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A

SYSTEM

OF

HUMAN ANATOMY.

EDINBURGH:
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PLAN OF THE EXTERNAL REGIONS OF THE BODY.

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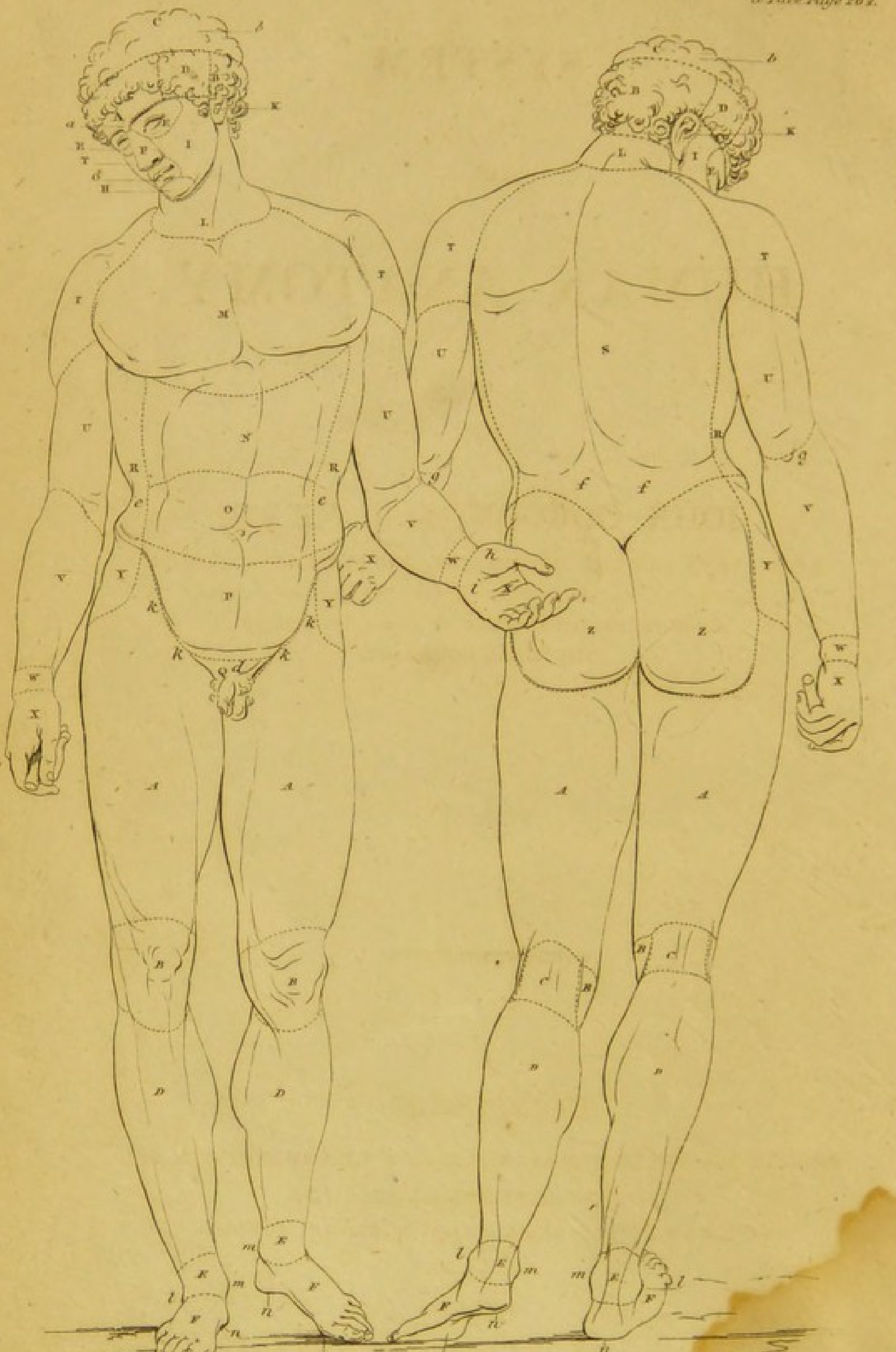

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A

SYSTEM

OF

HUMAN ANATOMY.

BY

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VOL. I.

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TO

JOHN THOMSON, M.D. F.R.S.E.

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THIS WORK

IS INSCRIBED,

IN TESTIMONY OF

THE RESPECT AND GRATITUDE

OF

THE AUTHOR.

PREFACE.

The following Work is intended chiefly for the use of those, who are attending Lectures on Anatomy, or who have access, in their private studies, to Anatomical Preparations.

I could wish to have given it a more popular form; and to have endeavoured, by the aid of a series of Engravings, to have rendered it, in some degree, intelligible to the general reader. But the experience of the last four years has fully satisfied me, that, in this part of the island at least, it could not have been executed according to such a plan, without the most inconvenient delay, and without an expence, which, were the work otherwise calculated to be useful, would have deprived it of half its utility.

In offering it to the Public in its present form, I think it right to observe, that the descriptions and facts which it contains, are, in most instances, the result of observations and experiments, made directly on the Human Body by myself. But as there are many subjects, which I have not hitherto enjoyed opportunities of investigating in this manner, to my own satisfaction, I have, when treating of these, selected the observations of those Anatomists, on whose accuracy I have felt inclined to place the most reliance.

I trust, however, that, although it is only in these last instances, that I have thought it necessary to refer expressly to other Anatomical writers, I shall not be considered as pretending ignorance of what other Anatomists have done before me. There are very few situations, if indeed there be any, in which such an avowal on the part of an author, is either creditable or becoming. I have consulted all the Treatises and Elementary Books on Anatomy, which are usually thought worthy of perusal in our times; and have profited, as much as was in my power, by the information which they contain. Those who are familiar with the science, will readily perceive, wherein the present work differs from these, either in point of matter or arrangement.

I have not ventured on many innovations in Nomenclature, in the following pages; but where innovation seemed to be unavoidable, I have uniformly accompanied the new term with the old; in order that, until the former, or some preferable appellation, be adopted, there may be no risk of ambiguity. As it is peculiarly desirable, however, in descriptive composition, to avoid circumlocution, I have not hesitated, in many instances, to apply names to parts which had no names before.

The work is, throughout, purely Anatomical. I have scrupulously avoided the introduction of any Physiological matter; being convinced, that it tends rather to interrupt and distract, than to illustrate, the descriptive detail. The unconnected views of the Functions of the Body, which have been so commonly interspersed in this manner with the description of its Structure, are generally superficial and not often accurate. I reserve every thing that relates to the department of Physiology, for a separate Elementary Treatise.

Being desirous of employing this Work as a Manual for my public Lectures, I have endeavoured to consult the convenience of the Student, by dividing it into Volumes of small size. In this respect, I have followed the example of some of the most judicious systematic writers on the Continent; and I trust, that the arrangement will not be objectionable to other classes of readers.

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A

SYSTEM

OF

HUMAN ANATOMY.

INTRODUCTION.

Though the division of Bodies into *Living* and *Dead*, is one which is familiar to us all, yet we do not often accustom ourselves to observe the precise circumstances, on which the distinction is founded.

Those Bodies are called *Living*, in which a certain appropriation of foreign matter is going on; and those, *Dead*, in which this process has either ceased, or never existed.

This appropriation of foreign matter, which is shortly denominated *Life* or *Vitality*, is exemplified in a Plant, when it adds to itself portions of the soil in which it is placed, and converts them into wood, and bark, and leaves, &c.; or in an Animal when it takes to itself food, and changes it into bone, and muscle, and skin, and so forth. The soil in the one case, and the food in the other, is the *foreign* matter;

and the introduction of this matter into the system of the Plant or Animal, and its subsequent conversion into wood or bone, &c., constitutes its *appropriation.* As long as this process goes on in the Plant or Animal, it is said to be *Living* or *Alive*, or to possess *Life*; the instant it ceases, it is denominated *Dead.*

Some Bodies, such as those commonly known by the name of *Minerals*, have always existed in the *Dead* state; no appropriating process, for example, has ever been discovered in a piece of Marble or of Iron. In others, the process of *Life* is occasionally renewed, after a *Temporary Death* of minutes or of centuries.

