever the average of their knowledge is high the standard goes up automatically, and when it is low the standard goes down. It is easy enough to say that this should not be; theoretically each examining body should have its own standard which should not be varied one fraction though all the candidates pass or all are rejected, but, practically, though one particular examination may be stiffened up or eased down, the pass marks soon come to mean about the average of what the students have to offer.

The logical sequence of this fact is that students of a University might combine to lower the standard of their examination by preventing any one presenting himself in a brilliant condition, and something of this sort has, I believe, been tried in other than academic circles, but, if it could be effected, the result would be that the low standard of the men would become known quickly and the value of that particular degree duly discounted.

Although the candidates unconsciously set their own standard as far as their pass marks are concerned, neither they nor their teachers can effectively control the scope of the examination, and consequently, as I have already pointed out, they cannot control the teaching.

This is the examiner's privilege, and it is one which, on the whole, is exercised with the greatest caution, because, with one or two survivals of bad old days, every examiner is also a present teacher of the subject in which he examines, and he knows that the measure which he metes to other men's students may be measured out again to his own elsewhere and at a future time. I do not say or think that this is the only reason which makes for conservatism, but in his fear lest he should do an injustice to any candidate, he tries to cover as large an area of the ground as possible, and in this way

encourages a widespread superficial knowledge of anatomy in general rather than a thorough and accurate acquaintance with certain parts which are of real importance to his candidates' future studies. Most teachers are being constantly told by surgeons that the students who go up into the wards know no anatomy; it is meant that they are ignorant of such things as the exact position of the inguinal rings, of the facial nerve, of Stenson's duct, of the mastoid antrum, of the epiphysial lines, and a great many other points which are frequently turning up in surgery. The physicians, too, complain that they have to teach the anatomy and position of the heart and brain over again, and that when they are training their *post-mortem* clerks the latter do not know when they are dealing with perfectly healthy viscera. In vain one pleads in extenuation that, at the time of their anatomy examination, the men knew the attachments of all the muscles by heart and could recite the branches of all the arteries both forward and backward. It seems to me that here are two points which we examiners and teachers might agree to be much less exacting about, and I fancy that I see indications which point to a move already taking place in this direction. The amount of brain-power which has been expended in learning by heart all these exact attachments is quite incommensurate with the benefit obtained by the practitioner from knowing them, even if he remembered them, which he seldom does. It would be an immensely instructive thing if, say, ten of our most successful physicians and surgeons could be put through an ordinary present-day examination in anatomy to see what parts they would do well in and what they had utterly forgotten without being any the worse. I venture to think they would get very few marks on their muscular attachments and arteries below the size of, say, the lingual.

The elimination of the smaller muscular attachments would relieve osteology of one of its greatest terrors, but even then we lay too much stress on the smaller details of the bones. To me it is a matter of much greater interest to see how a candidate recognises the general shape, sex and age of a skull than how glibly he can recite the exact

articulations of the various bones. So, too, with the carpus and tarsus ; they might be studied as a whole, their bony landmarks carefully noted and their mechanism understood without burdening the memory with the exact shape of the facets on each individual bone.

Our efforts to perpetuate the memories of illustrious anatomists by coupling their names with the structures they described is praiseworthy, but bought too dearly ; think of the mental effort to remember which are the foramina of Stenson and which of Scarpa, which is Scarpa's fascia and which Camper's. It is fairer perhaps to attack living than dead anatomists, because the former can reply, so I will single out the ligament of Lockwood, the bloodless fold of Treves and the groove of Lucas as being instances of inconsiderate nomenclature, and, though these perhaps cannot now be changed, I hope that future descriptions will be labelled with names of a greater descriptive, though less historic, value.

With the time and brain power thus set free I would expect a really good knowledge of the viscera under different normal conditions, of superficial anatomy and of the central and peripheral nervous system. In return for excusing the small arteries and their anastomoses I should expect an exact knowledge of the position of the large trunks as well as of the position and drainage area of all the main lymphatic glands. In return for not greatly caring how many surfaces a bone "presented for examination," I should want details of its epiphysial lines and their relations to the joint capsule, of its mechanism and weakest points. I should not care so much about the exact shape of the articular surfaces of a joint as about the extent and limits of its synovial membrane. Above all things I would lay no stress on that Greek classification of the joints which I find willing students are at such pains to commit to memory and to retain until the anatomy examination is over. Most of our students nowadays have never learnt Greek, and how much the better is any practitioner for his ability to fix "enarthrosis, synarthrosis, diarthrosis and amphiarthrosis" to the kind of joint which it represents ? Many a good

dentist does not know that every time he draws a tooth he "disarticulates a gomphosis," nor would he draw it any the better if he did.

Some teachers think that by the adoption of endless terms they clarify and classify the knowledge of the things themselves, and this undoubtedly is true, provided there are many things to classify, as, of course, there are in the books; but the student has so little time, and the names are so many and so long and, apparently, like Mesopotamia, so blessed, that by the time he reaches his examiner his mind is often like a large new stamp album, all the spaces are ruled and the headings clearly printed and defined, but there are very few stamps. Some examiners seem to like this state of mind, but it has never appealed very strongly to me.

The fact has yet to be generally recognised, that our anatomy text-books are written for anatomists and not for students of medicine, they are too good and too big for the average student; the time for this sort of book is when the anatomy examination has been passed, then it will be a valuable work of reference, and will be all the more appreciated because the owner will be able to approach it from the real critic's point of view—that of the man who knows something at first hand of what the book treats. I am perfectly convinced that all the anatomy which is really useful for the medical man can be learnt, and best learnt, by dissecting the dead body with a demonstrator at hand whenever a difficulty arises, by studying the surface anatomy of the dead body frequently with a demonstrator and checking the knowledge acquired by repeating it on the living model and by utilising every fresh viscus which can be procured from the *post-mortem* room, and, especially, every brain, even if it has already been cut into sections. The demonstrator, it is true, will not be nearly as accurate as the book, but his great superiority comes in this, that he will lead the student to notice as many points as possible for himself, supplying the names after the things themselves have been actually realised, whereas the book saves all the trouble of noticing anything afresh, and so one of the most valuable possibilities of the dissecting-room

year, for it is seldom more, namely, the training of the observation, is lost.

In the first case, the student discovers the actual thing for himself, and then fits the conventional name to it; in the second, he learns the name first, then has the thing described in detail, and then, if he is conscientious, checks that description with the thing itself, thus going to Nature last.

Lucky for him if he has the hardihood to say, even to himself, when he fails to see what the book says he ought. Some men do but most do not. By a long course of book training at school, they have so lost faith in their own powers of observation that they instinctively say to themselves, "The book says so, it must be right; I can't see properly". Unless this sort of thing is corrected in the wards later on, the man may make a gold medallist, but he will never have many patients.

Then what part should the lecturer on anatomy play in the system of education? One theory of his function, which I have heard supported by very experienced men, is that he should help the students to classify their knowledge by treating each subject in a very precise and formal way, tabulating, heading and subdividing so that their note-books reproduce almost exactly the pages of the text-books.

This method is valuable in preparing for written examinations, but it is a relic of bygone days when books were scarce, and, after all, is not really education. If books were not so much used it would be useful enough, but, even then, hardly requires a skilled anatomist; any reader could go through so many pages of one of the text-books and arrive at the same result. Another and quite opposite idea is to try to interest students in the study of topographical anatomy by discussing, in as informal a manner as possible, the causes which have led to the various shapes and relations of the structures.

This is perhaps a slightly underhand way of trying to fix these relations in the mind, but it does more than this, it enables the pupils to follow the lines of thought of their teacher and helps them to think

and inquire for themselves. There is a reason for the position and form of every structure in the body, and although the search for it leads the class away from their strictly human anthropotomy into the realms of mechanics, physiology, embryology, comparative anatomy and even anthropology and pathology, still, if these are treated in a common-sense way and without too many technical terms, the time is by no means wasted. At least it acts as a useful corrective to the destructive effect of learning things by heart for examinations, and very soon brings the teacher into close touch with those of his class who are able and willing to think for themselves. There is a third method of lecturing on anatomy which is found more in London Medical Schools than in the Universities; it is to look at everything from a purely surgical standpoint and only to deal with those parts which are of direct surgical interest. If all the students were to be operating surgeons this procedure would be good enough, but anatomy is just as much a training for the physician as the surgeon, and the general practitioner, who in embryo forms about nine-tenths of the class, is more of the latter than the former. Then, too, the future gynæcologist, ophthalmic surgeon and throat, ear and teeth specialists may fairly put in a claim to have their technology considered in anatomy lectures. I am convinced that, if the anatomist and physiologist can send their late students into the wards with a working knowledge of those parts of the body which will be useful, and with eyes that can see, brains that dare to think for themselves, and tongues that are not afraid to ask questions, they will have well played their part, and it is the duty of the examiner to see that this ideal is aimed at and that it is not frustrated by giving many marks to questions which demand a mere parrot-like memory of names.

There is one accomplishment which undoubtedly is a very great asset to a lecturer on anatomy, and that is freehand drawing. It is much better than the most elaborate diagrams or lantern slides, because the students see the structures built up before their eyes. If the lecturer is just artist enough to realise when he has made a bad drawing and not too proud to criticise and try to amend it before the

class, the actual details are, perhaps, driven more firmly home than if it had been drawn more perfectly in the first instance. Drawing from the dissected body is, I am sure, one of the best ways of honestly learning topographical anatomy, but I do not intend to waste time by discussing it now, because I have convinced myself, as others have done before, that very few students can be persuaded to take the trouble to do it; they will copy their teacher's drawings line by line, but they will not draw from Nature.

And now for the technique of the anatomy examination. Most of the Universities give one or two papers, a *viva voce* of any length the examiner likes, and the practical test of making a dissection. For the membership of the English College of Surgeons, there is only one paper, a *viva voce* lasting fifteen minutes, and no dissection. My own experience, as far as it goes, makes me place most reliance on the oral, and least on the dissection, which depends largely on the condition of the "part," and is so notoriously hard to mark fairly, that at one examination I know only a small margin above or below the pass mark is given. Considering the difficulty there is in procuring subjects in many places, I gravely doubt whether we are justified in using them in this way.

The paper is almost always the part of the examination in which candidates do worst, unless they have been specially taught to set down their thoughts on paper. All coaches set papers and correct them with their students, and in this way one or more questions at the examination are sometimes happily spotted. It should not, however, be forgotten that, while the object of the coach is to get his students through their examination, that of the teacher of anatomy is to give as much of a real education in that subject as time will permit, and it is rather unfair to expect him to do the work which should have been done long ago at school, and teach his students not only anatomy, but the art of setting out their ideas in due order on paper. If it is his duty, I often think that a useful lesson might be gained from the education of military cadets, who are repeatedly sent out to survey and furnish a report on some piece of country hitherto un-

known to them. They return with a map and description of the shape and relative positions of hills, rivers, woods, etc., the names of which do not matter at that stage. The description of an unknown piece of the body is singularly like that of a piece of country, and probably the method which helps the one would help the other. My belief is that half the young men who are turned out by our Schools and Universities would be incapable of writing a readable and reasonable description of any piece of road down which they had been in the habit of walking twice a day for many years. Men of this stamp are admitted as students of medicine in large numbers, and, apparently, the General Medical Council is satisfied that their incapacity to put their ideas on paper is no barrier to their healing the sick. Realising this fact that students do not, as a rule, do themselves justice on paper, I am inclined to lay less stress on this part of the examination, and whenever I get a good clear drawing or diagram, in answer to a topographical question, I mark it most liberally, because, if a man can draw a thing, he knows it no matter how involved his description may be. On the other hand, students fresh from the hands of a clever coach have often practised writing out the very questions set in the examination or at least some parts of them, and sometimes write a most excellent account of structures which they are quite unable to recognise in the body. I do not wish to be understood to hold that the written examination is useless. I think that the information it can give is most valuable, when used judiciously, but I do not think that the practice of allotting as many marks to the paper as to the oral is a wise one, and I believe that many of those miscarriages of justice which all teachers know do occasionally occur are due to this. A bad paper is a useful danger signal, showing that the writer is probably an incompetent anatomist, though possibly only incompetent at expressing his knowledge. A good paper shows that probably the writer is a good anatomist, perhaps only a skilfully crammed one, or, perhaps, one who has copied from notes during the examination, for I am told that in certain examinations a considerable amount of copying goes on, and, when a man is an adept at it,

the chances of detection are very small. To my mind, apart from the moral side of the question, there is very little difference between a candidate who has copied his facts in an underhand way from notes, and one who is crammed with facts to last just over the date of the examination.

Then comes the oral, which every candidate I examine convinces me more and more should be the essential part of the examination. The great point is to see whether he knows his way about the body. I often find it a good plan to hand him the forceps and ask him to find two or three things which are so easy that he can hardly go wrong; even if he does, it makes no difference, his examination has not yet begun. As soon as his confidence is established I ask him to find me something which requires some acquaintance with the body to do, and I watch, not so much whether he does it, as how he does it. If he knows the region he goes unhesitatingly to where the thing should be; if he does not he may take a long time fumbling about. If he needs it, I call attention to surrounding landmarks and clues until he finds the sought-for structure, because, if he fails to do so, he becomes crestfallen and not at his best. If this procedure is repeated in different regions it soon shows up the bookman and the crammer's product; it may be varied by pointing to different structures and asking their names, but, to my mind, the former is the better plan, because it is the thing itself which the practitioner needs to know, and it is possible to forget many names in an examination room and yet recognise them and quickly associate them with their structures when they are spoken. The man who does really well in a test of this kind I would unhesitatingly hand on to the physicians and surgeons, even if his papers were very bad; only the worse his papers, the longer and more searching should his oral examination be.

The question of nervousness during examination is one which has interested me a great deal. Some examiners hold that the man who cannot keep his head during an examination is not one who is likely to make a resourceful surgeon under an emergency; but I am sure that this is only partly true, and that so-called "examination

funk" is often associated with perfect calmness under other conditions. My experience is that exaggerated *bonhomie* on the part of the examiner is just as likely to make things worse as better, and the best thing to do is to continue asking perfectly easy questions without the least hurry for an answer until the candidate shows signs of being at his ease. I have sometimes spent ten minutes in asking a man of this kind simple questions and discussing little points which arose out of them before I began to take any real notice of what his answers were. I have never known one of these candidates who really knew his work referred by an experienced examiner, though I have sometimes seen them stricken absolutely dumb by an irritable, impetuous, or inordinately friendly one.

It is the nervous men who are near the line who tax the examiner's skill most, and in these cases I think the teacher's knowledge should always be available, though it is difficult to imagine nervousness so profound as to prevent a man, after a reasonable time, from pointing out structures when their names are asked, provided he has seen them several times before.

I have now tried to put before you some of the problems which the teachers and examiners of anatomy have before them, and I have tried to show how each acts as a drag on the other in making any rapid change. The teacher dare not modify his teaching much for fear of the examiner, while the latter is obliged to ask those things which are currently taught lest he should be doing a grave injustice to the candidates. Still there is little doubt that a considerable change could be gradually effected if we were all convinced of the need for it and agreed on the lines it should take. I have thought it well to bring the subject before this Society, instead of something more strictly anatomical, in the hope that it may lead to some discussion and that I may learn in what light the matter is viewed in one of our great northern schools of anatomy.

And now I must stop. If, in what I have said, I have seemed to disparage anatomy as a science really worth following for its own sake, it was not my intention. The scientific side of anatomy alone

first attracted me to it, and has kept me faithful to it for a good many years, though it offers few prospects either of scientific honours or material recompense. I have been speaking only of that knowledge of the topography of the body which is needful for the practitioner, and I have been urging that, as he cannot learn all, the student should be encouraged to master that which will be most useful to him. Above all, that he should learn it in the first instance really and truly from Nature, and should have his knowledge of the things themselves tested, rather than of their names or his capacity for describing them in a scholarly manner.

ORDINARY MEETING.

16TH JUNE, 1906.

Professor R. W. REID, M.D., F.R.C.S., President,
in the Chair.

The Minutes of the last meeting were read and approved.

The President introduced Dr. R. J. Gladstone, F.R.C.S., who delivered a lecture entitled, "Variations in the Shape and Size of the Skull". The lecture was illustrated by specimens, photographs and lantern slides. At the close a vote of thanks was accorded to Dr. Gladstone.

The Society took as read a paper by Dr. Arthur Keith, F.R.C.S., on "The Results of an Anthropological Investigation of the External Ear".

VARIATIONS IN THE SHAPE AND SIZE OF THE SKULL.

By Reginald J. Gladstone, M.D. Aberd., F.R.C.S., Senior Demonstrator of Anatomy, Middlesex Hospital.

(Read 16th June, 1906.)

In the course of this memoir, I shall, in the first place, briefly review and describe certain developmental and regressive changes in the life history of the skull; then give a short account of the more notable irregularities of the cranial sutures, and the effects which are produced by these abnormalities on the size and shape of the skull; and, finally, I shall endeavour to discuss some of the more important physiological and racial variations of the cranium, which have accompanied the evolution of the brain from the lower to the higher races of mankind.

I shall limit the paper, by confining my remarks to the cranial portion of the head, and in order to avoid repetition I shall deal with variations of the skull and head together, as some of my data have reference to the skull only, and some to observations on the heads of living subjects.

Adopting, with some modifications, the classification of certain standard text-books, it will be convenient to deal with the variations of the skull and head in the following order:—

1. Developmental changes, and changes attendant on the advance of age.
2. Sexual differences.
3. Changes which are associated with variations in stature.
4. Changes in form and size due to abnormalities of the cranial sutures.

5. Phylogenetic and racial differences.
6. Variations in form and size associated with variations in the form and size of the brain, and with varying degrees of mental ability.
7. Modifications in the form of the skull produced by the action of the temporal muscles.
8. Deformation :—
   (*a*) Artificial.
   (*b*) Pathological.
   (*c*) Posthumous.

1. Developmental Changes and Changes Attendant on the Advance of Age.

In order to clearly appreciate certain changes in the form and size of the adult cranium it will be necessary to briefly review some of the principal phases in the normal development of the brain and skull.

In the early stages of development the brain capsule is formed around the expanded anterior extremity of the primitive cerebro-spinal axis or neural tube. We have at this stage a rapidly-growing tube closed at each end, and at its cephalic extremity there are three expansions called the first, second and third primary vesicles of the brain. The walls of these vesicles are thin, especially along the dorsal aspect, and they are completely filled with cerebro-spinal fluid. The vesicles increase in size partly by the growth of the nerve tissue of their walls and partly by an increase in the amount of fluid which they contain.