The object of this continual appropriation of foreign matter, by which *Living Bodies* are distinguished, appears to be, to maintain in these Bodies such a constitution, as shall enable their various parts, to exercise properly the functions which the Creator intended them to perform;—to preserve, for example, a certain degree of hardness, roughness, or opacity in one organ; and of softness, smoothness, or transparency in another;—to enable one species of fibre to exercise Irritability; and to qualify another for being the material instrument, through which the immaterial and spiritual Mind may influence the Body, or the Body the immaterial Mind. But it would be foreign to the purposes of this Introduction, to enlarge on these views at present. It is sufficient, simply to have pointed out the process, by which Living Bodies are essentially characterized. It belongs to Physiology to investigate the uses of this process, and the phenomena from which its existence may be inferred.

Living Bodies, as every one knows, are divided into two great classes, *Animals* and *Vegetables*.

Those *Living Bodies* are denominated *Animals*, which appear to be capable of *Sensation* and *Ideas*, or of *Feeling* and *Thought*; and those, *Vegetables*, which do not seem susceptible of these phenomena.

Sensation and *Ideas* are states which require no explanation. It is to be remembered, however, that, as they are phenomena which no man can perceive, or be conscious of, but in himself, their occurrence in other Living Bodies, must always be to us, matter of inference only, not of actual knowledge. It is on this account, that an *Animal* is defined to be, a Living Body which *seems to be* susceptible of *Feeling* and *Thought*. It is the business of Physiology to shew, that the only foundation of this inference with respect to any particular Living Body, is, a certain resemblance in the motions which it exhibits, to motions, which we know to be dependent upon *Sensation* and *Ideas* in ourselves.

I PROPOSE to denominate the science which treats of *Living Bodies*, *Vital Economy*. This science will divide itself into two parts, *Animal Economy*, and *Vegetable Economy*; and each part will comprehend two distinct objects of investigation, *Anatomy* and *Physiology*.

Anatomy occupies itself, solely, with the Structure of *Living Bodies*; and the province of *Physiology*, is now universally restricted, to the investigation of their Functions.

It is usual to consider the Structure and the Functions of the Human Body, apart from those of the Lower Animals. Hence has arisen the division of *Anatomy* and *Physiology*, into *Human* and *Comparative*. This arrangement, I shall strictly observe.

The whole divisions and subdivisions of the Science of *Vital Economy*, may be exhibited in the following plan :

- VITAL ECONOMY.
  - Animal Economy.
    - Animal Anatomy.
      - Human Anatomy.
      - Comparative Anatomy.
    - Animal Physiology.
      - Human Physiology.
      - Comparative Physiology.
  - Vegetable Econom
    - Vegetable Anatomy.
    - Vegetable Physiology.

BEFORE entering on the proper subject of the present Work, one or two observations, relative to Nomenclature, require to be premised.

By the Period of *Impregnation*, or *Conception*, is uniformly meant, the moment at which a Child or Infant Being, begins to be formed within the Womb of the Mother.

While the Child is yet retained within the Womb, it is denominated a *Foetus* or *Embryo ;* the term *Embryo*, however, being chiefly applied to it, in the earlier stages of its existence.

The end of the ninth month after *Conception*, which is the natural *Period of Birth*, is often denominated the *Full Time.*

The inhabitants of Great Britain, and of Europe in general, are usually *Full Grown* or *Adult*, at the age of twenty-five or thirty years. This is the period of Life, therefore, which I wish to be understood as denoted by the term *Adult Age*, or *Maturity*.

All the descriptions throughout the Work, are to be considered as applicable to the *Adult Male*, unless when the contrary is expressly specified.

To regulate the interpretation of the terms *Above*, *Below*, *Before*, *Behind*, &c. I shall uniformly suppose the Body to be in the Erect Posture, with the Arms Hanging parallel to the Trunk, and the Palms of the Hands, and the Toes, turned directly forwards. This is a simple remedy, and the only effectual one, for the trifling ambiguity which might otherwise attend the use of these terms.

PART I.

OF THE EXTERNAL FORM, STATURE, AND WEIGHT OF THE BODY.

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OF THE EXTERNAL FORM, STATURE, AND WEIGHT OF THE BODY.

BOOK I.

OF THE EXTERNAL FORM OF THE BODY.

A FORMAL description of the External Appearance of the Human Body in its Full Grown state, is altogether unnecessary; it may be presumed to be familiar to every one.

For the sake of greater clearness, however, in describing the situation of the more internal parts, I propose, with the aid of the Engraving at the end of the Volume, to fix the limits of the External Regions of the Body, a little more precisely than has hitherto been done.

Adopting, therefore, the popular and well-marked division of the Body, into *Head*, *Trunk*, and *Extremities*, the following may be regarded as the Regions of each.

Regions of the Head.

A. The *Brow* or *Forehead;* the space *a*, towards the middle and lower part of it, being called *Glabella.*

B. The *Occiput* or *Hindhead;* its most prominent point backwards, being denominated the *Occipital Protuberance.*

C. The *Crown* of the Head; the most prominent point *b*, on each side of it, being called the *Parietal Protuberance.*

D. The *Temple*, on each side of the Head.

E. The Region of the *Eye*, on each side of the Head.

F. The Region of the *Nose.*

G. The Region of the *Mouth.*

H. The *Chin.*

I. The *Cheek*, on each side of the Head; its most prominent point above and laterally, being called the *Malar Protuberance.*

K. The *External Ear*, on each side of the Head.

The term *Face* is applied to all that part of the Head, which includes the Regions of the Brow, Eyes, Cheeks, Nose, Mouth, and Chin.

Regions of the Trunk.

L. The Region of the *Neck;* bounded on each side, below and before, by the ridge called the *Collar.*

M. The *Breast.*

N. The *Epigrastium*, or *Epigastric Re ion*, at the upper and middle part of which, there is a slight depression, called the *Pit of the Stomach*, or *Præcordia.*

O. The *Umbilical Region.*

P. The *Hypogastrium*, or *Hypogastric Region.*

Q. The *Pudendal Region;* of which the upper part *d*, is called the *Pubes*; and which comprehends below this, the *Penis* and *Scrotum*, the *Perinæum*, and the *Anus* in the Male; and the *Vulva*, *Perinæum*, and *Anus* in the Female.

R. The *Side*, Right and Left; of which the lower part *e*, is called the *Flank.*

S. The *Back;* the space *f*, on each side of it below, being called the *Loin* or *Lumbar Region.*

Regions of the Extremities.

Of the Upper Extremities.

T. The *Shoulder.*

U. The *Arm.*

V. The *Forearm*, its most prominent point *g*, above and behind, being the *Elbow.*

W. The *Wrist.*

X. The *Hand;* in which the prominence *h*, in the Palm, is called the *Ball of the Thumb;* and *i*, the Ball of the Little Finger.

Of the Lower Extremities.

Y. The *Haunch.*

Z. The *Hip* or *Buttock.*

A. The *Thigh ;* which is separated from the *Hypogastrium* and *Pubes* by the hollow k k, called the *Groin.*

B. The *Knee.*

C. The *Ham.*

D. The *Leg.*

E. The *Ancle ;* in which the prominence *l* is the *External,* and *m,* the *Internal Malleolus.*

F. The *Foot ;* in which the prominence *n,* in the Sole, is called the *Ball of the Heel ;* and *o,* the *Ball of the Great Toe.*

Very few enjoy opportunities of ascertaining, the gradual changes which take place in the External Form of the Fœtus, during the earlier periods of its developement. Anatomists are, therefore, the more indebted to Soemmering, for the excellent series of Engravings, in which he has represented these changes, from the first to the fifth month after Impregnation *.