Along with this growth of the cerebral vesicles there is an enlargement of the thin membranous capsule which invests them. This enlargement is partly a true tissue growth ; the growth of the investing capsule, however, is obviously modified by the expanding force of the growing brain within. The capsule yields where growth of the brain is most rapid, and, on the other hand, the enlargement of the brain is modified in certain directions by the resistance afforded by

the thickness and density of the tissues surrounding it. It would appear, therefore, that there are two important factors concerned in the enlargement of the cranial portion of the head :—

1. An *expanding force* acting from within and due to the growth of the brain and secretion of the cerebro-spinal fluid, and

2. A *restraining force*, exerted by the brain capsule.

If there is an increase in the expanding force, such as occurs in chronic hydrocephalus, the skull will become enormously enlarged, whereas in cases of anencephalus, in which the brain is rudimentary (Plate XI., Figs. 1 and 2), the vault of the skull is remarkably flattened owing to absence of the distending force. The vault of the skull in these monsters is usually represented by a membrane which covers over the base of the skull and vestiges of the brain, or in rare instances, such as the specimen represented in Fig. 1, the membrane bones of the vault may be ossified and appear to have fallen in over the base of the skull, the skull as a whole having a curious flat-topped appearance which is very characteristic of this type of monster. The condition appears to be due to an early rupture of the brain capsule, with escape of cerebro-spinal fluid into the amniotic cavity, resulting in the collapse of the membranes covering the brain and destruction of the brain itself. In those cases of anencephalus which I have examined there has always been an opening in the membranous covering of the brain, and in most there has been a history of hydramnios.

Returning to the description of the normal development of the skull, we find that about the seventh or eighth week of fœtal life ossification of the brain capsule commences by the deposit in it of ossific matter in situations corresponding to the centres of the separate bones which form the vault of the skull, and in certain situations at the base of the skull, where ossification is preceded by the formation of cartilage. Ossification of the membrane bones, forming the vault of the cranium, and of the basal cartilages, proceeds by an extension from the different centres of ossification in a radial direction outwards towards the margins of the separate bones. The fibrous layer, ex-

ternal to the bone, becomes the pericranium, the layer, internal to the bone, becomes the "dura mater," or endocranium, while the unossified portions of the capsule, between the edges of the growing bones, is left as the membranes of the fontanelles and sutural ligaments; and at the base of the skull, part of the cartilage remains as the cartilaginous plates, between the basioccipital and basisphenoid, and between the basisphenoid and presphenoid. Synostosis of the two portions of the body of the sphenoid normally occurs before birth, while the cartilage between the occipital and sphenoid bones does not become completely ossified till after the twentieth year. Growth in length at the base of the skull takes place at these cartilages; thus, if premature union of the bones takes place, there will be shortening at the base of the skull. This shortening of the base is usually accompanied by compensatory enlargement in other parts.

After birth the growth of the brain and skull is very rapid, the individual bones forming the skull enlarging by a growth which takes place at their edges, and also, it is said, by a deposition of new bone upon the surface and absorption of bone from within. Accompanying this increase in the size of the skull there is a gradual flattening of the bones, the curvature of the separate bones lessening as they come to form segments of a larger sphere. Thus the frontal and parietal eminences, which are well marked at birth, become less prominent, and sometimes quite indistinguishable in the adult. The occasional prominence of these eminences in the cuboidal form of skull, which is sometimes met with in the adult, may therefore be regarded as a persistence of a fœtal condition.

Finally, with the advance of age, and at a somewhat variable period, obliteration of the sutures between the bones takes place, and the bones of the skull become fused into one continuous whole.

The cause of this union of the bones is, so far as I know, unexplained; certain of the sutures, such as that in the occipital bone between the interparietal and the supraoccipital, and the suture between the two halves of the frontal bone, namely the metopic, or interfrontal suture, close early, long before the growth of the skull is

completed. They may, however, persist in adult life (Fig. 1). In these cases they do not close until the other sutures of the skull become obliterated.[1] Now, since these sutures normally close before the maximum size of the brain is reached, it would appear that the determining cause of their consolidation cannot be the mere cessation of an expanding pressure from within, more especially as in some cases of hydrocephalus the metopic suture becomes closed at the usual age, *viz.*, before the sixth year. In the normal condition, it is, however, just possible that since the pressure of the growing brain is not absolutely equal in all directions, and the falx cerebri is attached internally along the line of the metopic suture, that an outward force exerted on the lateral margins of each half of the frontal bone might cause an inward movement of the mesial borders, each half of the bone rotating round a vertical axis passing through or near the external angular process.

Now we occasionally meet with skulls in which the frontal region is extremely narrow, and comes to a point in front, whereas the skull behind is abnormally wide. The outline of such skulls when viewed from above is triangular, the apex of the triangle being directed forward. These skulls are called trigonocephalic (Plate XI., Fig. 3), and it is usually believed that the condition is due to premature closure of the metopic suture, which has prevented the expansion of the skull in the frontal region, and that the increased width in the parietal region is compensatory. Premature union of the two halves of the frontal bone, however, is not always followed by trigonocephaly, for in a specimen in the Anatomical Museum at Cambridge, which was shown me by Professor Macalister, though the two halves of the frontal bone of a fœtal skull were united, the suture being completely obliterated, there were no signs of trigonocephaly, though there is a

[1] The persistence of the metopic suture in aged subjects is shown in several specimens in the Museum of the Royal College of Surgeons, England, and a case is recorded by Simon, in which, in a man aged seventy-five, though all the other sutures of the skull were closed, the metopic had persisted ("Ueber die Persistenz der Stirnnaht," Dr. Theodor Simon, *Virchow's Archiv*, lviii., s. 572).

considerable separation of the parietal bones with widening of the interparietal suture. Now since premature synostosis of the metopic suture does not always cause trigonocephaly, it is evident that there must be some other factor in its causation, and it might even be argued that closure of this suture in cases of trigonocephaly was the result of a failure in the development of the frontal lobes of the brain, rather than that the arrest in the development of these lobes was secondary to closure of the suture. I am inclined to think, however, that as scaphocephaly is undoubtedly in many instances due to premature synostosis at the sagittal suture, that trigonocephaly is due to the same condition occurring at the metopic suture, more especially as the prominent ridge passing down the middle line of the frontal bone in trigonocephaly corresponds to the similar median ridge or keel which is frequently seen in scaphocephalic skulls. The early union of the bones in these cases is generally believed to be due to a pachymeningitis or osteitis occurring during intrauterine life. A consideration, therefore, of these cases of trigonocephaly, in which the cause of the synostosis of the metopic suture is believed to be pathological, does not assist us in the search for the determining cause of the closure of this suture in the normal subject.

Synostosis of the metopic suture normally takes place before the brain has attained its maximum size. Now since the remaining sutures of the vault do not close till long after the brain has ceased to grow, but, on the other hand, has already diminished very considerably in size, there is obviously no correspondence in the time of the closure of the cranial sutures and the time at which the growth of the brain ceases.

It must be remembered, however, that the intracranial pressure after the growth of the brain has ceased is dependent on the pressure of the cerebro-spinal fluid, which has been shown by Dr. Leonard Hill to vary directly with the venous blood pressure in the sinuses of the dura mater.

Now it it quite possible that a diminution of this pressure of the cerebro-spinal fluid may occur with the onset of old age and favour

closure of the cranial sutures. I do not think, however, that this can be regarded as a direct cause of the synostosis, for the sutures sometimes close as early as thirty-five, or even earlier, at an age when the individual is still vigorous, and there is no reason to suspect a falling off or lowering of the general blood pressure.

Further, it might be thought that the cause of the gradual closure of the cranial sutures, which takes place after forty, was to be found in the general tendency, which exists in old age, towards ossification of fibrous and cartilaginous structures, such as the cartilages of the ribs and larynx. The sutures, however, sometimes remain open in extreme old age, *e.g.*, Specimen 368, B. Davis, *Col. R.C.S. Eng.*, *æt.* 112 ; and we have no evidence that this tendency towards ossification is in abeyance in these particular subjects, the skulls of whom often show marked senile changes, such as absorption of the alveolar processes of the upper and lower jaw bones. It cannot be argued, therefore, that the persistence of the sutures in these people is attributable to a greater vitality and a general postponement of changes which normally take place at an earlier age, since the skulls show all the usual signs of old age, with the exception of the closure of the sutures.

A consideration of the skull represented in Plate XII., Fig. 1, appears to be in favour of increased intracranial pressure having some influence in keeping the sutures open. In the figure it will be noticed that one-half of the coronal suture, the left, has become obliterated, and that the left side of the skull in the frontal region is smaller than the right ; it will also be noticed that the interfrontal suture has persisted. Now the persistence of this suture might be thought to have been compensatory, for it would have allowed an increase in the width of the frontal bone to take place, which would have compensated for the diminution in the longitudinal diameter on the left side, caused by synostosis of the left half of the coronal suture. In cases in which the metopic suture has not persisted the deformity of the frontal region is more marked. The skull shown in Fig. 1 also shows a persistent metopic suture, which is associated with a synos-

tosis of the parietal bones at the sagittal suture. The premature union of the parietal bones has prevented an increase in the width of the skull in this region, whereas the persistence of the metopic suture has allowed a compensatory increase to take place in the width of the frontal region. Persistence of the metopic suture in cases in which the sagittal or coronal suture is obliterated is not, however, the general rule, and I am doubtful whether it is even more common than in normal skulls of the same nationality; thus, though the persistence of the suture has allowed compensatory growth to take place, it is not proven that the metopic suture has persisted as a direct result of the increased intracranial pressure in this region.

Fig. 1.

Nor do I think that the converse condition, *viz.*, diminution of intracranial pressure, will act as a direct cause in producing early union of the bones, though it will undoubtedly favour their union. The cranial sutures of microcephalic idiots which have reached adult life are usually open. It must be borne in mind, however, that though the growth pressure of the brain in these idiots must have been less than in normal individuals, the intracranial pressure of the cerebro-spinal fluid, which is dependent on the blood pressure, might be equal or nearly equal to that of a healthy and normally developed person.

It might, moreover, be supposed that early union of one-half of the coronal, or lambdoid suture, might be due to defective development of one-half of the cerebrum, and one case recorded by Virchow might be regarded as favourable to this view. A woman who died at the age of sixty-six had suffered from epilepsy from her earliest youth and was hemiplegic with atrophy of the whole of the right half of the body. The skull was microcephalic and obliquely contracted. There was synostosis of the upper part of the lambdoid suture, the hinder

part of the sagittal and the middle of the *left* coronal suture. The "crista galli" and internal occipital crest were deflected to the left and presented a concavity directed towards the right. The left cerebral hemisphere and left side of the cerebellum were much atrophied, and the posterior and descending horns of the lateral ventricle on both sides were enormously dilated. Thus we have in this case atrophy of the brain on the left side associated with a diminution in the size of the skull on the same side and a partial obliteration of the posterior sutures and of the left half of the coronal suture. I am inclined to think, however, that the union of the sutures in this case was normal, and the commencement of synostosis on the left side of the coronal suture before the right was not a direct result of the atrophic condition of the brain, as the atrophy of the left hemisphere must have been present long before the suture commenced to close. The closure of the left half of the coronal suture in the middle of its extent, namely, in the region of the stephanion, is characteristic of the normal synostosis which takes place with the advance of age, and it is quite common for one-half of the suture to begin to close before the other half. It is worth noting, however, that notwithstanding the atrophic condition of the brain, the closure of the sutures was not only incomplete at the age of sixty-six, but that in some sutures ossification had not even commenced. Further, the premature union of one-half of the coronal suture, which occurs at an early stage of development, and most probably before birth, is obviously not due to atrophy of the brain on that side of the skull, for the false cerebri, as judged from the position of the sagittal suture and bregma, is in these cases bulged over to the opposite side to give

Fig. 2.—Skull with absence of the left half of the coronal suture and the bregma to the right of the middle line.

room for the growing hemisphere on the same side as the obliterated suture. If the left half of the coronal suture is absent, as in a specimen No. 3282 in the Anatomical Museum, Cambridge, the bregma will be to the right of the middle line, and the sagittal suture will run obliquely from the lambda forwards and to the right; it is evident, therefore, that there can have been no atrophy of the brain upon the left side, for if that had been the case the falx would have bulged to the left instead of to the right.

We may conclude, therefore, from the foregoing cases, that:—

(1) Increased intracranial pressure, though favouring the persistence of the cranial sutures, and in some cases of hydrocephalus, being associated with the presence of additional sutures, such as the intraparietal, cannot be regarded as the direct and sole cause of the persistence of such sutures as the metopic, for, in certain cases of scaphocephaly, in which the pressure in the frontal region has been so great that the forehead has actually been bulged forwards so as to overhang the eyes, the metopic suture has apparently closed at the usual age.

(2) A defective development or atrophy of the brain, though probably favourable to premature or early union of the cranial sutures, does not as a general rule cause this union, as in the skulls of microcephalic idiots the sutures are usually open, and in one case of unilateral atrophy of the brain, they were not completely closed, even at the age of sixty-six.

(3) That the normal closure of the sutures does not coincide with the time at which the brain commences to decrease in size, as the metopic suture closes before the brain has reached its maximum size, and other cranial sutures do not close till long after the brain has attained its maximum, and has commenced to decrease in size.

I shall next discuss the changes in the size of the head, which occur with increase in age. Now it is well known that after the prime of life has been reached, the average brain-weight gradually diminishes. It has been calculated by Mr. J. Blakeman and Professor Pearson, from data furnished from the *post-mortem* room at the

Middlesex Hospital, that there is an annual decrease in the average weight of the brain in a "General Hospital Population" of rather more than 2 grammes (♂ −2·1974 grm. ± ·5245, ♀ − 2·7245 grm. ± ·4271).

It also appears probable that the "prime" in brain-weight is reached before the "prime" of the body as a whole, at the age of twenty, or even earlier.[1]

The questions which these facts suggest are: Is this decrease in weight and presumably size of the brain accompanied by any diminution in the size of the head or skull? or is it entirely compensated for by an increase in the amount of cerebro-spinal fluid in the subarachnoid space, or in the ventricles of the brain?

Now Venn, who measured the heads of the undergraduates at Cambridge throughout their entire student period, showed that the length, breadth and height of the head increased during this time, and my own measurement of students at the Middlesex Hospital are in entire agreement with his results, the highest averages occurring between the ages of twenty-five and thirty. See Table I.

TABLE I.

Age.	Length of Head, L (mm.).	Breadth of Head, B (mm.).	Height of Head, H (mm.).	Index of Size of Head, L × B × H (c. cm.).		Number in Group.
18	194·2	153·2	137·4	4088		14
19	196·5	151·2	137·1	4073	4065	32
20	195·3	150·9	136·4	4020		28
21	196·5	151·6	137·0	4081		27
22	196·4	153·1	136·7	4110		30
23	195·7	152·2	137·8	4104	4118	29
24	195·6	154·3	137·2	4141		19
25	196·5	152·5	139·7	4186		19
26	195·4	152·2	140·0	4164	4156	15
27	195·8	153·2	137·3	4118		13
28	197·2	154·0	138·5	4206		13
29	198·0	152·8	140·4	4247	4135	12
30	197·2	151·2	136·9	4082		8

[1] *Biometrika*, vol. iv., p. 154.

Now, in the heads of the subjects measured in the *post-mortem* room at the Middlesex Hospital we found that there was in both senses a gradual diminution in the size of the head, accompanying advance in age and commencing at about twenty-five. The amount of this decrease for each of the principal diameters of the head is shown in Fig. 2, p. 138, *Biometrika*, vol. iv. ; in which it is shown that the shrinkage is greater in the female than in the male subject, and affects chiefly the auricular height.

Part of this diminution in the size of the head is due to a thinning of the scalp, dependent on atrophic changes in the skin and subcutaneous tissue, and more especially atrophy of the hair follicles (see *Biometrika*, vol. iv., p. 111).

The lessening of the diameters of the skull due to atrophy of the scalp is shown by the following figures :—

Diameter of Head.	Reduction of Diameter caused by Atrophy of the Scalp.
Longitudinal	0·81 mm.
Transverse	0·88 mm.
Vertical	0·29 mm.

This is clearly not sufficient to account for the whole of the decrease in the size of the head, and more especially is this the case with the vertical diameter.

I have therefore made a comparison of the size of aged skulls with that of young adult skulls, taking a series of skulls in which the age was recorded to be above fifty, or in which the sutures were closed, the teeth much worn or fallen out, and the alveolar processes absorbed, and comparing these with skulls of young adults, mostly between twenty-five and forty years of age, and of corresponding nationality and sex (Tables VII.-X.).

Now, it is important to note that the diminution in the size of the skull, which occurs with the advance in age, affects not only the external measurements, but also the capacity, as the reduction of the former might be produced by absorption of the outer table of the skull, due to the atrophy of old age. This atrophy is sometimes met

with in a marked degree, causing great thinning of the skull; so that the bones of the vault become translucent, or in extreme cases perforated. The general atrophy with thinning of the skull in one aged specimen described by Barnard Davis was so great that the weight of the skull, which was female, was reduced to 15 oz., whereas the weight of a normal young skull of the same sex is about 28 oz. A simple absorption of the inner table would tend to increase the capacity of the skull; this does not take place, however. There is diminution, proving that an actual contraction of the skull takes place. This contraction of the brain case is not nearly so great as that of the brain itself, the shrinkage of the brain with age must therefore be accompanied by an increase in the amount of the cerebro-spinal fluid. Now, it is stated by Wakelin Barratt, in *Journ. Anat. Phys.*, vol. xxxvii., p. 150, that in chronic atrophy of the brain of a pathological nature "the atrophy of the gyri with corresponding widening of the sulci and distention of the pia-arachnoid with fluid, forms a striking appearance when the brain before removal is viewed, *in situ*, from above," and he has also proved that in chronic wasting diseases of the brain, such as dementia and general paralysis of the insane, a very considerable enlargement of the lateral and third ventricles takes place, this enlargement being essentially due to wasting of white matter. He also remarks that the enlargement which chiefly involves the lateral ventricles affects the anterior cornua and bodies more than the rest of the ventricular cavity; and that the appearance of the ventricular cavity in senile atrophy (four cases) was not observed to differ markedly in its general characters from that present in general paralysis of the insane. It is probable, therefore, that the normal atrophy of the brain which takes place with the advance of age is accompanied both by an increase in the cerebro-spinal fluid in the pia-arachnoid and by an enlargement of the cerebral ventricles.

2. Sexual Differences.

The principal distinguishing features of a typical male skull as compared with a typical female skull, such as the greater size of the

male skull and the more massive character of the supraciliary ridges and mastoid processes in the male sex are well known and are described in the general text-books. I shall, therefore, merely remark that the greater size of the cranial portion of the head in the male, as estimated by external measurements, is almost entirely proportional to the greater stature and weight of the male as compared with the female.

3. Changes in the Size and Shape of the Head which are Associated with Variations in Stature.

Tall men in the aggregate have larger heads than short men, but proportionally to the size of their bodies their heads are considerably smaller than those of short men; or, in other words, the proportion that the size of the head bears to the stature diminishes with an increase of the latter. This is especially noticeable in comparing giants with dwarfs.

With regard to the relation of the shape of the head to stature, speaking generally, tall men and tall races have longer heads and lower cephalic breadth indices than short, though there are certain notable exceptions, such as the Esquimaux (*B. I.*, 72·2) and the Veddahs of Ceylon (*B. I.*, 71), both of which races are of short stature.

4. Changes in the Form and Size of the Head Associated with Abnormalities of the Cranial Sutures.

Abnormalities of the sutures may be classed into three main groups.

1. Sutures which have united prematurely.

2. Sutures which normally become closed early, but which have remained open in adult life.

3. Sutures which occur in situations in which they are not normally present at any period of life.

In addition to these three main groups there are certain irregu-

larities, such as extreme complexity, or simplicity of the suture line, and persistence of the sutures in old age.

Now since growth of the bones of the skull takes place at their edges, it is to be expected that premature union of sutures will be accompanied by an arrest of growth of the skull in a direction at right angles to the suture, and conversely that if a suture that normally closes early remains open, that there will be an increased growth of the bones on each side of the suture and an increase in the diameter of the skull, which will be at right angles to the abnormal suture.

That such is the case is abundantly proved by the examination of skulls in which one of these two conditions is present or in which there are additional sutures, such as a transverse parietal.

A full description of the effect that premature ossification of the sutures has upon the shape of the skull is to be found in an article by J. Barnard Davis, on "Synostotic Crania," published in 1856; the subject has also been studied by Virchow, who first enunciated the law, that "in synostosis of a suture the development of the skull is arrested in a direction perpendicular to the synostotic suture," and who drew up a very complete classification of the different forms of skull which arise from this and other causes. I shall, therefore, merely describe a few of the more important examples of deformity due to synostosis.

Commencing with the lambdoid suture, we have obliteration of one side only of this suture, causing diminution of the same side of the skull, which is compensated for by a corresponding increase on the opposite side; there is thus an obliquity of the skull to which the name "plagiocephaly" has been applied. The deformity is not always present, however, or at any rate not in a marked degree, as in specimen 985, R.C.S. England. In this case the line of the suture is distinctly visible, and it is possible that it may not have closed till after the principal growth of the skull had been completed.

Obliteration of the whole of the lambdoid suture is accompanied by arrest of growth in the occipital region, with compensatory enlargement in the region of the anterior fontanelle. When associated

with synostosis of adjacent sutures, namely of the parietals with the temporal bones, and the posterior end of the sagittal suture, an enormous development in the region of the anterior fontanelle takes place, causing the "steeple shaped" deformity of the head, called oxycephalus; this is associated with great prominence of the eyeballs, or proptosis. In one extreme case of oxycephalus which was described by H. Power, in *Trans. Ophth. Soc.*, vol. xiv., p. 212, Professor Cunningham, who examined the skull after death, found "synostosis of every suture and synchondrodial joint, with the exception of the joint between the ex-occipital and basi-occipital". There was "absence of the corpus callosum," and he also found that "the convolutions of the brain had pressed so hard against the ossifying cranial vault, that the normal dimples on its inner surface had become deep bony pits like a honeycomb, and that the floors of the pits had become exceedingly thin and diaphanous". Other cases of this deformity have been described by Dodd and McMullen, *Lancet*, 1903, vol. i., p. 1665, and Captain Tucker, *Lancet*, 1904, vol. i., p. 88.

Another well-known condition is the deformity known as the boat-shaped skull, or "scaphocephalus". This is associated with premature union of the parietal bones at the sagittal suture. This causes arrest of growth in the transverse direction, and to make up for the narrowness of the skull, there is a compensatory increase in its length. In the most typical form, the line usually occupied by the sagittal suture is raised up into a rounded ridge or "keel". The keel is, however, frequently absent, as in specimens 129 A and 620 E in the museum of the R.C.S. England, in both of which there is a slight post-coronal constriction, while in 620 E the metopic suture has remained open, a circumstance which, if more frequent in these skulls, would be suggestive of the persistence of the suture being due to increased intracranial tension in this position; I am doubtful, however, whether this is the case, and, certainly, in the greater number, the suture is closed, and the union has presumably taken place at the usual time, or possibly in those cases in which the median keel ex-

tends into the frontal region, the metopic suture has closed earlier than usual, and at the same time as the sagittal, for the median keel or carina, in this position, is characteristic of premature synostosis of the metopic suture. The most extreme case of this deformity which I am acquainted with is a specimen which was shown me by Professor Macalister in the Anatomical Museum, Cambridge. The breadth of this skull is only 108·3 mm., and its breadth index 56·1. Elongation of the skull is, however, met with in some cases in which the suture remains open; though it is, so far as I know, not so extreme, and is sometimes a racial character. Again, skulls are occasionally met with in which the sagittal suture has become obliterated, and yet there is no scaphocephaly. In some of these the synostosis may not have occurred until after the growth of the skull had ceased, or the condition may have occurred in a normally brachycephalic skull.

Premature union of the squamous suture sometimes occurs, but very rarely; an excellent specimen of this is in the Anatomical Museum, Cambridge; there is reduction in the height of the skull, and compensatory elongation in the occipital region (Plate XII., Fig. 4).

Early synostosis of the spheno-parietal suture may give rise to a transverse constriction or narrowing of the skull behind the coronal suture; this condition is called "klinocephaly," on account of its saddle-shaped form. The constriction, however, arises independently of the synostosis, and is sometimes due to artificial deformation by bandages.

Another deformity produced by early synostosis of the coronal suture is "acrocephaly"; in this, growth being arrested in the longitudinal direction takes place in the vertical, the height of the head being increased, and in one specimen which I examined at Cambridge, the cribriform plate of the ethmoid was depressed, and there was enlargement of the middle and posterior cranial fossæ.

Enlargement of the skull in a downward direction is sometimes plainly visible from the outside in the occipital region, as in one case at the Cambridge Museum, in which the floors of the cerebellar

fossæ bulge downwards on each side of a median groove in the situation of the external occipital crest.

Finally, I shall mention the condition of trigonocephaly, which I have already described, and which is usually found associated with premature union of the metopic or interfrontal suture.

It may be of interest to note here that premature union of the skull bones does not very materially influence the total capacity of the skull; the compensation in other directions resulting from arrest of growth in one direction being almost complete. Thus in a skull of a native Fijian, which exhibits a remarkable degree of scaphocephaly, with complete parietal synostosis, the capacity is 1,620 cubic centimetres (No. 129, R.C.S. England).

Passing now to the consideration of sutures which normally close early, but sometimes persist in adult life, we find here that there is an increase in the diameter of the skull at right angles to the line of the abnormal suture. The most common of these sutures is the metopic or interfrontal.

In a series of 108 metopic skulls which I have measured at the Royal College of Surgeons, England, and in other collections, I have found the average minimum frontal diameter to be 104 mm., and the average maximum frontal diameter to be 120 mm.; the corresponding average measurements of an equal number of normal skulls of corresponding nationality I found to be for the average minimum frontal diameter 96·6 mm., and the average maximum frontal diameter 115 mm. The metopic skulls are thus wider than the normal skulls, the difference in the minimum frontal diameter being 7·4 mm., and in the maximum 5 mm. The fronto-parietal index also or the percentage ratio that the minimum frontal diameter bears to the greatest transverse diameter of the skull is also greater in metopic skulls than in normal. The fronto-parietal index of the metopic skulls is 72, that of the normal skulls 68, there thus being a difference of 4 per cent.

Now the question arises, does this difference in the width of the frontal region add to the total capacity of the metopic skulls or is the increased width of the transverse diameters accompanied by a cor-

responding diminution in others? The answer to this question is given by the following figures:—

Average capacity of 25 ♂ metopic skulls - - -	1,568 c.cm.
„ „ „ 25 ♂ normal „ - - -	1,450 „

A similar difference is to be noted in the female skulls (Tables I.-V.).

Metopism is found to be much more frequent in certain races than in others, and it is said in modern races than in ancient or prehistoric. Thus the frequency in modern European nations is about 10 per cent., the percentage being greater in the Southern broad-headed races than in the Northern. It is rare in African and American races, the frequency being, according to Professor Welcker, rather less than 2 per cent. In the Barnard Davis collection, in 127 African crania, only two are metopic, and these skulls of Guanches. On comparing ancient European races with modern I find that about 5 per cent. of the ancient skulls are metopic as compared with 10 per cent. in the modern. It was, however, very common in the skulls of the ancient Britons, and of the Romans and Romano-British. It is not infrequent in the ancient Egyptians: about 6 per cent. Metopism has thus been thought to be associated with a greater frontal development in civilised races as compared with uncivilised or barbaric races. Certain of the Asiatic races, however, such as the Indians, Chinese and Japanese, and the Northern races of Europe, in which metopism is rare, can boast of a tolerably high degree of civilisation, so that the presence of a metopic suture, with its associated increase in width of the frontal lobes, cannot without qualification be regarded as a mark of intellectual superiority.

Metopism, in some cases, appears to be hereditary. Dr. William Wright in examining skeletons from the barrows in East Yorkshire, found that out of nine skulls obtained from a single barrow four were metopic (44 per cent.); he also noted that there was a striking similarity in most of these skulls. It would appear, therefore, that the barrow was a family burial ground, and that the metopic suture was a hereditary character of this family. Another fact which is in favour of

the influence of heredity on the frequency of metopism, is that it is extremely common in certain isolated districts, such as some islands off the coast of Italy, in which it appears to be much more common than it is on the mainland.

Passing now to the occipital bone, we occasionally find a suture, which runs transversely across the bone, from one lateral angle to the other. This suture marks off a bone which occupies the angle between the two parietal bones. This bone is called the interparietal bone, or "Os Incae"; the latter name being given to it on account of the frequency with which it was found in the skulls of the Incas of Peru.

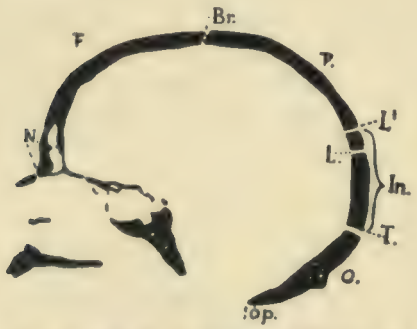


Fig. 3.—Median longitudinal section of a skull, showing the position of the lambda (L.) in a normal skull, and its average situation (L'.) in skulls with an interparietal bone. F., frontal bone; P., parietal bone; O., occipital bone; N., nasion; Br., bregma; Op., opisthion.

Now in skulls in which an interparietal bone is present, we find in accordance with the law previously mentioned, that there is an increase in the length of the occipital bone, or in other words in a direction at right angles to the line of the suture. To determine the amount of this increase, I measured the longitudinal arc from the posterior margin of the foramen magnum, or "opisthion," to the upper angle of the occipital bone, or lambda, Fig. 3, and compared this with the longitudinal arc from the opisthion to the middle of the nasal notch of the frontal bone, or "nasion". The average length of these arcs in the skulls with an interparietal bone as compared with the average length of the same arcs measured in an equal number of normal skulls of corresponding nationality is shown in the following table, in which I have also shown the average capacity of these two groups of skulls, and the difference between the average arcs and capacities.

	Arc from Opisthion to Lambda (mm.).	Arc from Opisthion to Nasion (mm.).	Capacity of Skull (c.cm.).
Skulls with a Transverse Occipital Suture - -	122·2	361·2	1365
Normal Skulls - - -	113·2	358·0	1328
Difference - -	9·0	3·2	37

It will be noticed that the increase in length of the occipital bone in the skulls with a transverse occipital suture is 9 mm., or just under one centimetre, but that the total length or arc from the opisthion to the nasion is increased by only 3·2 mm., showing that the increase in length of the occipital bone has been chiefly at the expense of the parietal and frontal bones. It will also be noticed that there is an average increase of 37 cubic centimetres in the capacity of the skulls, with an interparietal bone, as compared with that of normal skulls. Now, if we pass to the third class of abnormality of the cranial sutures, namely, sutures which occur in situations in which they are not normally present at any period of life, we again find a confirmation of the general law, that growth of the bones of the skull takes place at right angles to the lines of the sutures.

I have measurements of three cases in which the parietal bone of one side is divided by a suture into an upper and a lower segment. All of these cases show that there is increased growth in a direction at right angles to the abnormal suture, and they also show that this is, to a certain extent, although not entirely, compensated for by a diminution in the bones of the opposite side.

I shall allude first to two cases which were recorded by Gustav Schwalbe. Both of these occurred in hydrocephalic children ; a fact which appears to point to a causal connection between increased intracranial pressure during the growing period, and the formation of additional sutures, such as the intraparietal.

The first case was a specimen of a full-time hydrocephalic fœtus,

which showed a horizontal fissure in the left parietal bone. The suture lines and fontanelles were depressed below the level of the surface of the bone (Plate XI., Fig. 4), and the sutures, especially the sagittal, were widely open.

The measurements of the coronal arc, from the root of the zygoma to the middle of the sagittal suture, were the following:—

	Left.		Right.	
Sagittal suture - - -	1 mm.		1 mm.	
Superior parietal bone - -	47·5 mm.	97·5 mm.	89 mm.	Undivided parietal bone.
+ intraparietal suture = 0·5 mm.				
Inferior parietal bone - -	50 mm.			
Squamo-parietal suture - -	2 mm.		6 mm.	
Squama of temporal bone -	18 mm.		21 mm.	
	118·5 mm.		117 mm.	

The two parietal bones of the left side thus measure together 97 mm., as compared with the 89 mm. of the right bone, and there is a compensatory increase in the right squamo-parietal suture, and the squamous portion of the right temporal bone.

The second case was in the skull of a hydrocephalic child, who died, aged 7 years. There was a bipartite parietal on the right side, and marked asymmetry. The right coronal arc, from the middle of the sagittal suture to the lower border of the divided parietal, measured 280 mm. (upper segment, 105 mm.; lower segment, 175 mm.); the left coronal arc measured 205 mm., there thus being a difference of 7·5 cm. between the vertical diameters of the two parietal bones. The metopic suture was closed, and the skull trigonocephalic in form.

The third case which I shall mention has been described by Dr. Barclay Smith, and is in the Anatomical Museum, Cambridge. In this specimen a suture runs diagonally from the postero-superior angle of the parietal bone to the antero-inferior angle. Now, on comparing the diameter of the divided parietal at right angles to the line of the suture with the corresponding diameter of the parietal bone of the opposite side, I found the diameter from the postero-inferior angle to the postero-superior angle of the left parietal bone measured 188

mm., whereas the measurement on the opposite side was 168 mm., there thus being an increase of 20 mm. on the side presenting the additional suture.

To sum up the principal conclusions to be drawn from a consideration of these cases of abnormal sutures, it will be seen that they afford evidence :—

1. That the growth of the cranial bones takes place principally at their edges, and not to any extent by interstitial growth or deposit of bone upon the surface and absorption from within.

2. That if this growth is prevented by an early synostosis of the sutures, the diminution in size of the bones in one direction is largely compensated for by an increased growth in other directions, producing deformities such as scaphocephaly, trigonocephaly, or plagiocephaly.

3. That in cases in which an abnormal suture is present, such as the transverse occipital, the increase in the bone in which the suture is present, is partly at the expense of the adjacent bones and partly adds to the total capacity of the skull.

5. Phylogenetic and Racial Differences.

Our knowledge of certain intermediate stages in the phylogeny of the human race is imperfect. Anthropology has, however, from time to time received a fresh stimulus by the discovery of certain bones which are believed by the most eminent scientific authorities to be human, and which are of interest, not only as showing the antiquity of man, but also as supplying that link which was looked for by Huxley and his contemporaries between man and his supposed pithecoid ancestors.

I shall commence with a brief consideration of the principal characters of the skull of "pithecanthropus erectus," which was discovered in 1892 by Eugene Dubris. It was found in pliocene strata in Java, at Trinil. The skull is of a low type, and is believed to hold an intermediate position between the living races of mankind and the higher apes. With the skull were found three teeth and the

left femur, a critical examination of which has confirmed the position claimed for the skull by its discoverer.

The skull when viewed from above (Fig. 4), shows that the sides converge towards a narrow part situated immediately behind the enormous developed "brow ridges". This narrowing of the skull in front, the so-called "post-orbital constriction," is characteristic of low types of man, such as the natives of Australia, and of other fossil human skulls, and is also present in the higher apes. It is dependent partly upon the relatively small size of the frontal lobes of the brain and partly upon the relatively great development of the anterior portions of the temporal muscles and the prominence of the brow ridges.

Figs. 4 and 5.—Skull of Pithecanthropus erectus.

Viewed from the side the calvaria is seen to be remarkably low, especially in the frontal region, where it will be noticed that the forehead is of the receding type, which is noticeable in Australian skulls and which is seen also in the skulls of congenital idiots and cretins. Posteriorly the skull is flattened, and the occipital bone is seen to rise more vertically than in the skulls of living races; the angle which it forms with a line passing from the glabella to the opisthion, between that found in the lower types of living man, and in the skulls of Hylobates.

Now, with regard to size, though the skull of "pithecanthropus erectus" is distinctly small as compared with even the lowest races

of living man, having an estimated capacity of only 855 c.c., which is 245 c.c. less than the average capacity of the skulls of the Akka tribes or Equatorial dwarfs of Africa, it is 250 c.c. (over 30 per cent.) greater than the corresponding figure for the largest skull of the Simiidæ (W. L. H. Duckworth, *Anthropology and Morphology*, p. 514).

I shall next consider a group of skulls which have been classed together as forming a type, distinguished by the name "Homo primigenius," from the higher and living types, which are designated "Homo sapiens".