In this series, an Embryo only three or four weeks old, looks, to the naked eye, like a mustard-seed, which has just begun to grow; the Head being like the body of the seed, and the Trunk and remaining parts like the radicle. But with a magnifying glass, a little dark circle can be distinctly seen in the region of theEyes, and a small slit corresponding to the orifice of the Mouth. Four little prominences are observable on the Trunk, in the situation of the four Extremities; and between the two lower, there is a curious prolongation like a tail, which has been called the *Coccygeal Protuberance*.

In an Embryo of about seven weeks, the proportional size of the Head is so much less, that the peculiar form of the Human Body is quite apparent. Two small pores are perceptible in the Region of the Nose; and the upper Extremities seem divided into Arm and Forearm.

In an Embryo of about eight weeks, a small pore may be discovered, by the microscope, in the Region of each Auricle; a Shoulder, Arm, Forearm, and Hand, with five small tubercles in the situation of the Fingers, can be easily distinguished with the naked eye; and in the lower Extremities, parts can be seen corresponding to the Thigh, Leg, and Foot; but there is no appearance of Toes.

* Icones Embryonum Humanorum.

In an Embryo of about nine weeks, there is a projection in the Region of the Nose; part of the Auricles is formed; the Toes have appeared; the Pudenda begin to be distinguished; and the Coccygeal Protuberance has vanished.

After this, considerable changes take place in the External appearance of the Fœtus, in proportion as the developement of the different parts advances; but it would be impossible to convey an idea of these without the assistance of engravings. Hair generally begins to appear on the *Eyebrows* and in the Regions of the Hindhead and Temples, about the end of the fifth month.

According to the observations of SOEMMERRING, the younger the Fœtus, the larger is its Head compared to the other parts of its Body, the smaller its Face in proportion to the other parts of the Head, and the smaller its Limbs relatively to the Trunk. During the first, second, and third months, he has remarked that the Upper Extremities are larger than the Lower; but that about the fourth, they are equal; and that towards the fifth, the Lower have become larger than the Upper.

The same excellent author has pointed out the following distinctions, in External Form, between the Male and the Female Fœtus. The Head of the Male differs from that of the Female, in being larger in proportion to the whole Body, less rounded, flatter in the Crown, and more prominent behind. In the Male, the Breast is considerably more prominent than the Umbilical Region, while in the Female it is the reverse; and this is a distinction which is very perceptible even in the youngest Fœtuses. The Trunk of the Body, between the upper parts of the Loins, is arched in the Male, while in the Female it exhibits a depression; and this, too, is a difference, which SOEMMERRING has remarked at a very early period after Conception. The Upper Extremities in the Male are a little longer, in proportion to the Trunk, than in the Female; the Arms are less cylindrical;

the Forearms fuller; the Wrists broader; and the ends of the Fingers less pointed. The circumference of the Body, at the Haunches, is less, in the Male, than in the Female; the Thighs are more slender; the Feet are longer; the Malleoli and Heels are more prominent; and the Great Toe exceeds the others much more in length.

The various changes which take place in the External Appearance of the Human Body, both between Birth and *Maturity*, and between *Maturity* and the Decline of Life, require no description.

BOOK II.

OF THE STATURE OF THE BODY.

The mean Height of the Male at the period of Maturity, appears to be about 5 feet 8 inches, English Measure. If this be not the precise average, it is, I imagine, rather above than below it. The following table exhibits the comparative average dimensions of particular parts.

	In.
Height of the Body	68
From the tip of one Middle Finger to the tip of the other, the Upper Extremities being extende , laterally, to a right angle with the Trunk	68
From the Crown of the Head to the top of the Pubes	34
From the Crown of the Head to the lower margin of the Chin	9.75
From the lower margin of the Chin to the top of the Breast	3.85
From the top of the Breast to the Pit of the Stomach	6.8
From the Pit of the Stomach to the Navel	6.8
From the Navel to the top of the Pubes	6.8
From the top of the prominence of the Shoulder, to the fold of the Elbow	12.6
From the fold of the Elbow, to the top of the Hand	10.2
The Hand, measured in the Palm, from the lower fold of the Wrist, to the point of the Middle Finger	7.75

	Inch.
From between the Pudendal Region and the inside of the Thigh, to the Joint of the Knee on the inside	14.6
From the Joint of the Knee on the inside, to the Sole of the Foot	18.5
The Foot, measured on the Sole from the posterior margin of the Heel, to the point of the Great Toe	9.75

THE average Height of the Female, at the period of Maturity, seems to be about 5 feet, 5 inches; and the length of the different regions is proportionally less than in the Male.

THE Embryo of three or four weeks, represented by SOEMMERRING, and which we have already compared to a mustard seed just beginning to grow, measures only about $\frac{1}{8}$ of an inch.

At the sixth week, an Embryo examined by WRISBERG*, measured from $\frac{13}{20}$ to $\frac{13}{24}$ of an inch.

At the seventh week, an Embryo represented by SOEMMERRING, is only $\frac{5}{8}$ of an inch.

At eight weeks, an Embryo represented by the same, measures $\frac{7}{8}$ of an inch.

At nine weeks, an Embryo represented by the same, is $1\frac{1}{2}$ inch.

At ten weeks, an Embryo represented by the same, is $2\frac{1}{4}$ inches; and one of the same age described and delineated by WRISBERG†, measured $2\frac{1}{12}$ inches.

An Embryo delineated by SOEMMERRING, of about eleven weeks, measures 3 inches.

At the twelfth week, an Embryo represented by the same, is about $3\frac{1}{2}$ Inches.

* De Vita foetuum, &c.

† Descriptio Anatomica Embryonis.

About the middle of the fourth month, an Embryo represented by the same, is 5 inches; and one at the end of this month, is 8 inches.

A Fœtus represented by the same, and said to be of the fifth month, is 10 inches in length. According to Mr. BURNS*, however, the Fœtus is only about 6 or 7 inches in the fifth month; in the sixth, about 8 or 9 inches; in the seventh about a foot; and in the eighth about 15 inches.

At the *Full Time*, that is, at the end of nine months, or the natural period of Birth, the Foetus measures on an average, according to the observations of ROEDERER†, about 20½ inches. This, at least, was the mean length of sixteen Male, and eight Female, children, born at the regular period; the longest measuring 21½, and the shortest, 18¼ Inches.

Dr. CLARKE‡ measured the Heads of sixty Male, and sixty Female, children, born at the Full Time; and he found that the circumference, passing through the Occipital Protuberance and the middle of the Brow, was, on an average, 13.8 inches; while the arch from Ear to Ear over the Crown, was 7.32 Inches. One Head measured 15 inches in circumference, and one 8½ inches from Ear to Ear; but none were under 12 inches in circumference, or 6¼ across.

The longest diameter of the child's Head at Birth, is that from the Crown to the Chin; and this seems in general to measure about 5 inches. The breadth of the Head, from one Parietal Protuberance to the other, is usually about 3½ inches.

According to SOEMMERRING||, the most rapid increase of the *Foetus* takes place during the first weeks after Con-

* The Principles of Midwifery, p. 121.

† Comment. Soc. Reg. Scien. Gotting. MDCCLIII.

‡ Phil. Tran. 1786.

|| Icones Embryonum, &c.

ception. He has observed, however, that the growth does not proceed in a uniform ratio; but that it is a little retarded, during the second month; accelerated, during the third; again somewhat retarded, at the beginning of the fourth; from the middle of the fourth to the sixth, again accelerated; and from this period till the end of the ninth month, once more retarded.