The distinctive characters of "Homo primigenius" are well shown in the Neanderthal skull discovered in Germany, the cranium found at Spy, in Belgium, and the skull found at Krapina, in Croatia. These agree with one another in possessing massive brow ridges, and the above-mentioned "post-orbital constriction," both of which characters are seen in a marked degree in pithecanthropus erectus. The longitudinal arc in the Neanderthal and Spy crania is remarkably flattened, so that the vertical height of these skulls must have been low, and in the Krapina skull there is a median frontal keel, which is also present in pithecanthropus erectus. These skulls, however, differ markedly from that of the earlier type, "pithecanthropus erectus," in their much greater size. The longitudinal and transverse diameters of the Neanderthal skull being 199 mm. and 147 mm. respectively, whereas the corresponding diameters of "pithecanthropus erectus" are, length, 185 mm., breadth, 130 mm.

The capacity, however, of the skulls of homo primigenius cannot have been large in comparison with that of modern Europeans, as the length of these two diameters might lead one to expect, for the vertical height of these skulls, as compared with modern Europeans, must have been low, on account of the very low curvature of the sagittal arc.

The variations in the skulls of living races I shall have to pass over, with only a very brief and general notice, as the time at my disposal is too short to attempt a description even of the principal classes. I may mention, however, that specialisation of certain

features has apparently become more or less fixed in certain races, of whom we have historical evidence, that they have lived for long periods of time, under, presumably, similar external conditions, such as the ancient and modern Egyptians. I am inclined to think, however, that variations in external conditions, such as climatic changes, and the changes of habit which accompany civilisation, will tend, by favouring certain variations, to bring about comparatively rapid changes in type, but that there will always be a strong tendency towards reversion to the more primitive and more stable parent stock.

6. Variations in the Form and Size of the Head Associated with Varying Degrees of Mental Ability and Variations in the Form of the Skull due to Variations in the Form of the Brain.

Now although there are great individual variations in the form and size of the head among individuals of high or low degrees of ability, so that in the vast majority of cases we are not able to judge with certainty, from an examination of the head, whether an individual is above or below the average of intelligence, there are certain features, such as I have described as being characteristic of the skulls of savages and prehistoric man, which, when associated with small size of the cranial portion of the head, are indicative of a low order of intelligence; and conversely there are certain features, seen in a well-proportioned head such as that of Frederic Schiller's, which do indicate ability.

The mental powers of the individual, however, may or may not have been developed, and in some cases may even have deteriorated. Thus though in extreme cases it is possible to judge from external appearances that an individual is an idiot, or of a low order of intelligence, it is by no means so easy to be certain that an individual has a high degree of ability.

If we take the *average* measurements, however, of a large number of individuals belonging to a particular class, it will be found that there

is a small though definite correlation between large size of head and intelligence, and that the large size of head is not only actual, but is proportional to the stature and weight of the individuals. Thus it will be seen on looking at Table XI., showing the average measurements and weights of medical students studying at the Middlesex Hospital and King's College, London, that the more intellectual, which are grouped in Class A, have larger heads and are slightly heavier than Class B, which are of average intelligence, and that those in Class B have larger heads and are both slightly taller and slightly heavier than Class C, which are intellectually below the average. The proportion, however, that the size of the head bears to both the stature and the body-weight progressively increases in passing from the less to the more intellectual classes. This is shown in Table XI., which gives the proportion under the headings "Capitulo-statural" index and "Encephalo-somatic" index. The former is an index of the proportion that the size of the head bears to the stature and the latter the ratio of the calculated brain-weight to the body-weight. We may say, therefore, that these figures indicate that the more intellectual are not only finer specimens of humanity, but that they have both actually and proportionally to the size of their bodies larger heads than the less intellectual. It will be seen also on looking at the columns in Table XII., that the cephalic breadth-indices are approximately the same in the three groups, but that there is a progressive increase in the proportional height of the head in passing from Class C to Class A.

It will be necessary to mention here that irregularities in the form of the skull are often attributable to abnormal or unequal growth of the brain in certain directions, *e.g.*, enlargement of the occipital region of the skull. "Bathrocephalus" is apparently in some cases due to hypertrophy of the occipital lobes of the brain, which, as has been pointed out by Elliot Smith, is often unsymmetrical, the left occipital lobe being larger than the right. Other irregularities of the skull, due to asymmetry in the growth of the brain, have also been described.

7. Modifications in the Form of the Skull Produced by Muscular Action.

A considerable variation in the form of the skull is produced by variations in the size of the temporal muscles. In the lower races of mankind the lower jaw is massive, and the temporal muscles are correspondingly great in size, and extend upwards over the sides and vault of the skull towards the middle line. In the dry skull the size of the temporal muscles may be estimated by the depth of the temporal fossæ, and the height to which the temporal ridges rise upon the parietal bones. In the lower types of man, such as the Australian aborigines, and in certain of the fossil skulls, the ridges are high and near the middle line, indicating that the temporal muscles are relatively large. The development of these muscles is especially great in the gorilla, in which the temporal ridges actually meet in the middle line, and are raised up into a median keel or crest, which gives origin by its sides to the more superficial fibres of the temporal muscles, thereby considerably increasing their area of attachment.

In congenital idiots, the temporal ridges of the skull are also found to be high, and to approach the middle line; in them, however, the muscles are not actually larger than in healthy individuals, but they are relatively larger when compared with the size of the cranial portion of the skull, which is much diminished.

The depth of the temporal fossæ also depends largely upon the development of the temporal muscles, and the post-orbital constriction previously mentioned as characterising the lower types of humanity, is partly, although not wholly, attributable to this cause.

A similar relation of the muscular ridges on the skull to the size of the muscles which are attached to it, is seen in the occipital region, where the nuchal lines are found to be more pronounced, and extend upwards on the occipital bone farther, in lower types of man, than in higher.

8. Deformation of Skulls.

(*a*) *Artificial.*—Skulls deformed in this manner are found in considerable numbers in any large collection of crania, the deformation being produced by bandages or other appliances which are made use of to compress or mould the growing head into the particular form desired. This practice was common among the American Indians, but has been in vogue at one time or another in various countries. It does not appear to have injuriously affected the mental character of the individuals to any very great extent.

(*b*) *Pathological Deformation.*—The form and size of the skull is affected by various diseases, of which I shall mention specially hydrocephalus, rickets, cretinism, achondroplasia and acromegaly. I should also mention here the case described by Virchow, which I have already alluded to, in which congenital hemiplegia of one side was associated with atrophy of the opposite cerebral hemisphere and diminution of the corresponding half of the cranium.

Platybasic deformation, described by Barnard Davis, may be included also in this group. It consists of a flattening at the base of the skull, which appears to rise up into the cavity of the cranium, the condition being probably due to a pathological softening of the bones.

(*c*) *Posthumous Deformation.*—This is distortion of the skull which is sometimes observed in crania which have been long buried in moist earth and at the same time subjected to pressure. It occurs in various directions and is unaccompanied by any abnormality of the sutures.

Now, a consideration of the physiological variations of the skull, which I have alluded to in this paper, would be incomplete without some mention of the relations that the head and brain bear to the body generally. Although there are some exceptions, my own experience and that of my fellow-workers has been that success from the purely intellectual standpoint is very closely related to the general wellbeing or physical fitness of the body. The students, which are grouped in Class A, are more athletic and more robust than those in

Class C, whereas the students in Class B hold an intermediate position. Now, we find that the superior physical fitness of the more intellectual class is like their mental characteristics inherited from their parents, and that they thus have a start given them in the race of life from the very first, whereas those who are mentally unfit are doubly handicapped by also being physically below "par". The facts brought out by these statistics, therefore, I think, point to the importance of a physical training of the body being adopted as a remedy for the intellectually backward, and of the necessity of a due proportion of muscular exercise in the open air for all engaged in mental work.

In conclusion, I have pleasure in acknowledging with thanks the assistance which has been given me by many friends, and more especially Professor Peter Thompson and Dr. G. J. Jenkins, of King's College, London, and Mr. Freke Field, who has taken the majority of the measurements recorded in the tables.

My thanks are also especially due to Professor Stewart on behalf of the Council of the Royal College of Surgeons, England, Professor G. D. Thane and Professor Alexander Macalister for permission to make use of the skulls in the museums at the College of Surgeons, and University College, London, and the Anatomical Museum, Cambridge, also to Professor R. W. Reid for the use of specimens from the Anatomical Museum, Aberdeen, to help to illustrate my paper.

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TABLE I.

METOPIC SKULLS—MALE.

(Barnard Davis Collection, Royal College of Surgeons of England.)

Number in Series.	Number in Catalogue.	Minimum Frontal Diam. (mm.).	Maximum Frontal Diam. (mm.).	Capacity of Skull (oz. Avoir.).	Length of Skull (inches).	Breadth of Skull (inches).	Height of Skull (inches).	Nationality.
1	137	112·0	131·5	87	7·8	5·6	5·7	English.
2	90	113·0	133·5	78	7·8	5·8	5·4	English.
3	98	105·0	124·0	75	7·0	6·0	5·2	English.
4	120	101·0	129·0	84	7·7	5·9	5·5	English.
5	172	98·0	125·0	74	7·3	6·1	5·4	Scottish.
6	184	103·0	123·0	74	7·1	5·6	5·3	Scottish.
7	250	108·5	131·5	—	7·3	5·8	5·3	French.
8	248	102·5	131·0	75	7·1	5·5	5·3	French.
9	158	106·0	126·0	83	7·6	5·8	5·8	Welsh.
10	69	103·0	131·5	74	7·2	5·9	—	Anglo-Saxon.
11	47	97·0	119·0	—	7·0	5·3	—	Ancient Roman.
12	392	110·5	138·0	90	8·1	5·8	5·2	German.
13	388	115·5	124·0	78	6·9	5·7	5·5	German.
14	480	101·5	137·0	81	6·9	6·1	5 1	Russian.
15	476	100·0	133·5	92	7·8	6·1	5·4	Russian.
16	397	99·0	124·0	67	6·9	5·7	4·8	Czech.
17	804	91·0	112·0	70	7·2	5·2	5·5	Turk.
18	436	110·0	123·0	87	7·2	6·1	5·8	Turk
19	823	100·5	125·0	77	7·1	5·5	5·5	Chinese.
20	827	99·0	125·0	81	7·0	5·7	5·4	Chinese.
21	775	95·0	123·0	81	7·0	5·8	5·8	Bodo.
22	794	100·0	120·0	73	7·1	5·6	5·2	Naga.
23	795	84·0	110·0	73	6·8	5·1	5·3	Naga.
24	848	97·0	118·0	76·5	7·1	5·5	5·5	Aino.
25	880	100·0	118·0	83	6·9	5·6	5·5	Sumatran.

NORMAL SKULLS—MALE.

(Barnard Davis Collection, Royal College of Surgeons of England.)

Number in Series.	Number in Catalogue.	Minimum Frontal Diam. (mm.).	Maximum Frontal Diam. (mm.).	Capacity of Skull (oz. Avoir.).	Length of Skull (inches).	Breadth of Skull (inches).	Height of Skull (inches).	Nationality.
1	95	105·0	120·0	—	7·5	5·5	5·3	English.
2	115	97·0	123·0	75	7·5	5·9	5·8	English.
3	110	97·0	115·0	62	6·9	5·2	5·0	English.
4	69	92·0	110·0	—	—	—	—	English.
5	173	106·0	125·0	77·5	7·3	6·1	5·5	Scottish (Ancient).
6	182	108·7	135·0	—	7·2	6·0	5·0	Scottish.
7	249	96·0	123·0	75	6·9	5·7	5·3	French.
8	251	97·0	126·5	75	6·8	5·8	5·5	French.
9	159	95·5	114·0	73·0	7·5	5·3	5·4	Welsh.
10	57	94·0	118·0	—	7·4	4·8	4·8	Anglo-Saxon.
11	36	99·0	129·0	70	7·2	5·6	5·1	Ancient Roman.
12	391	102·0	124·5	71	7·0	5·7	5·3	German.
13	384	100·0	135·0	90	7·1	6·2	5·5	German.
14	477	100·2	119·5	83	6·8	5·7	5·8	Russian.
15	479	97·0	125·0	91	7·6	5·8	5·8	Russian.
16	398	106·0	136·0	85	7·0	6·3	5·5	Czech.
17	437	97·5	127·5	88	7·2	6·1	5·8	Turk.
18	805	94·5	119·7	87	7·2	5·6	5·7	Turk.
19	828	93·0	111·0	76·5	7·2	5·3	5·5	Chinese.
20	843	92·0	111·0	78	7·1	5·6	5·7	Chinese.
21	773	90·7	124·0	77	6·2	5·5	5·4	Bodo.
22	793	89·7	116·0	81	7·0	5·6	5·8	Naga.
23	778	92·0	114·0	74	7·1	5·4	5·4	Lhopa.
24	924	94·0	110·0	65	6·7	5·3	5·3	Javan.
25	881	95·2	113·5	82	7·6	5·4	5·6	Sumatran.

TABLE II.

METOPIC SKULLS—FEMALE.

(Barnard Davis Collection, Royal College of Surgeons of England.)

Number in Series.	Number in Catalogue.	Minimum Frontal Diam. (mm.).	Maximum Frontal Diam. (mm.).	Capacity of Skull (oz. Avoir.).	Length of Head (inches).	Breadth of Head (inches).	Height of Head (inches).	Nationality.
1	85	103·5	117·0	68	7·3	5·3	5·2	English.
2	111	92·0	118·0	—	6·6	5·4	5·0	English.
3	114	99·0	122·0	—	7·3	5·4	5·4	English.
4	56	102·5	122·0	63	7·1	5·3	5·1	English.
5	193	97·0	115·0	65	7·0	5·2	5·1	Irish.
6	181	88·0	114·5	66	6·7	5·1	5·6	Scottish.
7	243	97·0	117·7	—	7·3	5·5	4·6	French.
8	356	116·0	135·0	82	7·0	5·8	5·4	Dutch.
9	357	99·0	119·0	67·0	7·3	5·6	4·7	Dutch.
10	367	96·0	118·0	66	6·8	5·8	4·7	Dutch.
11	323	95·0	122·0	77	7·1	5·4	5·5	Italian.
12	271	102·0	121·5	66·5	6·7	5·4	5·2	Portuguese.
13	481	103·0	123·0	83	7·4	5·7	5·1	Russian.
14	743	95·0	117·0	74	6·9	5·4	5·4	Khas.
15	1053	98·5	120·0	71	6·9	5·5	5·4	North American Indian.
16	842	90·2	107·5	70	6·8	5·0	5·6	Chinese.

NORMAL SKULLS—FEMALE.

(Barnard Davis Collection, Royal College of Surgeons of England.)

Number in Series.	Number in Catalogue.	Minimum Frontal Diam. (mm.).	Maximum Frontal Diam. (mm.).	Capacity of Skull (oz. Avoir.).	Length of Head (inches).	Breadth of Head (inches).	Height of Head (inches).	Nationality.
1	86	101·0	113·0	62	6·9	5·2	5·0	English.
2	91	97·0	116·5	68	7·1	5·3	5·3	English.
3	142	97·0	116·0	—	—	—	—	English.
4	138	93·0	102·5	80	7·2	5·5	5·5	English.
5	196	98·0	125·0	72	7·2	5·3	5·2	Irish.
6	168	101·0	118·0	—	7·1	5·5	5·3	Scottish.
7	244	95·0	118·0	75·5	7·1	5·1	5·5	French.
8	348	95·0	116·0	67	6·9	5·5	5·0	Dutch.
9	352	105·0	125·0	67	6·9	5·3	5·0	Dutch.
10	354	95·0	127·0	70	7·0	5·5	5·3	Dutch.
11	307	94·0	118·0	72·5	6·7	5·6	5·2	Italian.
12	272	98·0	115·0	63·5	7·0	5·3	5·0	Portuguese.
13	489	100·0	129·0	76	6·7	5·7	5·3	Cossack.
14	744	89·0	108·0	60	6·7	5·1	5·2	Khas.
15	1054	89·0	104·0	65·5	6·8	5·2	5·5	North American Indian.
16	824	98·0	114·0	65	6·7	5·3	5·3	Chinese.

TABLE III.

METOPIC SKULLS—MALE.

(Royal College of Surgeons of England.)

Number in Series.	Number in Catalogue.	Minimum Frontal Diam. (mm.).	Maximum Frontal Diam. (mm.).	Capacity.	Length of Head (mm.).	Breadth of Head (mm.).	Height of Head (mm.).	Nationality.
1	290	100·0	120·0	1500	187	133	140	English.
2	306	99·5	126·5	1790	193	149	142	English.
3	360	104·5	127·2	1500	180	146	135	France.
4	364	94·5	115·0	1150	175	137	126	France.
5	415	97·0	119·0	1440	182	140	129	Lecce.
6	420	99·0	115·0	1250	170	145	129	Naples.
7	432	103·0	122·5	1425	180	143	130	Ceprano.
8	448	105·5	115·5	1390	182	140	134	Isola di Sora.
9	506	99·5	118·5	1450	188	138	128	Chieti, Abruzzo.
10	511	96·0	115·0	1310	184	135	127	Modena.
11	526	95·0	119·5	1400	172	139	130	Palermo, Sicily.
12	535	94·0	116·0	1450	175	142	136	Zante.
13	580	103·0	123·0	1560	185	140	135	Carthage.
14	616	95·0	114·5	—	175	140	130	Pyramid of Ghizeh.
15	655	94·0	115·0	1200	171	134	126	Madura.
16	861	100·0	119·5	1450	186	140	140	Indian from Tennessee.
17	1158	102·5	109·0	1225	176	128	129	Port Sandwich, Mallicollo.
18	1278	98·5	118·0	1280	183	134	129	Manganja Negro.
19	553	101·0	126·2	1600	181	149	135	Lapp.
20	561	109·0	130·5	1610	196	146	153	Finn.
21	754	100·2	123·0	1450	175	148	133	Tonga Islands.
22	696	95·5	118·0	1290	163	142	129	Chinese.

NORMAL SKULLS—MALE.

(Royal College of Surgeons of England.)

Number in Series.	Number in Catalogue.	Minimum Frontal Diam. (mm.).	Maximum Frontal Diam. (mm.).	Capacity.	Length of Head (mm.).	Breadth of Head (mm.).	Height of Head (mm.).	Nationality.
1	292	98·0	118·0	1500	182	138	134	English.
2	303	94·5	110·0	1290	178	133	126	English.
3	366	96·0	115·0	1450	178	138	134	France.
4	367	95·0	113·0	1360	185	133	132	France.
5	416	94·0	117·0	1420	183	142	138	Lecce.
6	426	94·0	108·5	1330	177	137	134	Fondi.
7	433	99·0	125·0	1440	172	147	134	Ceprano.
8	443	97·0	117·0	1380	168	143	130	Isola di Sora.
9	508	97·0	120·0	1280	171	144	112	Liguria.
10	512	101·0	129·5	1570	173	154	135	Modena.
11	524	100·5	118·5	1360	175	140	121	Solino.
12	536	96·0	112·0	1290	173	135	140	Paxo.
13	581	93·0	116·0	1460	168	144	132	Carthage.
14	614	92·5	102·0	1380	183	138	133	Egyptian (Ancient).
15	656	92·5	101·5	1230	173	130	135	Madura.
16	862	92·5	119·0	1390	183	138	138	Mohawk.
17	1160	86·0	99·2	1275	180	125	131	Mallicollo.
18	1279	96·0	110·0	1235	182	131	134	Manganja Negro.
19	555	96·0	122·2	1475	185	151	124	Lapp.
20	562	95·0	118·5	1520	182	145	137	Russian.
21	753	97·0	112·0	1320	175	141	141	Samoan.
22	698	94·0	115·5	1410	188	137	140	Chinese.

TABLE IV.

METOPIC SKULLS—FEMALE.

(Royal College of Surgeons of England.)

Number in Series.	Number in Catalogue.	Minimum Frontal Diam. (mm.).	Maximum Frontal Diam. (mm.).	Capacity.	Length of Head (mm.).	Breadth of Head (mm.).	Height of Head (mm.).	Nationality.
1	301	97·0	117·5	—	172	129	120	England.
2	362	94·0	124·5	1385	167	145	122	France (Modern).
3	363	96·0	119·5	1410	184	136	127	France (Modern).
4	418	89·0	107·0	1090	168	124	118	From Naples.
5	488	100·0	123·5	1435	172	148	129	From Capistrello.
6	513	92·0	113·5	1235	170	132	117	Modena.
7	518	94·5	117·5	1290	167	133	125	Breschia, Lombardia.
8	534	92·5	114·5	1230	179	134	125	Corfu.
9	576	93·0	111·0	1330	174	132	130	Constantine.
10	600	—	—	1180	173	130	128	Ancient Egyptian.
11	960	88·2	104·5	1230	170	137	127	Ancon.
12	441	92·0	108·5	1220	175	137	120	Isola di Sora.
13	418	88·0	107·0	1090	168	124	118	Naples.
14	1301	95·5	107·0	1250	171	134	124	Bushman.
15	1132	97·0	106·0	1300	181	126	142	Viti Levu, Melanesia.

NORMAL SKULLS—FEMALE.

(Royal College of Surgeons of England.)

Number in Series.	Number in Catalogue.	Minimum Frontal Diam. (mm.).	Maximum Frontal Diam. (mm.).	Capacity.	Length of Head (mm.).	Breadth of Head (mm.).	Height of Head (mm.).	Nationality.
1	299	90·0	119·5	1390	175	145	120	England.
2	369	92·2	113·5	1200	179	131	120	France (Modern).
3	370	92·0	105·0	1220	178	130	123	France (Modern).
4	417	90·0	107·0	1050	158	130	119	From Lecce.
5	489	97·0	117·5	1370	168	146	125	From Avezzano (Abruzzo).
6	515	94·0	116·5	1225	170	137	122	From Bologna.
7	517	96·2	114·0	1300	170	138	125	Pavia.
8	541	92·0	117·5	1255	156	140	126	Albania.
9	579	88·0	99·0	1110	167	129	120	Arab.
10	601	—	—	1350	178	134	133	Ancient Egypt.
11	957	93·0	113·0	1305	165	146	130	Ancon.
12	445	92·0	116·0	1320	165	144	129	Isola di Sora.
13	428	93·0	104·0	1250	174	141	126	Portecorvo, Terra di Lavoro.
14	1302	93·0	109·0	1170	170	130	125	Bushman.
15	1133	92·0	103·5	1380	185	124	137	Viti Levu, Melanesia.

TABLE V.

COMPARISON OF METOPIC WITH NORMAL SKULLS.

(Barnard Davis Collection, Royal College of Surgeons of England.)

Male Skulls.

	Minimum Frontal Diameter.	Maximum Frontal Diameter.	Length of Head.	Breadth of Head.	Height of Head.	Fronto-parietal Index.	Capacity of Skull (c. cm.).
	mm.	mm.	mm.	mm.	mm.		
Metopic skulls -	102·4	125·4	182·8	144·7	137·1	70·7	1568
Normal skulls -	97·2	121·0	180·3	142·2	137·1	68·3	1450

Female Skulls.

	Minimum Frontal Diameter.	Maximum Frontal Diameter.	Length of Head.	Breadth of Head.	Height of Head.	Fronto-parietal Index.	Capacity of Skull (c. cm.).
	mm.	mm.	mm.	mm.	mm.		
Metopic skulls -	98·3	119·3	177·8	137·2	132·1	71·6	1405
Normal skulls -	90·9	116·5	175·2	134·6	132 0	61·3	1369

General Collection, Royal College of Surgeons of England.

	Sex.	Minimum Frontal Diam. (mm.).	Maximum Frontal Diam. (mm.).	Capacity of Skull (c. cm.).	Length of Skull (mm.).	Breadth of Skull (mm.).	Height of Skull (mm.).	Fronto-parietal Index.	Number of Skulls.
Metopic - -	M	99·4	119·3	1415	179·9	140·3	132·9	70·8	22
Normal - - -	M	95·3	114·5	1380	177·9	139·2	132·5	68·4	22
Metopic - -	F	93·5	112·9	1262	172·7	133·4	124·8	70·0	15
Normal - - -	F	92·4	111·0	1259	170·5	136·3	125·3	69·2	15

The above table shows the average diameters and capacities of metopic compared with normal skulls of corresponding sex and nationality. It will be observed that there is a slight increase in the width of the frontal bone in the metopic skulls as compared with the normal skulls; that the fronto-parietal index, or proportion that the minimum frontal diameter bears to the maximum frontal diameter, is greater in the metopic than in normal skulls, and also that the capacity of the metopic skulls is greater than that of the normal.

TABLE VI.

A.—SKULLS WITH A TRANSVERSE OCCIPITAL SUTURE. (R.C.S., England.)					*B.*—NORMAL SKULLS. (R.C.S., England.)				
Number in Series.	Number in Catalogue.	Arc from Opisthion to Lambda (mm.).	Arc from Opisthion to Nasion (mm.).	Capacity (c.cm.).	Number in Series.	Number in Catalogue.	Arc from Opisthion to Lambda (mm.).	Arc from Opisthion to Nasion (mm.).	Capacity of Skull (c.cm.).
1	557	11·7	34·7	1330	1	558	11·0	35·0	1300
2	604	11·7	37·5	1340	2	605	10·8	34·3	1280
3	611	11·3	38·4	1575	3	612	11·5	36·5	—
4	629	13·2	36·2	1470	4	630	9·5	33·6	1230
5	651	12·0	35·0	1100	5	652	10·0	34·5	—
6	689	13·0	36·3	1280	6	690	12·2	38·8	1540
7	698	14·5	38·7	1410	7	699	11·0	37·4	1460
8	702	14 0	37·0	1475	8	703	11·5	37·3	1260
9	724	12·0	37·2	1460	9	726	11·0	34·5	1340
10	779	13·0	39·0	1610	10	750	11·0	37·0	1520
11	749	13·0	37·0	1490	11	780	12·3	35·8	1430
12	816	13·2	37·6	1460	12	817	12·7	41·5	1710
13	837	12·0	34·4	1650	13	857	12·5	35·3	1330
14	843	12·0	34·3	1600	14	898	10·4	34·3	1350
15	838	12·0	37·0	1320	15	905	11·8	35·3	1330
16	846	13·0	34·6	1510	16	903	11·0	36·2	1465
17	856	14·5	42·3	1630	17	933	11·0	32·7	1000
18	871	11·0	33·3	1305	18	939	10·0	32·4	1110
19	900	12·0	35·5	1300	19	950	12·0	32·3	1080
20	901	12·0	35·0	1380	20	952	10·8	34·2	1300
21	902	11·0	35·3	1450	21	961	12·0	37·2	1330
22	932	11·3	34·3	1120	22	964	12·1	36·7	1400
23	938	11·9	35·1	1280	23	967	12·0	35·5	1410
24	950	12·0	32·2	1080	24	984	11·8	36·0	1220
25	952	11·5	34·2	1300	25	986	12·5	33·3	1050
26	960	12·0	36·0	1230	26	993	11·0	33·4	1175
27	963	11·5	36·0	1260	27	1071	10·6	34·3	1130
28	966	11·5	35·4	1460	28	1084	11·5	37·6	1310
29	983	10·6	33·6	1170	29	1223	10·2	37·1	1280
30	992	12·8	34·0	1225	30	1228	11·2	38·5	1360
31	1070	11·0	37·0	1170	31	1234	11·7	40·0	1525
32	1222	11·0	37·4	1310	32	1302	11·0	35·7	1170
33	1227	12·4	37·5	1225	33	309	12·0	37·4	1475
34	1333	13·0	38·5	1340					
35	1301	10·5	34·8	1250					
36	308	15·0	38·2	1600					

TABLE VII.

A.—SKULLS OF YOUNG ADULTS—MALE.
(Barnard Davis Collection, R.C.S., England.)

Number in Catalogue.	Age.	Length of Skull. L, inches.	Breadth of Skull. B, inches.	Height of Skull. H, inches.	Capacity of Skull. (oz. Avoir.)	Nationality.
331A	26	6·6	5·4	4·8	78·7	English.
132	46	7·7	6·0	5·4	90	English.
137	46	7·8	5·6	5·7	87	English.
140A	35	7·5	5·6	5·3	78·5	English.
152	35	7·5	5·8	5·6	81·4	English.
197	30	7·5	5·5	5·7	78	Irish.
215	40	7·1	5·4	5·3	72	Irish.
255	35	6·9	5·4	5·3	74·5	French.
251	35	6·8	5·8	5·5	77	French.
252	35	7·2	5·9	5·5	84	French.
249	40	6·9	5·7	5·3	75	French.
361	35	6·6	5·7	5·1	73	Dutch.
363	25	7·3	5·8	5·7	87	Dutch.
342	44	7·3	5·1	5·4	76	Dutch.
487	35	7·5	5·5	5·5	77	Russian.
478	29	7·6	5·7	5·7	87	Russian.
479	35	7·6	5·8	5·8	91	Russian.
492	30	7·1	5·8	5·4	81	Cossack.
262	35	7·3	5·8	5·5	80	Spanish.
270	35	7·4	5·7	5·0	75·5	Portuguese.
278	35	7·6	5·7	5·5	78	Portuguese.
313	30	6·9	5·8	5·4	84	Italian (Turin).
812	35	6·9	5·4	5·6	76	Chinese.
1536	35	7·6	5·6	5·3	80	Dahoman.
262	35	7·3	5·8	5·5	80	Spanish.
3	35	7·7	6·7	5·3	93	Esquimaux.
1221	25	7·1	5·9	5·5	82·5	Shushwap (North America).
711	40	6·9	5·0	5·2	64	Veddah.
804	40	7·2	5·2	5·5	70	Turk or Tátár.

B.—AGED SKULLS—MALE.
(Barnard Davis Collection, R.C.S., England.)

Number in Catalogue.	Age.	Length of Skull. L, inches.	Breadth of Skull. B, inches.	Height of Skull. H, inches.	Capacity of Skull. (oz. Avoir.)	Nationality.
116	85	7·7	6·1	5·7	92·5	English.
130	80	6·7	5·7	5·4	76	English.
139	60	6·9	5·4	5·4	70	English.
149	80	7·3	5·5	5·4	76	English.
151	80	6·9	5·6	5·8	76	English.
	60	7·4	6·0	5·2	79	Irish.
190	60	7·5	6·3	5·7	79·3	Irish.
245	60	7·2	5·6	5·1	68	French.
247	70	7·2	6·0	5·3	80	French.
248	60	7·1	5·5	5·3	79	French.
250	80	7·3	5·8	5·3	—	French.
240	75	7·5	5·1	5·7	79	Merovingian Frank.
366	107	6·9	5·8	5·5	81	Dutch.
368	112	6·7	5·8	5·2	75·5	Dutch.
350	60	7·5	6·0	5·4	87	Dutch.
484	60	7·3	5·4	5·3	72	Russian.
480	60	6·9	6·1	5·1	81	Russian (Moscow).
476	50	7·8	6·1	5·4	92	Russian (Crimea).
488	80	7·2	5·5	5·4	80·5	Cossack.
265	80	7·2	5·5	5·0	73	Basque.
275	70	7·3	5·6	5·4	78	Portuguese.
276	65	7·3	5·8	—	—	Portuguese.
312	60	6·8	5·6	5·6	74·5	Italian (Turin).
813	80	7·0	5·9	5·5	77	Chinese.
1532	70	7·3	5·1	5·7	75	Dahoman.
1177	70	7·5	5·6	5·8	76	Esquimaux.
1223	60	7·3	5·8	5·5	82	Chemesyan (North America)
275	60	7·3	6·1	5·2	81·1	Portuguese.
720	Aged	7·6	5·2	5·6	81	Veddah.
806	60	6·6	5·9	5·7	84	Turk or Tátár.

TABLE VIII.

A.—FEMALE SKULLS BETWEEN 25 AND 40 YEARS OF AGE.

(Barnard Davis Collection, Royal College of Surgeons of England.)

Number in Catalogue.	Age.	Length of Skull (inches).	Breadth of Skull (inches).	Height of Skull (inches).	Capacity of Skull (oz. Avoir.).	Nationality.
86	30	6·9	5·2	5·0	62	English.
129	35	6·8	5·6	5·2	—	English (Calvaria).
131	40	6·7	5·9	5·0	72	English.
222	30	7·1	5·1	5·3	72	Irish.
277	30	6·9	5·3	5·6	70·5	Portuguese.
357	39	7·3	5·6	4·7	67	Dutch.
364	35	6·8	5·5	5·3	70	Dutch.
196	25	7·2	5·3	5·2	72	Irish.
214	35	7·1	5·4	5·3	72	Irish.
216	35	7·2	5·7	5·2	81	Irish.
256	35	6·9	5·5	5·3	70·5	Irish.
269	35	7·4	5·5	5·1	77·8	Basque.
650	25	7·1	5·0	5·5	72	Hindoo.
598	30	6·7	5·6	5·3	75	Mussulman.
—	25	6·9	5·3	5·7	71	Amoy.
1577	30	6·8	5·3	5·5	70	M'Fau.
333	27	6·8	5·1	4·7	75·5	English.
550	30	7·2	5·5	5·4	75	Georgian.

B.—FEMALE SKULLS BETWEEN 50 AND 110 YEARS OF AGE.

(Barnard Davis Collection, Royal College of Surgeons of England.)

Number in Catalogue.	Age.	Length of Skull (inches).	Breadth of Skull (inches).	Height of Skull (inches).	Capacity of Skull (oz. Avoir.).	Nationality.
134	aged	7·2	5·6	5·3	67	English.
105	aged	7·1	5·4	5·1	71	English.
85	c. 50	7·3	5·3	5·2	68	English.
205	c. 80	7·1	5·4	5·4	68·5	Irish.
272	c. 80	7·0	5·3	5·0	63·5	Portuguese.
365	106	7·3	5·4	4·8	66	Dutch.
367	110	6·8	5·5	4·7	66	Dutch.
192	c. 80	7·0	5·2	5·0	64	Irish.
209	aged	7·4	5·5	5·1	63·5	Irish.
211	c. 80	7·2	5·4	5·2	66·5	Irish.
205	c. 80	7·1	5·4	5·4	68·5	Irish.
273	c. 80	6·4	5·3	5·0	59	Portuguese.
655	c. 90	6·6	5·1	4·8	60	Hindoo.
597	c. 80	6·9	5·1	5·2	65	Mussulman.
—	c. 90	7·0	5·1	5·4	—	Chinese (Amoy).
1578	c. 70	6·8	5·6	5·4	74	M'Fau.
96	aged	6·7	5·3	5·2	—	English.
554	aged	6·9	5·1	5·3	67	American.

TABLE IX.

A.—SKULLS OF YOUNG MALES.
(Royal College of Surgeons of England.)

Number in Catalogue.	Age.	L. (mm.).	B. (mm.).	H. (mm.).	Capacity (c.cm.).	Nationality.
						Europe.
77	—	194	144	139	1780	Englishman.
78	—	186	144	130	1475	Englishman.
79	—	169	127	126	1190	Englishman.
80	—	183	139	135	1510	Englishman.
81	—	170	137	132	1375	European.
82	—	195	145	133	1710	European.
120	—	178	144	130	1496	(Metopic) European.
300	—	193	145	131	1575	British Isles, Roman or Roman British.
338	31	191	146	143	1640	Englishman.
479	—	183	146	140	1500	Italian, Rome.
487	—	180	153	137	1590	Italian, Capistrello, Abruzzo.
493	—	176	133	140	1250	Italian, Luco.
510	—	178	153	136	1550	Italian, Parma.
533	—	186	137	137	1450	Greek, Corfu.
						North Africa.
584	—	194	135	137	1590	Ancient Egyptian.
602	—	185	142	141	1600	Ancient Egyptian.
613	—	179	137	134	1455	Ancient Egyptian, Ghirzeh.
						Asia.
690	—	187	147	134	1540	Chinese.
691	—	173	143	132	1225	Chinese.
692	—	168	142	137	1435	Chinese.
700	—	175	137	130	1320	Chinese from Shanghai.
730	—	170	141	122	1280	Malay.
731	—	167	137	129	1325	Malay.
746	—	180	145	132	1500	Bugie Malay.
749	—	178	142	141	1490	Manilla.
						America.
894	—	172	154	134	1500	Pasamayo.
992	—	165	140	125	1225	Peru (♂ ?).
						Australia.
1028	—	181	125	135	1250	King Sound, Dampier Land.
1042	—	172	142	142	1400	Cape York.
1048	—	174	123	128	1050	Bathurst.
1047	—	172	127	126	1110	Bathurst, New South Wales.
1069	—	197	141	125	1375	Adelaide.
1077	—	191	132	134	1410	Near Adelaide.
1099	—	181	139	133	1330	Tasmania.
						Melanesia.
1126	—	194	120	141	1550	Fiji-Viti Levu.
1127	—	193	134	143	1530	Viti Levu.
1128	—	203	134	147	1660	Viti Levu.
1180	—	176	127	130	1290	Lydia Island.
						South Africa.
1252	—	179	124	140	1480	Ashantee.
1296	—	185	130	138	1400	Hottentot.
1299	—	193	140	134	1490	Koranna.
						Polynesia.
753	—	175	141	141	1320	Samoan.
749(B)	—	183	140	147	1580	Gilbert Islander.