The Male and Female differ, in dimensions, even in the Foetal state. Roederer* found the mean length of sixteen Male children, born at the Full Time, to be $20\frac{10}{12}$ inches; and of eight Females, only $20\frac{4}{12}$ inches. Dr. Clarke† measured the Heads of sixty Male, and sixty Female Children born at the Natural Period, and he found that the circumference passing through the middle of the Brow and the Occipital Protuberance, was, on an average, 14 inches in the Males, and only $13\frac{5}{8}$ inches in the Females; and the Arch, from Ear to Ear over the Crown, $7\frac{1}{4}$ inches in the Males, and only $7\frac{1}{5}$ inches in the Females. Out of one hundred and twenty children, there were only six, in whom the circumference of the Head exceeded $14\frac{1}{2}$ inches, and these six were males.

Both Sexes have usually arrived at their full Stature at the period of Maturity. The changes which take place in the External appearance of the Body, between this period and the commencement of the Decline of Life, are perhaps more owing to slight alterations of Form in particular Regions, than to any very sensible difference of total Dimensions. But in the Decline of Life, there is, in general, an obvious diminution of Stature. The degree of the diminution varies very much in different individuals; but in all it seems to take place, to the greatest extent, in the Regions of the Head and Trunk. The Head is diminished in all its Dimensions, the Trunk chiefly in Length.

* Comment. Soc. Reg. Scient. Gotting. MDCCLIII.

† Phil. Trans. 1786.

BOOK III.

OF THE WEIGHT OF THE BODY.

At the period of Maturity, but still more remarkably towards Middle-Age, there seems to be the greatest variety in the Weight of different persons, even of the same Stature. From an examination, however, of a Register of the Weights of about fifty Full-Grown Males, of the average Stature, I am inclined to think, that the mean Weight of the Adult Male is about 140 lbs. English Troy.

I have had no opportunity of forming a satisfactory estimate of the average weight of the Adult Female; but I should suppose it to be about 30 or 40 lbs. less than that of the Male.

An Embryo of six weeks, which was examined by Wrisberg*, weighed only 37 grains: and one of ten weeks†, weighed about 3 drams.

According to Mr. Burns‡, an Embryo in the twelfth week, weighs, in general, about 2 oz; at the sixth month, about 1 lb; and at the eighth from 4 to 5 lbs Troy.

* De Vita Foetuum, &c.

† Descrip. Anat. Embryon.

‡ Principles of Midwifery, p. 121.

The average weight of the Foetus at the Full Time is about 7 lbs. Avoirdupois. Dr. Hunter* states, that, of several thousand new-born and perfect Children, which were weighed at the British Hospital in London by Dr. Macaulay, the smallest was about 4 lbs. and the largest about 11 lbs. 2 oz ; but by far the greater number were from 5 to 8 lbs. Avoirdupois. He adds, that he himself never knew an instance of a Child, born at the natural period, weighing 12 lbs. Avoirdupois. Of sixty male, and sixty female children, born at the Full time, which were weighed by Dr. Clarke†, the lightest was 4 lbs. and the heaviest 10 lbs ; and the average weight was 7 lbs. 13 dr. Avoirdupois. Roederer‡ weighed eighteen Male, and eight Female Children, born at the natural period ; and if the weights he employed do not differ materially from Avoirdupois, the average weight of the twenty-six Children, was about 6½ lbs ; the heaviest being 8 lbs. and the lightest about 5½ lbs.

Dr. Clarke found that the average weight of sixty male children, born at the Full Time, was 7 lbs. 5 oz. 7 dr. Avoirdupois ; and of sixty Females, only 6 lbs. 11 oz. 6 drams. He therefore, estimates the difference between the weight of the Male and Female at Birth, at about 9 oz. Avoirdupois. The results of Roederer's observations do not, probably, differ much from this estimate ; though I am uncertain as to the weights he employed. Supposing them to have been equivalent to Avoirdupois, the mean weight of eighteen Males, born at the Natural period, which he weighed at Birth, was 6 lbs. 10 oz. 3 dr ; and of eight Females, 6 lbs. 4 oz. 4 drams.

In cases of *Twins*, it would appear, that the weight of each Twin, is, in general, less than the average weight of *Single Children*, though their combined weight is greater. Dr.

* Anatomical Descrip. &c. p. 68.

† Phil. Transact. 1786.

‡ Comment. Gotting. MDCCLIII.

CLARKE found the average weight of twelve Twins to be 11 lbs. Avoirdupois, a pair; the heaviest pair weighing 13 lbs. and the lightest $8\frac{1}{2}$ lbs. MR. BURNS*, however, states, that he has known instances, in which each Twin was rather above, than under, the usual weight of a single child.

* Principles of Midwifery, p. 122.

PART II.

THE ANATOMY OF THE COMMON SYSTEMS AND COMMON TEXTURES.

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In almost all parts of the Body, certain tubes called *Blood-vessels* are found, which convey the Blood to these parts from the *Heart*, and return it from them to the *Heart* again. The *Heart* and the *Bloodvessels* together, therefore, form one System; which, from the important function of the Living Body, to which it is subservient, viz. the Circulation of the Blood, is denominated the *Circulating System*.

In almost all parts of the Body, too, certain tubes are found, which are constantly employed in *absorbing* substances from these parts, and are therefore called *Absorbent Vessels*, or *Absorbents*. These uniting one with another, at last form two Trunks, which open into Bloodvessels; and the whole constitute another System, denominated the *Absorbent System*.

Further, almost every organ in the Body, is supplied with certain filaments or cords, called *Nerves*, which are all, either directly or indirectly, connected with a *Central Mass*, consisting of the *Brain* and *Spinal Cord*. This *Central Mass* and the *Nerves* connected with it, form a third System, called the *Nervous System*.

These three *Systems*, the *Circulating*, *Absorbent*, and *Nervous*, as they are common to so many parts, I propose, for the sake of brevity, to call the *Common Systems*.

Again, there are certain substances, or textures, which, although they be not so general in their distribution or connections as the *Common Systems*, enter, notwithstanding, into the composition of many different parts of the Body. These may be denominated the *Common Textures*; and in this class I should be disposed to include, *Cellular Substance*, *Adipose Substance*, *Muscle*, *Skin*, *Hair*, *Cartilage*, *Bone*, *Tendon*, *Serous Membrane*, and *Synovial Membrane**.

There will be many advantages, in considering the Anatomy in general, of these *Common Systems* and *Common Textures*, before proceeding to treat of the structure of any individual part or organ in the Body.

This, therefore, will form the subject of the two following Books.

* Other Textures might, perhaps, have been admitted into this class. But I thought it better to include only those, of which the distribution was so general, as decidedly to entitle them to the appellation of *Common*.

BICHAT seems to me, to have arranged together, under the name of *Mucous Membranes*, Textures which differ most materially from each other. (See his Anat. Gen. IV.)

BOOK I.

OF THE ANATOMY IN GENERAL OF THE COMMON SYSTEMS.

CHAPTER I

OF THE ANATOMY IN GENERAL OF THE CIRCULATING SYSTEM.

This System consists of two parts; an Organ called the *Heart*, and a series of Tubes denominated *Bloodvessels*, communicating with this Organ. I shall treat of each of these separately.

Before entering on the consideration of either, however, it may be proper to apprise the reader, that no remarks are introduced into this Chapter, respecting the relative position, either of the Heart or of the Bloodvessels, to other organs. These properly belong to another Part of the Work. At present, we must confine ourselves, in all that relates to situation, merely to the consideration of general aspect. These observations apply equally, to the succeeding Chapters on the *Absorbent* and *Nervous Systems.*

SECTION I.

OF THE HEART.

This is an organ consisting of two cavities, completely separated from each other by a *Septum* or partition. Each cavity is formed into two compartments, called *Auricle* and *Ventricle*, which communicate freely with each other. Several *Bloodvessels*, denominated *Veins*, are connected with each Auricle, and one large one, called an *Artery*, arises from each Ventricle.

When moderately distended, the Heart resembles, externally, a three-sided pyramid.

The base is turned backwards, to the right, and a little upwards; the apex, forwards, to the left, and a little downwards.

The surface which looks downwards is flat; the anterior and posterior surfaces, are slightly convex. The anterior margin is sharp; the posterior and upper, a good deal rounded. The apex is obtuse, and, sometimes, a little forked.

The flat surface is about five inches in length, and its greatest breadth, about four. The greatest height of the other two surfaces is about three inches and a half.

The Auricles occupy, chiefly, the base of the Heart; a slight groove forming the line of separation, between them and the Ventricles, externally. They are placed, one behind the other; and the two Ventricles have the same relative position. From this arrangement, the Cavities of the Heart might be divided into *Anterior* and *Posterior*. But owing to the oblique position of this organ, the Anterior Auricle and Ventricle, are placed more to the right, than the Posterior; and, therefore, the four compartments are usually distinguished, by the terms *Right* and *Left*.

A slight furrow marks the division between the two Auricles externally. They differ a good deal from each other in point of shape; and the Right appears larger than the Left. Neither of them rises so high, by one half, as the upper angle of the Right Ventricle; but there is a little *Tip* or *Lappet*, which projects upwards from the superior, left, and anterior corner of the Right one, and from the superior, left, and posterior corner of the Left. It is this Lappet, which, from its resemblance to the tip of the dog's ear, seems to have given rise to the term *Auricle*. The Tip of the Right Auricle, has an even margin, and points a little backwards and to the right; the Tip of the Left, which is narrower, and is twisted like the letter *S*, has a notched margin, and points a little forwards and to the left.

The trunks of three *Veins* are usually seen opening into the Right Auricle; viz. the two *Cavæ (Venæ Cavæ,)* and the *Coronary Vein*. The *Superior Cava* enters at the right, upper, and anterior corner; the *Inferior Cava*, at the right, lower, and posterior one; and the *Coronary Vein* at the left, lower, and posterior corner.

Four *Veins* called *Pulmonary*, are seen entering into the Left Auricle. The two *Right Pulmonary Veins* enter at its right and anterior angles; and the two *Left*, at its right and posterior angles.

The boundaries between the two Ventricles externally, are marked by two superficial furrows, one below and another above. The former runs nearly parallel to the groove dividing the Auricles, but is a little farther forward; and the latter, beginning immediately before the tip of the Left Auricle, extends to the left and a little forwards, and then passing over the apex of the Heart, is continued into the one below.

One large Artery, called the *Pulmonary Artery*, is seen arising from the Right Ventricle at its upper angle; and from a point of the Left Ventricle, immediately underneath this of the Right, another large Artery takes its origin, denominated the *Aorta*.

The whole outside of the Heart is quite smooth. The colour of the Ventricles, at those parts where there is no Adipose Substance between the Serous and the Muscular Coat, is a brownish-pink, interspersed with whitish lines of different sizes, which are caused by the ramifications of Bloodvessels, and Absorbents, and Nerves. The Auricles are usually paler than the Ventricles. The Fatty parts in both are always straw-coloured.

When we lay open the Right Auricle to examine its cavity, we observe, in the first place, that its posterior surface is of a whitish colour. Towards the lower part of this surface, there is an elliptical, but very superficial depression, which slopes a little backwards, and is called the *Oval Fossa.* This *Fossa* is about half an inch long, and the third of an inch broad, with smooth edges, and having its long diameter turned upwards and downwards. Its size, however, varies very much in different individuals, and frequently it is entirely wanting.

From what has been affirmed by several Continental Anatomists, on whose accuracy I am inclined to place considerable reliance, I am disposed to believe, that, in most instances, there is a small slit, sufficient to admit the point of a probe, immediately behind the upper margin of the Oval Fossa, leading upwards and a little to the left, into the Cavity of the Left Auricle. At same time, this is contrary to my own experience hitherto.

On the fore part, the Auricle exhibits a sort of net-work of smooth, pinkish-coloured, cords, which run chiefly in a direction from right to left.

On the upper surface of the Auricle, is seen, the orifice of the Superior Cava, having an inclination downwards, and a little forwards; and to the left of this, we find a cavity, extending into the Tip of the Auricle, the whole surface of which exhibits a net-work, like that on the forepart of the Auricle, but, composed of smaller cords, and more irregular.

On the lower surface of the Auricle, we remark, in the first place, towards the back-part, the opening of the Inferior Cava. Immediately to the left of this, is a thin, whitish, crescentic fold, denominated the *Eustachian Valve.* The posterior horn of this Valve is connected with the left edge of the Oval Fossa, and the anterior, with the right surface of the Auricle, directly above the opening of the Lower Cava; so that it runs from behind obliquely forwards and to the right. Its free, curved, edge, looks upwards and a little backwards; and one surface of it is continuous with the left and anterior side of the Inferior Cava, while the other is turned towards the left and fore part of the Auricle. Were it prolonged straight upwards, it would run into the upper margin of the Oval Fossa; and even, as it is, when we look into the Auricle from before, it cuts off from our view, the lower half of this Fossa. The breadth and thickness of this Valve, vary extremely. Sometimes it is nearly half an inch broad, at other times scarcely perceptible; in some, it is as thick as a wafer at its attachment, but tapering towards its edge, and without any holes in it; in others, it is as thin as silk paper, transparent, and quite reticulated.

Immediately to the left of the posterior extremity of the Eustachian Valve, is the orifice of the Coronary Vein, looking forwards and to the left. Its margin, also, below and to the right, is provided with a *Valve;* the posterior horn of which, usually runs into the corresponding horn of the Eustachian Valve, while the free, crescentic edge, looks upwards and to the left. Like the Eustachian Valve, however, it varies very much in its dimensions. Sometimes, in place of it, there is merely a slight ridge; at other times, it is so broad, as to cover almost entirely the orifice of the

Vein. It is frequently notched at its margin, and full of holes.

Anterior to these parts, the lower surface of the Auricle begins to exhibit the same kind of lattice-work, which we found on the fore part.

The surface of the Auricle to the right, is smooth and pale coloured.

The left side of the Auricle presents a large circular hole, about an inch and three fourths in diameter, with a smooth, white, shining circumference, leading into the Cavity of the Right Ventricle. This is denominated the *Auricular Orifice* of the Ventricle.

The cavity of the Right Ventricle resembles somewhat the hollow of a three-sided pyramid; the base and the point, corresponding to the basis and the apex of the Heart. The lower side of the cavity is flat, the posterior a little convex, and the anterior slightly concave. The Upper angle of the base gives origin to the Pulmonary Artery.

The whole surface of this cavity, except towards the Upper Angle, presents an extremely intricate net-work of smooth, rounded, and flat, *Fleshy Columns*, of various sizes. Some of the Columns are attached by both extremities to the sides of the cavity, but quite free in the middle, so that a probe may be passed under them. These are found chiefly towards the Apex of the Ventricle; where many of them may be seen crossing, in every direction, from one side of the cavity to the other. Others remain attached by one side, throughout their whole length, to the surface of the Ventricle, and have the appearance of ridges. These intersect each other in various directions, and leave hollows between them, in the bottom of which are seen smaller ridges, crossing each other, in a similar manner. Other columns, again, have one extremity attached to the surface of the Ventricle, while the other projects, in a pointed form, into its cavity, and gives origin to certain *Tendin-*

ous Cords, that go to be attached to the edge of the *Tricuspid Valve* immediately to be described. These are larger than the other Fleshy Columns, and are, in general, three or four in number. The largest arises from the middle of the anterior side of the Cavity, and the other two or three, from the middle of the inferior side, or of the angle between that and the posterior. Lastly, some of the Columns are usually found inserted into the outer surface of the Tricuspid Valve, towards its root.