B.—SKULLS OF AGED MALES.
(Royal College of Surgeons of England.)

Number in Catalogue.	Age.	L. (mm.).	B. (mm.).	H. (mm.).	Capacity (c.cm.).	Nationality.
						Europe.
330	54	195	142	145	1730	Englishman.
335	61	179	140	135	1610	Englishman.
83	—	188	140	130	1500	European.
92	—	167	140	127	1401	European.
93	—	190	132	131	1506	European.
94	—	177	133	130	1431	European.
95	—	184	134	129	1471	European.
121	—	188	151	130	1640	(Metopic) European.
298	—	196	145	132	1700	British Isles, Roman or Roman British.
484	—	182	134	129	1400	Italian, Abruzzo.
495	—	175	140	137	1355	Italian, Luco.
491	—	182	144	137	1500	Italian, Luco, Abruzzo.
511	—	184	135	127	1310	Italian (Metopic).
535	—	175	142	136	1450	Greek (Metopic).
						North Africa.
585	—	185	140	135	1390	Ancient Egyptian, Thebes.
604	—	179	139	134	1340	Ancient Egyptian, Memphis.
614	—	183	138	133	1380	Ancient Egyptian.
						Asia.
684	—	178	157	125	1520	Samoyede.
685	—	172	146	123	1380	Samoyede or Ostiak.
688	—	168	165	121	1520	Tartary.
699	—	180	140	130	1460	Chinese from Shanghai.
732	—	175	137	130	1330	Java.
733	—	173	141	144	1460	Borneo.
747	—	165	140	127	1240	Philippine Islands.
748	—	175	145	135	1500	Philippine Islands.
						America.
893	—	163	148	135	1320	Pasamayo.
997	—	170	136	128	1230	Peru (♂ ?).
						Australia.
1029	—	178	121	132	1200	Arnhem's Land.
1039	—	187	128	130	1210	Cape York.
1051	—	175	128	124	1080	Sydney.
1052	—	185	132	135	1275	Illawarra, N.S.W.
1068	—	186	136	138	1450	Adelaide.
1078	—	178	124	130	1120	Port Augusta.
1100	—	188	135	140	1330	Tasmania.
						Melanesia.
1129	—	193	127	140	1370	Viti Levu.
1130	—	190	125	138	1375	Viti Levu.
1131	—	186	123	140	1350	Viti Levu.
1178	—	166	137	127	1240	Lydia Island.
						South Africa.
1253	—	185	129	139	1380	Ashantee.
1300	—	175	134	128	1260	Bushman.
1303	—	185	140	134	1400	Bushman.
						Polynesia.
752	—	172	153	138	1535	Samoan Islands.
749(C)	—	180	137	134	1460	Gilbert Islander.

TABLE X.

A.—SKULLS OF YOUNG FEMALES.
(Royal College of Surgeons of England.)

Number in Catalogue.	Age.	L. (mm.).	B. (mm.).	H. (mm.).	Capacity (c.cm.).	Nationality.
						Europe.
84	—	183	135	115	1375	European.
332	27	180	140	134	1410	English.
417	—	158	130	119	1050	Lecce, Italian.
445	—	165	144	129	1320	Italian, Isola di Sora.
452	—	181	134	130	1330	Italian, Isola di Sora.
501	—	178	142	121	1330	Italian, Popoli Abruzzo.
517	—	170	138	125	1300	Italian, Pavia.
						North Africa.
591	—	179	127	125	1220	Ancient Egyptian-Thebes.
						India.
671	—	173	139	127	1200	Madura.
673	—	162	126	128	1100	Madura.
						Siberia and Central Asia.
687	—	165	139	126	1160	Kalmuck.
						America.
864	—	161	135	128	1150	Uchee Indian.
952	—	165	145	124	1300	Ancon.
						South Australia.
1076		188	134	128	1320	South Australian.
						Melanesia.
1159	—	176	122	127	1250	Mallicollo.
1168	—	190	120	135	1225	New Hebrides.
						South Africa.
1286	-	178	129	134	1300	Zulu.

B.—SKULLS OF AGED FEMALES.
(Royal College of Surgeons of England.)

Number in Catalogue.	Age.	L. (mm.).	B. (mm.).	H. (mm.).	Capacity (c.cm.).	Nationality.
						Europe.
91	—	178	132	114	1325	European.
334	70	178	138	126	1200	English.
414	—	177	128	129	1205	Italian, Lecce.
450	—	184	143	133	1520	Italian, Isola di Sora.
459	—	176	142	126	1400	Italian, Arpina.
503	—	169	134	126	1160	Italian, Aquila.
532	—	175	140	130	1200	Italian, Trentino.
						North America.
590	—	180	126	125	1200	Ancient Egyptian-Thebes.
						India.
665	—	174	134	130	1220	Madura.
668	—	168	118	129	1110	Madura.
						Siberia and Central Asia.
686	—	167	141	123	1125	Samoyede or Ostiak.
						America.
865	—	174	139	127	1230	Shawnee Indian.
953	-	160	149	134	1300	Ancon.
						South Australia.
1079	-	180	124	117	1025	South Australian.
						Melanesia.
1156	—	170	122	126	1061	Mallicollo.
1161	—	173	132	118	1200	Mallicollo.
						South Africa.
1285	—	176	132	133	1240	Zulu.

TABLE XI.

SHOWING THE AVERAGE MEASUREMENTS AND WEIGHT OF 215 MEDICAL STUDENTS OF THE MIDDLESEX HOSPITAL AND KING'S COLLEGE, LONDON.

Class.	Number in Group.	Age.	Stature.		Body-weight.		Length of Head (mm.).	Breadth of Head (mm.)	Height of Head (mm.)	Circumference of head (mm.)
			In.	Cm.	Ki.	St. lb. oz.				
A	87	22·5	69·2	175·7	68·834	10 11 12	197·9	154·1	139·6	569·5
B	110	21·3	69·2	175·7	67·388	10 8 9	195·6	151·8	137·0	562·8
C	18	24·7	68·4	173·3	65·361	10 4 1½	192·4	150·0	134·0	555·8

Class A.—Medallists, scholarship and prizemen.
Class B.—Students of average intelligence.
Class C.—Students below average intelligence.

TABLE XII.

SHOWING THE AVERAGE BRAIN-WEIGHT AND PRINCIPAL INDICES OF THE SAME GROUPS.

Class.	Index of Size of Head (c.cm.) L × B × H.	Calculated Brain-weight (grm.).	Cephalic Breadth-Index.	Cephalic Height-index.	Capitulo-statural Index : $\frac{\sqrt[3]{\text{Index of size}} \times 100}{\text{Stature.}}$	Encephalo-somatic Index : $\frac{\text{Calculated Brain-weight}}{\text{Body-weight}}$
A	4261·2	1470	77·6	70·5	0·0932	0·0213
B	4064·1	1427	77·6	70·0	0·0911	0·0211
C	3866·3	1375	77·8	69·6	0·0904	0·0210

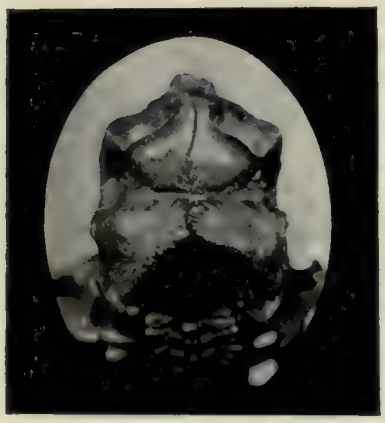

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

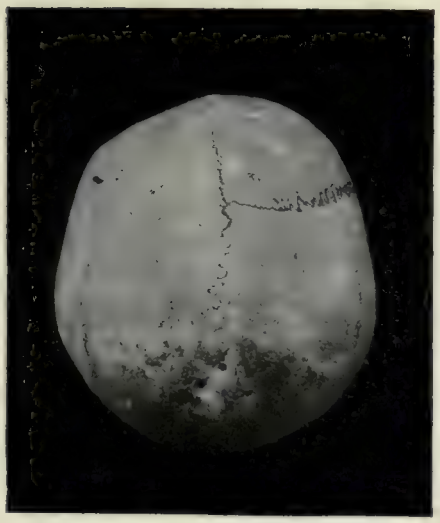

Fig. 1.

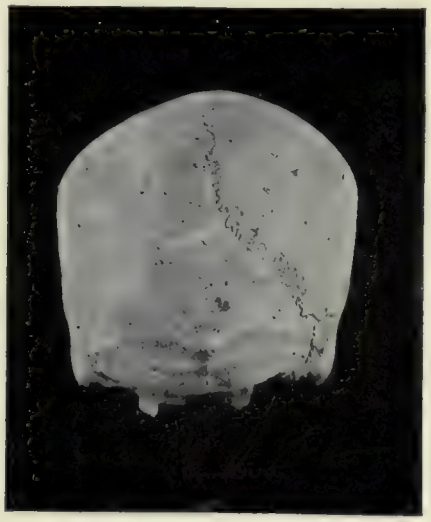

Fig. 2.

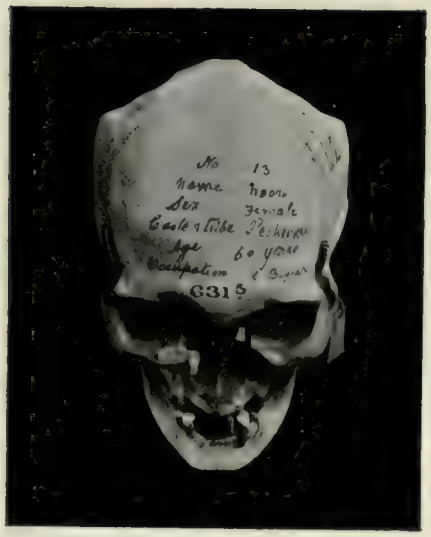

Fig. 3.

Fig. 4.

THE RESULTS OF AN ANTHROPOLOGICAL INVESTIGATION OF THE EXTERNAL EAR.

By Arthur Keith, M.D. (Aberd.), F.R.C.S., Lecturer on Anatomy at the London Hospital Medical College; Examiner in Anatomy, Royal College of Surgeons, England.

(Presented 16th June, 1906.)

This paper, if its full history may be told, really commenced in an early day of May some two and twenty years ago when, with some forty companions, I entered the dissecting-room of Marischal College to prepare myself for the practice of medicine. Yet the subject with which it deals is not, properly speaking, one which lies within the bounds of practical medicine, nor have the means by which I have earned a livelihood since we sat in the benches which you now occupy been those usually employed by medical men. It is strange that the circumstances which determine the main course of a man's life are those which appear at the time to be trivial and passing, for I now see, looking back over those years, that on the morning I entered the dissecting-room I had turned aside, unconsciously, into a side path of medicine.

The dissecting-room has been altered much since then; men and methods have changed with the times. Physical anthropology as a separate branch of study was confined then to France; had the instruction and the means which Professor Reid has made free to you been accessible to me, it would have saved me many a vain endeavour and made my work of higher value. It is strange that all details relating to dissecting and to reading in the dissecting-room have left no trace in my memory now, but there remains fresh as yesterday the impression of a man who, as he lectured, and as he

taught, took us up into the region of research, to the verge where men work from the known into the unknown, and infused into us something of his enthusiasm and independence of judgment.

That was the living influence which fascinated and turned me aside, but the words that directed my steps came through books; books by Owen, books by Huxley, books by Darwin. It seemed to me then, and the conviction has remained, that the course in life which was most worth striving for was the one most likely to help in answering the questions: When, where and how did man, and the races of men, arise? It was years later that I discovered that all inquiries and observations which are made, in order that these questions may be answered, constitute the subject known now as anthropology.

Like many others, I had become an anthropologist unconsciously, and this paper, which you have afforded me the pleasure of contributing to your Proceedings in a year when our University is entering another century of beneficence, contains the results of one of those inquiries, and it may have value to you because of its failures and of its negative rather than of its positive conclusions. In the matter of conduct we often learn more from failures than from success.

My observations on the ear were commenced in the summer of 1895, when I was studying in Leipzig. The methods which Dr. Beddoe was then employing to analyse and classify British races by observing and estimating their degree of pigmentation, a method which happily combined travel and observation, undoubtedly suggested to me that a complicated structure such as the external ear, which is admittedly characteristic of families, was suitable for such a method of observation, would be likely to give important clues to the relation of one race of mankind to another, and of one species of animal to another. It seemed well worth trying to see if an inquiry into the forms of ear found in the peoples along the western shores of the North Sea bore any direct relationship to those found in the people of our country, as one would expect if the history of invasions by Saxon, Jute, Angle and Dane are historically true.

The inquiry into the physical conformation of the unfit, which Lombrosa and his followers were then carrying out, and which they had applied to the ear, demanded extension and confirmation ; it was evident that, before such a method could be applied to the insane and the criminal, it must be widely applied first to the sane to give a sure foundation on which to build. Further, the relationship of man to other primates was a problem which was, and still is, far from being definitely settled, and the external ear being a complicated structure and one which, so far as we then, or even now, know serves no definite function, was, therefore, one which would not be directly subject to variation on account of use. It was a character which at least would remain unaltered by those conditions which do lead to alteration of structures which play an important part in the economy of the individual. So far at least my inquiry had that which every investigation must have, if it is to yield real knowledge—a definite aim —or to be more exact three definite aims :—

(1) To discover what relationship lay between the peoples on the shores of the North Sea ;
(2) To ascertain the degree of correlationship between a disordered mind and the form of the outer ear ;
(3) To see if the external ear of man indicated any definite relationship between man and any other primate.

Having definitely settled the object of my inquiry, there remained to be determined the features of the external ear to be observed, and the manner in which they were to be recorded. Papers on the ears of sane, insane, and of criminals, and also on the stigmata of degeneration, such as those which had been then published by Gradenigo, by Vali, by Féré and Leglas, and many other articles[1] of a similar nature which have been published since, appeared to me useless for my purpose, because they were records of anomalous forma-

[1] The best introduction to and summary of the literature on the external ear is given by Professor Schwalbe in *Bardeleben's Lehrbuch der Anatomie*, Theil ii., Bd. v., 1898.

tions, and did not deal with the various degrees of development of the ear as found in normal races.

In the *Festschrift* published to celebrate the attainment by Virchow of his seventieth year in 1892, Schwalbe codified the inquiries he had made into the morphology of the external ear, and provided a sure basis for others to build on. The features of the ear which Schwalbe laid most stress on were the auricular tip (Darwin's point) and the proportions of its measurements. Exact measurements have this one supreme advantage—that they are definite facts, which can be added to, verified and compared by workers all the world over; they are not expressions of opinion or indefinite expressions of fact, which are useless to other observers; measurements must ever constitute the firm basis on which every department of knowledge is to be reared. But the method I sought for was one that could be applied in the street and to large numbers, and yet would lead to the accumulation of facts which could be used by other observers, and for this purpose actual measurements were out of the question; further the relative diameters of any structure is one of the least essential of its features; the method desired was one which would record not only the form of the organ as a whole, but also the form and arrangement of the individual parts.

But what were the individual parts of the ear; how could they be determined? I accepted embryology as my chief guide and took each one of the six tubercles or elevations which His[1] had described as entering into the formation of the external ear, as a definite element to be studied and recorded. Fortunately I had studied the ears in many forms of primates, and, as will be seen presently, the experience so obtained also influenced my method. But were I now to begin again I do not think that embryology would be my chief guide; rather I would found the basis of my method on principles established by observations on the ears of the lower primates, especially on the lower forms of monkeys found in the New World.

[1] *Die Formentwickelung des äusseres Ohr: Anatomie Menschlicher Embryonen*, Theil iii., Leipzig, 1885.

There was, however, in all this one fatal omission, namely, a total neglect of the functional meaning of each part of the ear; in my opinion it is this neglect of function that renders so profitless much of the anthropological work of the present day. It is only now when I return to my accumulated records, which have been cast aside for some years, that I see that much of my labour has been in vain because I did not, nor do I yet, know the meaning of the structures which I had attempted to study. One of my reasons for bringing this paper before you is that it may save some from making the mistakes which I have made.

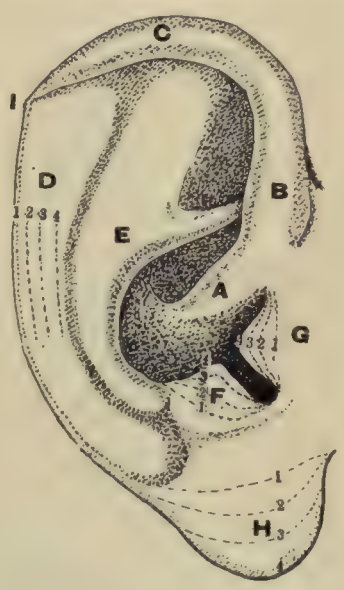

Fig. 1.—Diagram to explain the method used in making observations on the ear. A, root of helix; B, ascending helix; C, horizontal helix; D, descending helix; 1, 2, 3, 4, showing the four degrees into which the infolding of the helix was divided; E, anthelix; F, antitragus; 1, 2, 3, 4, the four degrees of classification; G, tragus; 1, 2, 3, 4, the four degrees of classification; H, lobule; 1, 2, 3, 4, the four degrees of classification; I, the auricular point (Darwin's point).

After some preliminary work in the streets of Leipzig the points on which I determined to make observations were the following—they are shown diagrammatically in Fig. 1: These were, first, the degree of infolding of the posterior border of the helix, from the situation of the auricular point above to the lobe of the ear below. The posterior border may show no trace of infolding, or it may be turned into an extreme degree of 10 mm. (see Figs. 1 and 2). The degree of infolding was divided into four stages, represented by 1, 2, 3, 4 (1 = no infolding, 2 = infolding to an extent of 3 mm. or less, 3 = infolding to an extent between 3-6 mm., and 4 = more than 6 mm.).

The condition of the auricular tip was noted, but only those cases in which there could be no doubt of its presence. Three conditions were noted: (1) where the tip formed a distinct triangular projection, whether it projected backwards or was inrolled with the posterior

border of the helix ; (2) where it was distinct but not pointed ; (3) where it formed a distinct tubercle.