The size and distribution, however, of all these Columns, vary very much in different individuals; and the whole appearance of the net-work, is never precisely the same, in any two subjects.

Towards the Upper Angle of the Ventricle, the surface becomes gradually smoother, and sometimes the ridges disappear altogether. This smooth surface terminates in a circular opening, looking upwards, backwards, and to the right, from which the Pulmonary Artery springs, and which is denominated the *Arterial Orifice* of the Ventricle. The three *Semilunar Valves* which are found here, partly attached to the margin of the opening, will be afterwards described along with the Pulmonary Artery.

Occupying the lower and posterior part of the base of the Cavity, and separated from the Upper Angle only by a smooth fleshy ridge, is the *Auricular Orifice* of the Ventricle.

Attached to the circumference of this orifice, all round, there is a sort of curtain of a white, thin, semi-transparent substance, quite pliable, but very tough and strong, which is folded towards the Ventricle. Its opposite margin is formed into three unequal *Flaps*, of a parabolic shape, and hence the name *Tricuspid Valve* has been given to it. These Flaps correspond in situation to the three sides of the Ventricle; the Anterior which is the largest, is applied close to the anterior side; the Posterior, the next in point of size, is folded back on the posterior surface; and the Inferior, which is the smallest, lies on the lower side of the Ventricle.

The free margin of the Valve, however, does not float loose within the cavity of the Ventricle. A number of small white, tough threads, called *Tendinous Cords*, arising, some from the projecting extremities, and others from the sides, of certain of the Fleshy Columns, branch off in every direction into smaller threads, which again ramify in various ways, and go at last to be inserted into the edge of the Valve along its whole extent; so that it looks as if it were fringed with a sort of net-work. Several of the threads, however, are often found inserted into the outer surface of the Valve instead of the margin.

The lower edge of the Anterior Flap, and the anterior edge of the Lower one, are in general attached to three or four Tendinous Cords, which arise from those Fleshy Columns, that spring from the anterior side of the Ventricle. Three or four Tendinous Cords, arising from the Columns which project from the lower side of the Ventricle, send off the little threads which are inserted into the posterior edge of the Lower Flap, and the lower edge of the Posterior one. The threads which are attached to the upper margins of the Anterior and Posterior Flaps, are all derived from five or six Tendinous Cords, which arise from the sides of some of the superficial ridges or small fleshy papillæ, that are to be found immediately below the smooth surface leading to the Upper Angle of the Ventricle.

But besides these Tendinous Cords, the extremities of some Fleshy Columns are often found directly inserted into the outer surface of the Valve, towards its root. It is generally the Lower and Anterior Flaps of the Valve which have these connections.

In consequence of the shortness of the Tendinous Cords, the Valve, even when the Ventricle is only moderately distended, is kept closely applied to the sides of the Cavity. It is only by compressing the Ventricle, in all directions, that we can make the Flaps fold together so as to shut up the Auricular Orifice; and unless the Tendinous Cords be completely cut across, it is impossible to force them beyond this Orifice, towards the Auricle. When these Cords, however, are divided, and the Flaps of the Valve are then properly folded together, we shall find that they are of sufficient size to close the Auricular Orifice entirely, even when the Ventricle is distended to the utmost.

The cavity of the Left Auricle is smooth on all sides and of a pale colour.

At the two right and anterior angles are seen the orifices of the two Right Pulmonary Veins, and at the two right and posterior angles, the openings of the two Left Pulmonary Veins.

At the left, upper and posterior angle, a cavity is observed extending into the Tip of the Auricle, which when laid open, is found to correspond in shape to the Tip viewed externally. It exhibits on its surface a kind of net-work similar to that in the Tip of the Right Auricle, but simpler, and composed of whiter and more superficial ridges.

The whole left side of the Left Auricle, is formed into an orifice, which leads to the Left Ventricle. This is denominated the *Auricular Orifice* of the Left Ventricle.

It is circular in its shape, about half an inch less in diameter than the Right Auricular Orifice, and has a smooth margin, all round.

The cavity of the Left Ventricle resembles an elliptical cone, the Base and Apex corresponding to the Base and Apex of the Heart, and the long diameter of the cross section running from before backwards.

The whole surface of this cavity presents a net-work of Fleshy Columns, similar to that in the Right Ventricle, although there is a considerable difference between them in the shape, and size, and interweaving of the Columns It would not be easy to give an exact idea of this difference, in words; but the Columns are, upon the whole, smaller and rounder; they are no where seen stretching across the cavity from one side to the other, as in the Right Ventricle; and the intersections of the more superficial Columns, correspond better with those of the Columns deeper seated, so that although the net-work be not deeper than that in the Right Ventricle, we see farther into it.

Two columns, however, considerably larger than any in the Right Ventricle, are seen arising, one from the middle of the upper, and another from the middle of the lower surface, close to the posterior edge of the cavity. These, after running a short way towards the Auriclar Orifice, terminate in a projecting extremity which is usually divided into a number of papillae. They differ a good deal in shape in different individuals; and in some they are much deeper cleft towards the middle, than in others. The one arising from the upper side of the Ventricle is generally the larger; and this one also is, in most instances, divided at its projecting extremity, into three parts.

From these Fleshy Columns a set of Tendinous Cords arise, which go to be attached to the *Mitral Valve*.

This Valve corresponds to the Tricuspid Valve in the Right Ventricle. It is connected to the circumference of the Auricular Orifice, which occupies the posterior part of the base of the cavity; but instead of three, its floating edge is divided only into two *Flaps*, parabolic in their shape, and somewhat like the two segments of a mitre; hence the name given to it of *Mitral Valve*.

It is white, pliable, and strong like the Tricuspid Valve; equally thin in some parts, but much thicker in others, particularly towards its edge; and it is always folded towards the Ventricle.

One Flap of the Valve is attached to the anterior half of the margin of the Auricular Orifice, and lies towards the anterior edge of the cavity of the Ventricle; the other arises from the posterior half of the Auricular Orifice, and looks towards the posterior edge of the cavity. Their bases are of nearly equal length; but the Anterior Flap projects fully twice as far into the Ventricle, or is twice as long, as the Posterior.

Tendinous Cords like those of the Tricuspid Valve, and arising from the Fleshy Columns just described, are inserted into the whole margin of the Mitral Valve, and several into its outer surface. They are considerably thicker than than those in the Right Ventricle, and in proceeding to their attachment do not branch off into so many smaller threads. From eight to ten in general arise from the extremity of the Fleshy Column which springs from the upper side of the Ventricle, and these are inserted into the upper edge of each of the Flaps, and partly into their outer surface. From ten to twelve arise in a similar manner from the lower Fleshy Column, and are inserted into the lower margin of each of the Valves, and some also into their outer surface.

These Tendinous Cords, like those belonging to the Tricuspid Valve, are too short to allow the Flaps to be folded towards the Auricular Orifice, when the Ventricle is in a distended state; but if we divide the Cords, and then pull the Flaps towards the Auricle, we shall find that they are more than sufficient to shut up this orifice completely.

In the base of the cavity on the fore-part of the Auricular Orifice, and concealed, in the distended state of the Ventricle, by the Anterior Flap of the Mitral Valve, there is a smooth surface leading to a circular opening, which looks to the right, and a little upwards and forwards. This is called the *Arterial Orifice* of the Ventricle; and from it the Aorta springs. It is placed immediately underneath the Upper Angle of the Right Ventricle.