The lobe of the ear, which I then knew was not a structure peculiar to man, but which, in the degree and form of its development,

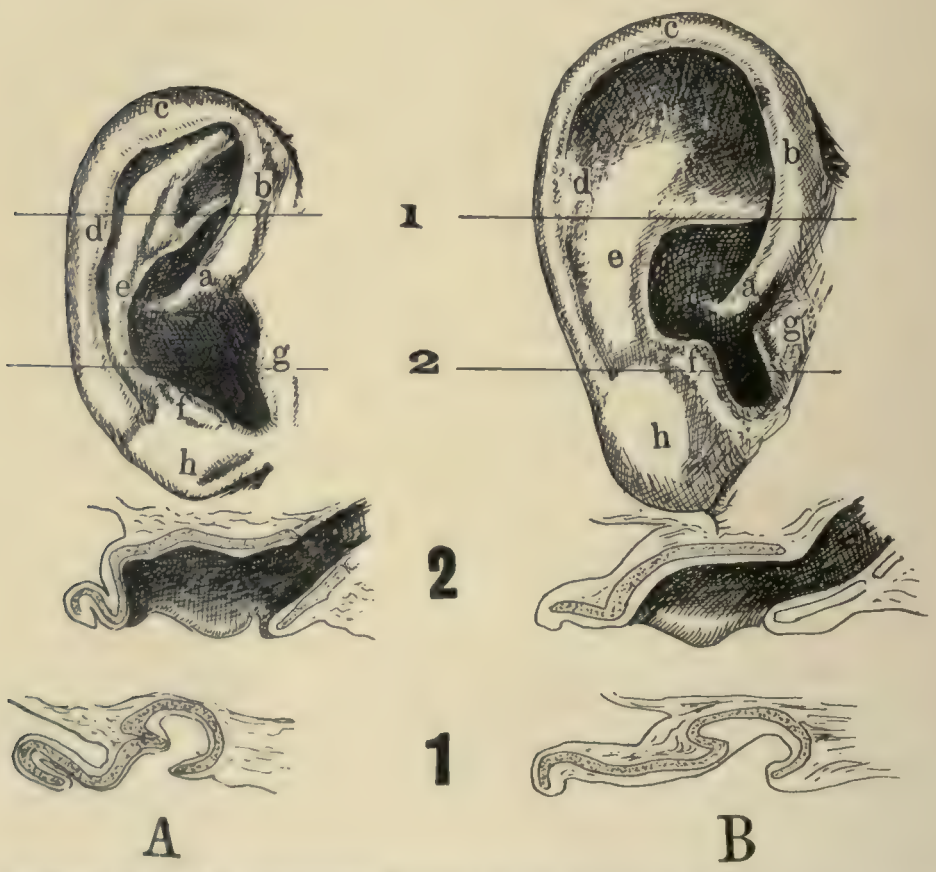

Fig. 2.—The types of ear distinguished as orang (A) and chimpanzee (B). 1, 2, sections across the ears at the positions marked 1, 2. The cartilage is stippled. a, root of helix ; b, ascending helix ; c, horizontal helix ; d, descending helix ; e, anthelix ; f, antitragus ; g, tragus ; h, lobule.

is a human character, was peculiarly worth observation. In it, too, I recognised four degrees, 1, 2, 3, 4 (see Fig. 1). I have never seen an ear in which the lobe was completely absent. In stage 1 were counted all cases in which the lobe extended less than 5 mm. below the border

of the intertragal notch; stage 2, all between 5-10 mm.; stage 3, all between 10-15 mm.; stage 4, all over 15 mm. Cases of complete adhesion of the lobe were also noted.

Similarly four stages were recognised in the development of tragus and antitragus (see Fig. 1). In their fullest development these structures project as triangular plates in the outer wall of the concha of the ear, separated by a narrow and deep intertragal notch; in their lowest development they form mere elevations on the anterior and lower margin of the conchal fossa; between those two extremes, which constitute stages 4 and 1, two intermediate degrees may be recognised.

The anthelix (Fig. 1) assumes various degrees of development, but they may be roughly grouped into four stages:—

1. Those in which it is so little prominent that it projects outwards to a distinctly less extent than the posterior part (descending limb) of the helix.
2. Where it projects outwards to an equal extent with the descending limb of the helix (Fig. 2 B, 1, 2).
3. Where it is distinctly more prominent than the helix (Fig. 2 A, 1, 2).
4. Where it projects outwards 4 mm. or more than the descending helix.

To a certain extent I had followed the embryological divisions of His; the tragus, antitragus, lobule, descending helix and anthelix were distinguished by him as elementary parts of the ear, and it would have been better had I pursued in my investigations, as I had originally intended, two other divisions distinguished by him, the root and ascending helix (*tuberculum anterius*) and also the horizontal helix or upper margin (*tuberculum intermedium*, Fig. 1), but after some attempts I abandoned these for want of a suitable method of recording their forms. As it so happened an observation I included in my method to record the type of ear does express to some extent the condition of these parts.

Nearly every one who had before then inquired into the various

forms of the human ear had distinguished certain types, but the characters on which these types were based seemed to me arbitrary and artificial. Since the four kinds of anthropoid apes, the gorilla, the chimpanzee (Fig. 3), the orang and the gibbon, are admitted by all

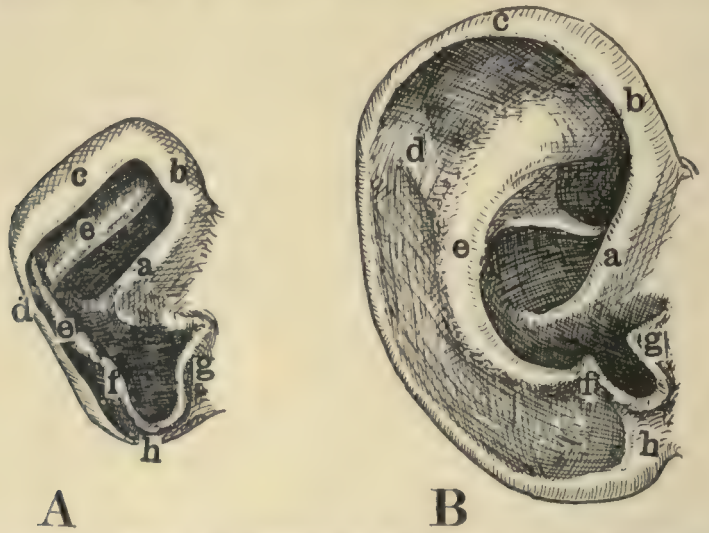

Fig. 3.—Ear of orang (A) and of chimpanzee (B) (natural size). a, root of helix; b, ascending helix; c, horizontal helix; d, descending helix; e, anthelix; f, antitragus; g, tragus; h, lobule.

to be co-descendants with man from a common stock, it seemed to me most probable that in the forms of ear met with in these animals—for each has a characteristic type—would be found a natural basis for the classification of the forms found in men. In Figs. 3 and 5 are given diagrams representing to scale the forms of ears found in the four anthropoids. The ear of the gibbon is interesting (Fig. 5 B), but may be at once excluded as far as our present purpose is concerned; it is apparently a type intermediate to that found in the other anthropoids and certain ear forms found in the lower primates of America. But in the gorilla, chimpanzee and orang we have forms of ear very similar to types found in men. The gorilline type is the more human; the orang and chimpanzee have ears which are sharply contrasted, and very little inquiry serves to show that among human ears types occur which correspond to the chimpanzee and to the orang forms.

I therefore resolved to keep a record of these types, but I was not then aware of what I learned later, that the orang type represents an extreme degree of retrogression, while the chimpanzee ear represents an opposite stage, *viz.*, one which is at its fullest degree of development. Later I shall recur to these two contrasted types of ear and give more exact definition of their characters and the meaning of these characters. These were distinct types, but they included less than 40 per cent. of the whole—how were the others to be classified? It would have been wiser to group all that remained into one class, but I sought to divide the remaining 60 per cent. into four groups :—

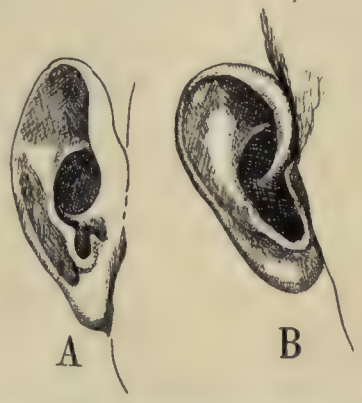

Fig. 4.—The ear of the chimpanzee (A) and of the "chimpanzee" type in man (B), seen on a full face view.

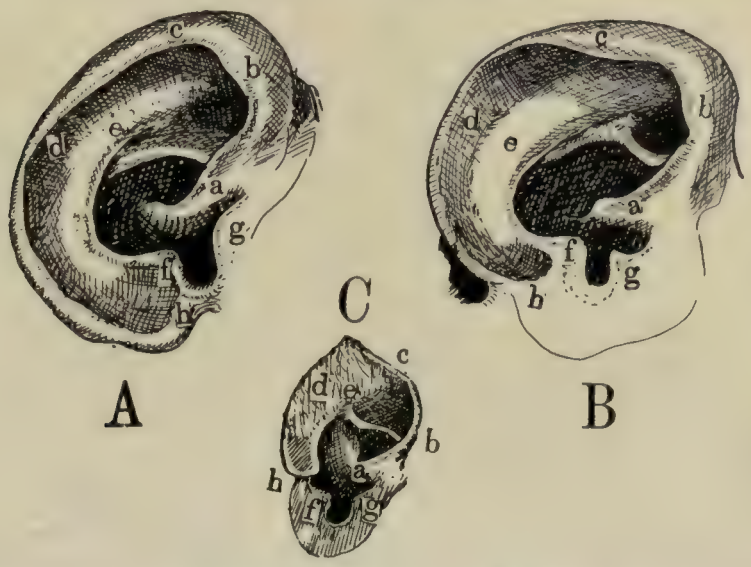

Fig. 5.—Ear of gorilla (A), of gibbon (Hylobates lar) (B), and of lemur (Nyctipithecus tardigradus) (C). a, root of helix; b, ascending helix; c, horizontal helix; d, descending helix; e, anthelix, f, antitragus; g, tragus; h, lobule. The ear of the lemur is reproduced for comparison with that of the gibbon. The gibbon is seen to retain the lemurine form of implantation, the lobule being undifferentiated from the tissues of the cheek.

1. Those which I called typically human (that is, represented a degree of development intermediate to the orang and chimpanzee types);
2. Anomalous or atypical ears;
3. A form which is distinguished from the chimpanzee type only by the smallness of its size (see Fig. 6); and
4. A cercopitheque form, which I soon abandoned because I found that in reality the peculiarity of the type depended on the absence of infolding of the posterior border of the helix.

Thus, finally, I distinguished—or rather attempted to distinguish—five types of ear: (1) Typically human, (2) orang, (3) large chimpanzee, (4) small chimpanzee, and (5) anomalous or atypical forms. But the attempt brought home to me the truth that in the distinction of types, or rather, in classifying forms into groups, one attempts to draw lines of demarcation where Nature has drawn none, for between every type distinguished there occurs a chain of intermediate forms, some of which belong as much to one type as to the other. It is a difficulty which is encountered in every branch of anthropological investigation, whether one is inquiring into the form of head, the form of face, of nose, or the degree of pigmentation; everywhere artificial lines have to be drawn. The results we obtain in such a method as this cannot have a mathematical exactness; the personal error must be large, but not so large as to invalidate the general truth of the results acquired or to prevent the comparison of the results obtained at one time and place with those acquired at another time and place. At least such a method would serve the useful purpose of finding out whether the vast labour, which accurate measurement by tape and compass entails, would repay the man who undertook the task. Were I again to commence observations I would adopt the ear of the typical West Coast negro as another type.

Fig. 6.—The form of ear distinguished as the small chimpanzee type (⅔ natural size). The ear is small, but the upper parts of the helix and anthelix are wide.

In making my observations two other considerations were taken into account. Dr. Beddoe, as I have already mentioned, used the degree of pigmentation as a means of distinguishing racial affinities; I wished to see if there were a correlationship between the type or form of ear and the colour of hair. I classified the observed individuals into three groups: the fair-haired, the black-haired, and the intermediates. In the black-haired group I placed those with dark or distinctly red hair, and in the fair-haired those in which the red was a fawn or sandy hue. Besides noting colour of hair, I also took into consideration the question of age, and excluded those whom I considered under twenty, and those who appeared to me over sixty, for Schwalbe had clearly demonstrated that the ear enlarges rapidly after sixty, and before twenty it has not attained its adult form and size, nor is the colour of hair finally determined.

The method I adopted in making observations was the following. They were made in the street or market place, and I found that, with practice, I could note five points or features on those whom I casually passed. For instance, I noted colour of hair, sex, type of ear, degree of infolding, condition of the auricular tip. In the palm of my hand I carried slips of stiffish paper, of convenient size and ruled into six vertical columns—three for fair, intermediate and black males, and three for the corresponding grades of females. Suppose, for example, that the individual just passed is a man, with fair hair, orang type of ear, infolding of the helix to the extent I have classed as Stage 1, the auricular tip represented by a slight elevation (Stage 3), then the record made (in the column for fair-haired men) was "Or., 1, 3".

The number of individuals I wished to include in each group was 250 of each sex, but in reality the number was twice that, because after observing the points just mentioned in 250 of each sex, I had to begin an equally extensive series for observations on the lobule, tragus, antitragus and the anthelix. Thus at each place of observation I intended that my observations should extend over a series of a thousand individuals. Observations on the insane and criminals were made

more leisurely, and all the points were recorded from the same series of individuals. Only the ear of one side was examined—always, when possible, the right ear.

The following table shows the order of places in which observations were made, the number of individuals examined (or rather half the individuals examined, for, as already mentioned, the observations were made on two series of individuals), and the date at which the work was done :—

TABLE I.

Place.	Males.	Females.	Year.	Class.
Leipzig	588	605	1895	Town inhabitants
Hamburg	578	456	1895	Town inhabitants
Elmshorn	672	570	1895	Country inhabitants
Aberdeen	631	655	1896	Town inhabitants
Turriff	119	—	1896	Country inhabitants
Cornhill	385	121	1896	Country inhabitants
Whitechapel	700	492	1896	Town inhabitants
Jews (Whitechapel, mostly Polish)	109	62	1896	Town inhabitants
Peterborough	306	227	1897	Town and country
Liverpool	453	243	1897	Town inhabitants
Carlisle	241	248	1897	Town and country
Preston	264	190	1897	Town inhabitants
Dumfries	305	170	1897	Town and country
Castle Douglas	270	81	1897	Country inhabitants
Larne	129	100	1897	Country inhabitants
Lisburn	128	89	1897	Country inhabitants
Belfast	336	226	1897	Town and country
Dublin	278	268	1897	Town inhabitants
Killorglin	281	205	1897	Country inhabitants
Cork	256	245	1897	Town inhabitants
Caermarthen	296	256	1897	Country inhabitants
Royal Asylum, Aberdeen	190	211	1896	Town and country
County Asylum, Durham	211	208	1896	Town and country
Richmond Asylum, Dublin	189	204	1897	Town and country
Cork Asylum	202	205	1897	Town and country
Profile photographs of criminals, Scotland Yard	526	200	1896	Town and country
Vagrants, London	60	28	1896	Town and country
Vagrants, Liverpool	74	12	1897	Town and country
Photographs of various races and antique statues in British Museum	150	38	1896	
Anthropoids and apes	170 both sexes			

Altogether my records extend to 8,567 males and 6,577 females belonging to Central and Western Germany, Scotland, England, Wales and Ireland; and include representatives of the insane, criminal and vagrant classes. To give at length all the data I have accumulated and to discuss the various results and conclusions I have reached would occupy far too much of your time. I intend to deal with my subject only in so far as it relates to the people in the North of Scotland.

I take this opportunity of expressing my indebtedness to those gentlemen who have afforded me the opportunity of obtaining data relating to the insane. In this matter I am particularly indebted to Dr. William Reid.

So far I have merely mentioned the manner in which I have noted down the observations as they were made in the street. When a sufficient number of observations had been made, they were then classified and summed up. For an illustration I will take the observations made on the lobule of the ear of inhabitants of Aberdeen. The accompanying table shows the result :—

TABLE II.

DEVELOPMENT OF LOBULE IN INHABITANTS OF ABERDEEN.

	Males.				Females.			
	Fair.	Interm.	Black.	Total.	Fair.	Interm.	Black.	Total.
Stage 1 - -	34	66	17	117	28	66	27	121
Stage 2 - -	36 (4)	64 (14)	11 (2)	111	23 (6)	64 (17)	15 (5)	102
Stage 3 - -	32 (8)	76 (7)	11 (1)	119	27 (1)	100 (7)	28 (4)	155
Stage 4 - -	46 (1)	56 (2)	24 (2)	126	37 (2)	102 (1)	46 (1)	185
	148	262	63	473	115	332	116	563

Note.—The figures in brackets represent the numbers in which the lobule was completely adherent.

Thus, in 473 men I estimated that the lobule was less than 5 mm. in depth in 117, between 5-10 mm. in 111, between 10-15 mm.

in 119, and over 15 mm. in 126. In 563 women the results will be seen to be approximately similar. For purposes of comparison it is necessary to estimate what may be named the mean or index development of the lobule; this was obtained as follows: The lobule of Stage 1 was taken as a unit, Stage 2 as two units, Stage 3 as three and Stage 4 as four, so that in the group of males at present under consideration the mean development of the lobule was:—

$$\frac{117 \times 1 + 111 \times 2 + 119 \times 3 + 126 \times 4}{473} = 2{\cdot}53.$$

The index for the female series is 2·71. That is to say, the average development of the lobule in the groups I examined lay between Stages 2 and 3, but it reaches a distinctly greater development in the women than in the men.

It will be observed that the number of individuals is nearly equally divided among the four stages (117, 111, 119, 126), and it will occur to those who are familiar with the manner in which anthropological data group themselves into a maximum near the mean and diminish towards the extremes, that either my method is artificial or inaccurate, or that the lobule is not subject to the laws that regulate the development of other parts of the body. It will be noticed that the observations made on the females show a similar distribution, so that at least if the method is artificial it has evidently been applied in a similar manner to each group. But there can be no doubt that in my earlier work I placed many examples of the two intermediate stages into the two extreme groups.