In the Heart, as we usually find it after Death, the Cavities of the Ventricles are always larger than those of the Auricles. The Cavities, also, of the Right Side, in general, appear to the eye larger than the corresponding Cavities on the Left; though in a much less degree in some cases than in others. In some instances they seem pretty nearly alike.

None of the experiments which have hitherto been made*, with a view to measure the capacity of these Cavities in the state in which they are found after Death, are perfectly satisfactory. In some, we are uncertain, whether precautions were taken to prevent the fluid employed in the measurement, from escaping by some of the Bloodvessels communicating with the cavities; in others, it is doubtful whether the Coagula which often form in these cavities after death, and greatly diminish their capacity, had been carefully removed; in others again, the fluid employed was calculated to extend the parietes of the cavities too much by its weight.

In several experiments in which these precautions were attended to, I found that the Right Ventricle contained $2\frac{1}{2}$ oz. of Water, while the Left contained only 2 oz; but further trials are necessary relative to this point.

The posterior surface of the Right Auricle, and the anterior surface of the Left, are formed by the opposite sides of a common *Septum*.

This Septum towards its edge is more than an eighth of an inch in thickness; but it becomes gradually thinner towards the part corresponding to the Oval Fossa, where it is seldom thicker than a wafer.

The insertion of the other sides of the Auricles into the margin of this Septum, gives rise to that furrow seen ex-

* See SENAC, Traité, &c. I. 189. HALLER, Elem. Phys. I. 323-7. LE GALLOIS, Diction. des Sciences Medicales, V. p. 434.

ternally, by which the Auricles are distinguished from each other.

The remaining sides of the Right Auricle, except where there is any of that net-work of Fleshy Cords formerly described, are about an eighth of an inch thick; but in the furrows between these Cords, they are so thin as to be semitransparent; and opposite the Cords themselves, they are sometimes nearly a quarter of an inch in thickness.

The other sides of the Left Auricle, are, every where, about an eighth of an inch; excepting at the Tip, which is thinner, particularly opposite to the furrows which were described on its inner surface.

The posterior surfaces of the Right Ventricle, and the anterior and upper third of the Left are formed by the opposite sides of a common *Septum*.

The edge of this partition looking towards the Base of the Heart, has its lower half continued into the left margin of the Septum of the Auricles, while the upper half is partly connected to the root of the Aorta, and partly to that portion of the base of the Right Ventricle which is betwixt the Auricular and the Arterial Orifice. The upper and lower margins of this Septum, have the corresponding edges of the upper and lower sides of each Ventricle attached to them; and it is along the course of this attachment, that the groove formerly described as pointing out the division between the Ventricles externally, runs.

The Septum of the Ventricles varies in thickness in different parts. It is no where less than a third of an inch; but opposite to some of the larger Fleshy Columns it is more. The thickest part is in general between those smooth surfaces in each Ventricle which lead to the Arterial Orifices. At the base, where it is connected with the Septum of the Auricles, and the other parts already mentioned, it is considerably thinner.

The Anterior and lower sides of the Right Ventricle are thinner than the Septum, being only about a quarter of an inch thick, except opposite to some of the larger Fleshy Columns. The thinnest part is in the Anterior side, towards the base of the Upper Angle leading to the Pulmonary Artery. The posterior and inferior sides of the Left Ventricle, on the other hand, are thicker than the Septum. They are in most parts fully half an inch thick, and opposite the larger Columns a good deal more.

The Heart is formed of the following Textures.

In the first place, the whole external surface of the organ is covered by a *Serous Membrane**, which is thickest and strongest on the Auricles.

Under this, at particular parts, is a quantity of *Adipose Substance* or *Fat* †, which, shining through the Serous Membrane, gives the Heart a straw colour at these parts. But the extent of surface which the Fat covers, and the depth of the Stratum, vary exceedingly. In most instances the Auricles are without any; but sometimes there are thin patches on their upper surface, and along the edges of the Lappets, and in the Right one, around the entrance of the two Cavæ. In general a ridge of it is found running round the side next the Ventricles of that groove which separates the Auricles and Ventricles externally; another thinner layer occupies the whole of that furrow which distinguishes the Ventricles from each other on the upper and under surface of the Heart; and usually there is a little papilla of Adipose Substance, projecting from the Apex. Very often, too, there are borders of Fat seen extending from these larger strata, along the ramifications of the Blood-vessels. Sometimes, the whole surface almost of the Ventricles is covered with a thick layer of it.

* See Anatomy of *Serous Membranes*.

† See Anatomy of *Adipose Substance*.

Under the Serous Membrane and Adipose Substance, and extending inwards so as to form the principal part of the Septum both of the Auricles and the Ventricles, is situated what is called the *Muscular Coat* of the Heart, upon which the thickness and strength of its sides chiefly depend. It is this Coat which, shining through the Serous Membrane at those parts where no Fat intervenes, gives the Heart its pinkish or purplish hue externally; and within the Cavities, the same Coat is seen still more distinctly and of a darker colour, through the delicate *Inner Membrane*.

As its name imports, it is composed of *Muscle**. The fibres are of a reddish brown colour, dryish, and with scarcely any intermixture of *Cellular Substance*†. A very fine, but pretty dense Cellular Substance, however, connects them to the Serous Membrane externally.

The thickness of this Coat at any particular part of the Heart, may be ascertained merely by examining the colour of a section of the parietes at that part; for the Muscular Texture is easily distinguished by its reddish hue. The usual thickness of the sides of the Heart has already been stated; and it will suffice for giving an idea of the thickness of the Muscular Coat to mention, that except where there is Adipose Substance, the whole parietes are constituted of the Serous Membrane, the Muscular Coat, and an *Inner Membrane* just to be described; and that the Serous and the Inner Membrane taken together, are not so thick as a wafer.

The distribution of the Muscular Fibres in the sides of the Auricles is most easily seen, by holding the sides between the eye and the light.

On the right side of the Right Auricle they run chiefly from before backwards; but in the lower, and the anterior,

* See Anatomy of *Muscle*.

† See Anatomy of *Cellular Substance*.

side, and in the Tip, they are collected into Fasciculi which constitute those ridges or cords formerly described on the inner surface. In the furrows between the ridges, the Fasciculi are connected only by a very few fibres, so that here, in many points, the Serous and the Inner Membrane are in contact with each other.

In the right and upper sides of the Left Auricle, the fibres seem to run chiefly from before backwards; and in the Tip they are fasciculated. In the lower side, they incline principally from right to left; and in the posterior, mostly from above downwards.

In the Septum of the Auricles, the fibres are very irregularly disposed around the margin of the Oval Fossa; and in the Fossa itself, there are in general a few Muscular threads, formed into an irregular net-work.

Some Anatomists have described the Muscular Fibres of the Ventricles with a most tedious and unprofitable minuteness*. It is sufficient to observe, that these fibres seem to be formed into three strata, which pass insensibly into each other.

The outer stratum, which is covered by the Adipose substance and the Serous Membrane, consists of fibres, which, at different parts of the Ventricles, are seen running for a considerable extent of surface, parallel to each other. On the outer surface of the Right Ventricle, for example, the fibres run from the right and from below, obliquely upwards and to the left. The fibres on the outer surface of the Left Ventricle again, are seen running from above and from the right, obliquely downwards and to the left. Along the groove between the Ventricles above, the direction of the fibres belonging to each, corresponds pretty exactly;

* SENAC, Traité, &c. I. p. 12, 181. WOLF, Acta Acad. Scient. Imper. Petrop. MCCLXXX-I; Acta Nova Ejusd. MDCCLXXXIII-VIII, MDCCXC-II.

so that many of them seem to pass over the groove, and to be continued from the one Ventricle to the other. Along the Inferior Furrow, the course of the fibres on each side does not correspond so nearly; accordingly they are distinctly seen intersecting each other.