The result so far obtained is that the index of development for the lobule of the ear in Aberdeen men is 2·53; the female index is greater by ·18. Is there constantly a sexual difference and what is its meaning? The lobule always obtains a greater development in the female ear. The lobule represents tissue which in lower primates is utilised in the formation of the lower part of the helix; that is, it represents a retrograde change in the outer ear. Its greater size in the female is probably due to the fact that the outer ear of the female shows more evidence of retrogression than that of the male.

In the two following tables are given data relating to the lobules of the insane of the Aberdeen asylum, and of the country people of Cornhill and Turriff—people living on the confines of the shires of Aberdeen and Banff:—

TABLE III.

ABERDEEN ASYLUM.

	Males.				Females.			
	Fair.	Interm.	Black.	Total.	Fair.	Interm.	Black.	Total.
Stage 1 - -	9	4	4	17	5	13	4	22
Stage 2 - -	26 (12)	32 (9)	26 (9)	84	25 (14)	31 (10)	28	84
Stage 3 - -	26 (5)	26 (4)	14 (2)	66	11 (4)	32 (8)	25	68
Stage 4 - -	9 (1)	7 (2)	10 (2)	26	10	10	16	36
	70	69	54	193	51	86	73	210

Index for males, 2·52. Index for females, 2·56.

TURRIFF AND CORNHILL.

	Males.				Females.			
	Fair.	Interm.	Black.	Total.	Fair.	Interm.	Black.	Total.
Stage 1 - -	16	38	5	59	1	7	2	10
Stage 2 - -	36 (14)	67 (14)	7	110	9 (1)	19 (2)	1	29
Stage 3 - -	52 (7)	78 (14)	10 (2)	140	8	34 (2)	4	46
Stage 4 - -	29 (2)	71 (8)	13 (1)	113	5	17	4	26
	133	254	35	422	23	77	11	111

Index for males, 2·72. Index for females, 2·79.

It was not until I had collected the greater part of my data that I calculated and compared my results; had I compared the figures for Aberdeen city and Aberdeen asylum I should have paused before proceeding further, for it is now quite clear to me that the observa-

tions which I made on the insane—made without any need for haste—are by far the more reliable; the distribution of the individuals in the tables for the insane are in conformity with what is expected of anthropological measurements, while those drawn from the city are certainly not. With the exception of those for Hamburg, Elmshorn and Aberdeen city, the earliest obtained, my figures and data are in conformity with data obtained by exact measurements.

Having thus estimated that the mean development of the lobule of the ear is 2·52 for the males in the city and the asylum, and 2·72 for the men of Cornhill, I shall now compare these results with the figures obtained in other localities, shown in the following table :—

TABLE IV.

	Males.					Females.				
	Stages.					Stages.				
	1.	2.	3	4.	Mean.	1.	2.	3.	4.	Mean.
Hamburg - -	125	173	137	164	2·56	89	153	134	159	2·67
Elmshorn - -	70	72	54	56	2·38	37	44	42	41	2·52
Durham Asylum -	24	88	72	27	2·48	40	50	59	57	2·64
Peterborough - -	33	79	45	25	2·34	27	49	50	14	2·35
Whitechapel - -	108	233	200	107	2·47	65	118	142	58	2·76
Whitechapel Jews -	17	32	34	36	2·75	6	26	22	29	2·90
Scotland Yard (criminals) -	32	147	108	43	2·52	11	82	67	41	2·68
Liverpool - -	66	227	186	51	2·41	43	173	169	41	2·48
Preston - -	31	94	104	35	2·54	22	40	81	53	2·84
Carlisle - - -	27	86	87	43	2·60	23	87	109	39	2·63
Dumfries - -	25	101	123	45	2·63	14	45	72	34	2·76
Belfast - - -	37	138	109	52	2·49	24	83	95	25	2·53
Dublin - - -	30	71	114	52	2·70	15	73	119	61	2·84
Richmond Asylum, Dublin - -	20	78	68	23	2·49	17	67	90	29	2·64
Killorglin - -	18	121	121	22	2·52	8	61	129	11	2·68
Cork City - -	14	87	118	35	2·68	9	76	122	47	2·81
Cork Asylum - -	6	56	104	36	2·86	13	60	75	57	2·85
Caermarthen - -	12	104	129	57	2·76	10	76	115	54	2·83
Aberdeen City -	117	111	119	126	2·53	121	102	155	185	2·71
Aberdeen Asylum -	17	84	66	26	2·52	22	84	68	36	2·56
Cornhill - -	59	110	140	113	2·72	10	29	46	26	2·79

Having thus compiled the results of observations made on the lobule of forty-two groups of people (twenty-one male and twenty-one female), are we in any better position to answer the inquiry on which we set out—the relationship of one group of people to another? In such an inquiry we proceed on the belief that those groups which show a similarity in form and size in their corresponding parts owe that similarity to a community of descent, and are therefore related.

If such a principle could be accepted as even probable, then from the above inquiry we should infer that the Aberdeen people find their near relatives amongst the groups examined in Kerry (Killorglin), Scotland Yard, Lancashire and Hamburg. Now, if there is any well-marked race in Great Britain and Ireland, it is the tall, dark, excitable men from Kerry; they are very different from the people of Aberdeen. I have raised the point simply to emphasise the fact that one cannot determine the relationship by taking into consideration one point only, whether it be size of lobule, shape of ear, colour of hair, characters of mind; to settle the affinities of a people one must take into consideration every one of the characters of body and mind. One point in my inquiry impressed me, and that was the resemblance of the people living near the coast, north of the mouth of the Elbe (Elmshorn), to those of Peterborough, a superficial resemblance in physical characters, which was also manifest long after, when I worked out the observations I had made on their ears.

In the groups examined (with one exception—Cork Asylum), the lobule was larger in the female than in the male, but the degree of sexual difference varied: in seven groups the difference was ·01 to ·10, in nine groups from ·10 to ·20, in three groups ·20 to ·30, and in one group between ·30 and ·40. In Cork Asylum the female lobule was ·01 less than the male.

If colour of hair is distinctive of race—if fair-haired people are fair-haired because of their community of origin and descent, and black-haired are allied to black-haired, then one would expect that this character of pigmentation would be accompanied by many others. Does the lobule of the fair-haired individuals differ from that of the

black-haired? To answer this question I worked out the mean development in the fair-haired and black-haired individuals, and found in every group examined in this country the lobule was ·04 to ·60 larger in the black than in the fair-haired. This was also the case at Elmshorn; but in Leipzig and Hamburg the case was reversed—there the fair-haired had the larger lobule. These were the brachycephalic, fair-haired people, while those at Elmshorn and in this country are in the majority mesocephalic or dolichocephalic.

Many of those who have inquired into the condition of the ear in the insane, the criminal and vagrant classes have regarded what they have called the absence—in reality the smallness—and adhesion of the lobule as a mark or stigma of degeneration. My inquiries, made on a more extensive basis, show no grounds for such an inference. But, on the other hand, I found that the auricular tip and a marked degree of inrolling of the helix were distinctly more frequently present in criminals and in congenital idiots than in normal people (*Nature*, Nov. 7, 1901, p. 16).

It would exceed the bounds of this paper were I to discuss the results of my observations on the infolding of the helix, the occurrence and significance of Darwin's point, the development of the tragus and antitragus to the extent with which I have dealt with the lobule. I propose to bring my paper to a conclusion by a brief description of the characters, significance and distribution of the two types of ear I have distinguished as the "orang" and "chimpanzee".

The orang type (see Figure 2 A) of ear is small, its long diameter measuring under 60 mm.; the helix is markedly inrolled, the anthelix is well developed deepening the concha of the ear, and projecting outwards beyond the level of the helix. It is commonly closely applied to the head. In the chimpanzee type (see Figure 2 B) the helix, especially the upper part, is wide, expanded and inrolled to a slight degree, the anthelix is neither prominent nor markedly convex, and usually is not closely applied to the head, but projects outwards (see Figure 3 B).

These two types represent the extremes of a developmental pro-

cess which can be observed in the ear of all primates. In this mammalian order there is a rivalry between the helix and anthelix as to which will play the chief part in forming the external ear. In the orang type is to be seen the pre-eminence of the anthelix; in the chimpanzee type, the helix. In man and the gorilla the majority of individuals show forms between these extremes; in the remarkable ear of the gibbon (which is set at a peculiar angle, and has its lobule undifferentiated from the tissues of the cheek, see Figure 5 B) one finds, in the majority of individuals, a type which resembles the chimpanzee rather than the orang. Schwalbe is the only writer who has rightly recognised the nature of the change at work in the ear of man, namely, that it is not a rudimentary or vestigial structure, but one in which a great transformation is taking place, whereby the anthelicial part is superseding and replacing the helicial part in forming a receiver for sound waves.

In Table V. I reproduce the results I obtained as regards the frequency with which the orang and chimpanzee types occur in the various groups of people examined. From that Table it will be observed that I attempted to distinguish six types in all, but saving the two types mentioned—the orang and chimpanzee (named large chimpanzee in Table)—I regard the others as of little value. The type distinguished as the average human type lies, as regards its characters, in an intermediate position to the orang and chimpanzee types. At the commencement I was impressed with a type of ear, which in all its characters, save its size, resembled the chimpanzee type; I named it the small chimpanzee, but its distinction frequently caused me perplexity and difficulty (see Fig. 6). The type called cercopitheque was one in which the ear was, as in most cercopithecus monkeys, as broad in its lower as in its upper part, and its helix was not inrolled, but it too I found difficult to discriminate. In the anomalous group I placed ears which were abnormal in form, or could not be classified with any of the other five groups.

TABLE V.

THE PERCENTAGE WITH WHICH THE VARIOUS TYPES OF EXTERNAL EAR OCCURRED IN THE VARIOUS GROUPS OF PEOPLE EXAMINED.

H = The human type (see Fig. 1).
O = Orang type (see Fig. 2 A).
Ch′ = Large chimpanzee type (see Fig. 3 B).
Ch″ = Small chimpanzee type (see Fig. 6).
Cerco = Cercopitheque type.
An = Anomalous forms.

	Males.						Females.					
	H.	O.	Ch′.	Ch″.	Cerco.	An.	H.	O.	Ch′.	Ch″.	Cerco.	An.
Hamburg	23	20	20	29	4	4	44	32	10	10	2	1
Aberdeen City	31	28	15	21	1	3	36	43	5	12	1	2
Cornhill and Turriff	37	26	14	16	3	3	56	31	2	6	3	1
Elmshorn	24	28	23	20	1	2	39	36	13	10	½	1
Peterborough	32	19	19	22	1	1	30	50	6	8	5	1
Aberdeen Asylum	38	23	16	17	3	2	37	40	8	8	3	3
Durham Asylum	29	26	18	18	5	3	45	39	3	10	1	1
Scotland Yard	34	36	15	8	5	2	34	34	13	10	5	3
Richmond Asylum (Dublin)	37	29	12	17	10	3	50	33	3	10	1	1
Cork Asylum	52	12	19	14	½	3	45	37	3	10	3	2
Cork City	32	22	28	15	1	1	45	42	3	6	3	—
Killorglin (Kerry)	41	18	27	13	—	1	52	42	1	2	1	1
Dublin City	26	22	33	17	1	—	44	41	6	5	3	1
Belfast	34	29	28	11	½	1	36	52	5	4	1	1
Castle Douglas	43	27	17	11	1	1	41	49	9	1	—	—
Dumfries	32	30	23	11	1	2	41	49	3	2	3	1
Carlisle Market	38	27	18	16	½	½	40	43	5	9	2	1
Preston	38	30	12	19	1	—	35	54	½	8	1	1
Liverpool City	40	28	11	18	2	1	43	48	2	4	2	1
Liverpool (vagrants)	40	16	22	18	4	—	50	42	—	8	—	—
Caermarthen Market	44	17	19	19	—	—	38	47	5	7	1½	1½
Mansfield	38	20	20	21	1	—	39	38	5	12	5	1
Whitechapel (East London)	43	17	13	23	—	3	45	44	2	8	—	—
Whitechapel (Polish Jews)	43	16	17	18	—	5	40	19	20	7	—	3
Whitechapel (vagrants)	45	10	18	25	—	2	57	43	—	—	—	—

One point comes out very distinctly from my data—*viz.*, that there is a very marked sexual difference in the orang and chimpanzee types of ear. The orang type of ear is met with much more frequently in women, while the chimpanzee type is seen more frequently in men. In the twenty-five groups of women given in the table, the proportion in which the orang type occurs varies from 30

to 55 per cent., while in only two groups (at Elmshorn and Scotland Yard) does the proportion of the chimpanzee type exceed 10 per cent. In nineteen of the male groups the proportion of the orang type varies from 15 to 30 per cent., the chimpanzee type occurring in a nearly equal proportion.

There is also a correlationship between the colour of hair and the ratio in which these types of ear occur. In every one of the groups examined the fair-haired individuals showed a distinctly greater percentage of the orang type than the black-haired ; while the chimpanzee type occurred in a larger proportion of black-haired than of fair-haired.

From an examination of the data given in Table IV. it will be found that there is no correlationship between the ratio in which these two types of ear occur and the bias to insanity. The insane men in Aberdeen and Cork asylums show the orang type less frequently than the sane ; in Dublin the case is the reverse ; so, too, as regards the occurrence of the orang type in women of these asylums. Nor is there any constant difference in the ratio in which the chimpanzee type is found in the sane and insane.

The types of ear described by Continental writers as Wildermuth and Morellische, and regarded by them as occurring with undue frequency amongst the insane forms are marked examples of what is here regarded as the orang type.

In the criminal population of Scotland Yard there is a distinct departure from the usual ratio in which the orang and chimpanzee types occur. In the males the orang type occurs more frequently than in any other group of men examined, whilst amongst the women criminals exactly the opposite obtains—the orang type occurs less frequently than in any other group of women. There is here a sexual inversion. The chimpanzee type occurs among male criminals with a normal frequency, but amongst the women this type is abnormally frequent.

When, however, we wish to put the data to the main purpose for which this investigation was undertaken, namely, to discover the

relationship of the various groups examined, the indications afforded are indefinite. Take the Aberdeen inhabitants, for instance: amongst the males the orang type occurs in 28 per cent. in the sane, 23 per cent. in the insane; a similar percentage is found in people so widely apart as Hamburg and Cork; the percentage with which the chimpanzee type occurs associates the Aberdeen people with the South Welsh and Whitechapel Jews. Yet in some instances the type of ear is characteristic of race. Nearly 80 per cent. of the Bushmen and Hottentots have ears of the orang type. The chimpanzee type prevails in the south-west and north-east of Ireland, and from descriptions given by travellers it is evidently the common form met with in Northern Mongolia and in Siberia. In estimating the value of these two types of ear, as anthropological characters, one has to remember that they are the result of a tendency to be seen at work on the ears of all the higher primates.

In the genus cynocephalus (baboons) alone is the helix fully developed and pointed; in the order in which the various genera of primates are named below there is to be seen a reduction of the helix and an increased prominence of the anthelix: cynocephalus, macacus, cercopithecus, colobus, semnopithecus, mycetes, lagothrix, cebus, chimpanzee, gibbon, man, gorilla, orang. The processes which have given the primate ear its peculiar form are evidently a common inheritance, and have been in operation in all the members of the order—in some more and in some less—so that it is doubtful how far similarity in form of ear can be utilised as a guide to genetic relationship.

My main reason for bringing this investigation before the members of the Anatomical and Anthropological Society of Aberdeen University is because I believe it to be true of anthropological as of medical investigation, that more is to be learned from men's failures than from their successes. For the main purpose of my inquiry—the relationship of one group of people to another—this labour of mine has been a complete failure. Nor do I believe, had my methods been more exact and all my observations made by measurement, that

the result, as far as the end I had in view, would have been more valuable. The chief gain I derived from it was this : it brought me face to face, in a more extensive manner than happens to most inquirers, with the method of statistical inquiry and showed me how far that manner of inquiry is likely to help us in settling racial affinities. It brought home to me the fact that the statistical method is one which raises rather than answers questions ; it produces data but it cannot explain them. The second lesson my inquiry taught me, and one which I mean to apply to every piece of work of this kind I may undertake, is that any statistical inquiry to be of value must be made on structures whose function and significance are completely understood, and the measure of whose function can be accurately represented by the data recorded. That is to say, my inquiry ended at the point where it should have commenced, namely, in a complete investigation by physiological and comparative methods, into the meaning and use of each part of the outer ear.

It would have been a matter of the greatest satisfaction could I have brought before you a piece of work which was more worthy of our University, and a better acknowledgment of the debt which I, in common with thousands of men of the North of Scotland, owe her. These 400 years she has provided her graduates with the means of joining the ranks of those who, all the world over, seek to keep natural knowledge not only living but also growing.

ORDINARY MEETING.

30TH JUNE, 1906.

Professor R. W. REID, M.D., F.R.C.S., President,
in the Chair.

The Minutes of the last meeting were read and approved.

An anatomical variation was described by Mr. G. S. Melvin, and the President demonstrated peculiarities in a vertical section of the body, prepared in the Department.

The treasurer's report for the past year was then read and adopted.

The following were elected office-bearers for the ensuing year :—

President—Professor R. W. REID, M.D., F.R.C.S.
Vice-Presidents—ALEX. LOW, M.A., M.B., C.M.; W. A. H. MCKERROW, M.B., Ch.B.; JAMES WATT, M.A.
Secretary—A. G. STEWART, M.A.
Recording Secretary—J. D. FIDDES, M.A.
Treasurer—G. S. MELVIN.

The retiring office-bearers were thanked for their services.

RECORD OF ANATOMICAL VARIATION.

Date of observation, May, 1906.
Sex, Male.

Presence of rectus sternalis muscle.

This variation was met with in the dissection of the left superior extremity of a negro subject. The muscle presented the appearance

of a triangular structure seen on the removal of the skin and fascia, superficial to the pectoralis major.

The long axis of the muscle inclined from above down and out, with the base attached to the sixth rib cartilage, and the apex lying on the second cartilage—a length of four inches. The base, tendinous in structure, was $1\frac{1}{2}$ inches broad, continuous with the sheath of the rectus abdominis, its inner margin lying about $\frac{3}{4}$ inch external to the left edge of the sternum.

The apex, also tendinous, lay on the second rib cartilage, close to the sternum. Here the muscle split into two parts, an inner and an outer. The inner was a thin well-defined tendinous band, about $\frac{1}{8}$ inch broad, which, crossing over the sternum, became continuous with the pectoralis major on the right side. The outer division was fan-shaped attached, internally to the sternum, while externally it radiated into the great pectoral of its own side.

No nervous or vascular supply could be made out, and there was no similar structure on the right side.

(Signature of observer) G. Spencer Melvin.

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