The second or middle stratum consists of fibres which intersect each other in every direction.

The fibres of the third or innermost layer, seem to follow exactly the direction of the ridges and Fleshy Columns seen on the inner surface of the Ventricles, of which they constitute the greatest part.

In the Septum, there are two layers similar to the last of these three, one corresponding to each Ventricle; and between these a stratum similar to the second or middle one.

Within the Muscular Coat, and lining the whole inner surface of the Cavities of the Heart, is found what is denominated the *Inner Membrane.*

In the Ventricles, this membrane is as thin almost as the fibres of cotton, perfectly transparent, and without the slightest appearance of fibres. Neither Bloodvessels, Absorbents, nor Nerves, have yet been seen in it. Maceration in water, renders it slightly opaque. It is easily detached from the Muscular Fibres which it lines; but no intervening Cellular Substance, or such like medium of connection, can be seen between them. It is too tender to admit of being peeled off in large patches. Towards the tops of those ridges or Fleshy Columns which give rise to the Tendinous Cords, it is somewhat thicker and more opaque than at other parts.

In the Right Auricle, the Inner Membrane which lines the Fleshy Cords is quite similar to that in the Ventricles; but at all other parts of this Auricle, and over the whole of the Left, it has a different appearance. It is white and semi-transparent, and considerably thicker and stronger than the Serous Membrane. After slight maceration, it is disposed to peel in laminæ; but no fibres are perceptible in it; and so far as I know, no one has yet seen its Vessels or Nerves. It is firmly connected to the Muscular Coat by a fine Cellular Substance.

The Eustachian Valve and the Valve of the Coronary Vein, appear to be formed of doublings of the Inner Membrane of the Auricle. The former, however, generally contains a fasciculus of Muscular Fibres at its basis, which is included between the folds of the Membrane.

The structure of the Tricuspid and Mitral Valves is not so simple. A delicate prolongation of the Inner Membrane of the Auricles can indeed be easily traced over their inner surface; but I have never been able to detect any similar continuation of the Membrane of the Ventricles over their outer surface. They seem to consist of a fine but dense web of slender fibres continued from the Tendinous Cords. These Cords, as their name imports, are composed of *Tendinous Substance** ; and after they have been inserted into the Valves, they spread out and are interwoven within their substance in every direction, as may be easily seen by holding the Valves between the eye and the light. It is the intersection of these Cords just after their insertion, that causes those knots and ridges on the Valves, which are so common, particularly towards the margin of the Mitral Valve.

The Heart is supplied with *Arteries* entirely from two Arterial Trunks, denominated *Coronary* or *Cardiac Arteries*. These arise from the Aorta close to its origin, in a manner afterwards to be described.

The *Anterior Coronary Artery* is seen, immediately behind the Tip of the Right Auricle, entering the top of the groove between this Auricle and the Right Ventricle. It then runs along in the bottom of this groove, until it reaches the furrow between the Ventricles on the inferior surface of the Heart.

* See Anatomy of *Tendinous Substance*.

Into this, it turns at a right angle, and following its direction, terminates towards the Apex.

During the whole of this course, it is situated between the Serous Membrane, and the Muscular Coat, and is often surrounded with Adipose Substance. It gives off numerous branches to the Right, which are small, and supply the Right Auricle, some of them extending to the Cavæ. Branches equally numerous and greatly larger are sent off to the left, and are seen running in a tortuous manner, and ramifying on the surface of the Right Ventricle, from the basis towards the point. The largest of these, in general, runs along, immediately above the anterior acute margin of the Heart; and, several of its branches anastomose towards the Apex, with branches of the *Posterior Coronary Artery.* Just where the Anterior Coronary, too, is turning into the groove between the Ventricles, it sends off a pretty large branch, which is continued on into the furrow between the Left Auricle and Ventricle, and extends as far as the posterior margin of the Heart, giving off branches to the Auricle and Ventricle, in the same manner as the trunk from which it is derived.

All the branches of the Anterior Coronary Artery, which are distributed on the Ventricles, run at first between the Serous Membrane and the Muscular Coat; and it is not until they have ramified in this situation to the smallness of a pin, that they dip down between the Muscular fibres.

The *Posterior Coronary Artery* enters the furrow between the Ventricles on the upper surface of the Heart, immediately before the Tip of the Left Auricle. It runs along this furrow, winds round the Apex of the Heart, and terminates along with the Anterior Coronary on the inferior surface.

Just after entering the groove, this Artery gives off a branch, which gets into the furrow between the Left Auricle and Ventricle, and runs round until it meets with the branch of the Anterior Coronary formerly described, where it terminates. It supplies branches to the Auricle and the Ventricle.

All the remaining branches of this Artery are distributed on the Ventricles. The larger ones go to the Left Ventricle, coming off at acute angles, and winding obliquely round the posterior margin of the Heart. Smaller branches are distributed on the Right Ventricle; and others still smaller penetrate the bottom of the furrow directly, to supply the Septum.

This vessel, like the Anterior Coronary, runs between the Serous Membrane and the Muscular Coat; and all its branches ramify to an equal degree of minuteness, in this superficial situation, before they insinuate themselves between the Muscular fibres.

All the *Veins* of the Heart run into one trunk, called the *Coronary* or *Cardiac Vein*, which terminates in the Right Auricle.

This Vein is made up of three principal branches; a *Main* or *Posterior Branch*, a *Middle*, and an *Anterior*.

The *Main Branch* may be considered as beginning on the inferior surface of the Heart, close to the Apex, where it receives a number of small branches corresponding to the last ramifications of the Posterior Coronary Artery. It then turns up over the Apex, and follows the course of this Artery, becoming larger and larger in its progress, by the addition of new branches from the Right and Left Ventricles. At the top of the furrow between the Ventricles, it turns downwards into the groove between the Left Auricle and Ventricle, winds round in this, receiving branches from the Auricle and Ventricle all the way, and just before entering the Right Auricle, is joined by the *Middle* and *Anterior Branches*.

The *Middle Branch* begins at the extremity next the Apex of the furrow between the Ventricles on the inferior surface of the Heart. It runs along this furrow in company with the Anterior Coronary Artery; receives branches on each side during its course; and then opens into the left side of the *Main Branch* close to the Right Auricle.

The *Anterior Branch* begins towards the origin of the Anterior Coronary Artery, and runs along the groove between the Right Auricle and Ventricle with this Vessel. It receives branches on each side as it goes on, and then terminates in the *Main Branch*, immediately anterior to the *Middle* one; very often in the *Middle Branch* itself.

The *Coronary Vein* thus formed scarcely runs an eighth of an inch before it opens into the Right Auricle. At its termination it is about a third of an inch in diameter.

Very often the *Anterior Branch*, instead of commencing so far up as has been described, is much smaller, and begins in the groove between the Auricle and Ventricle, opposite the acute margin of the Heart. In this case, all the Venous branches coming from the Auricle and Ventricle above this point unite together into a distinct trunk, which running down along the Upper part of the groove just mentioned, opens directly into the Right Auricle, about the middle of its left Anterior margin. The orifice of this vessel within the Auricle is concealed by a part of the net-work of Fleshy Cords.

I have, also, occasionally seen another distinct *Coronary Vein* opening into the Right Auricle, immediately behind and above the Orifice of the principal Vein of this name. This vessel began before the Tip of the Left Auricle; run down behind the Artificial Orifice of the Left Ventricle to the Septum between the Auricles; and then passed obliquely through this Septum, towards its left margin, and opened at the point described, about the size of a crow-quill.

All the branches of the Coronary Veins which are larger than a pin, like the ramifications of the corresponding Arteries, are seen running superficially between the Serous and the Muscular Coat.

The *Absorbent Vessels* of the Heart are in general too small to be perceptible to the naked eye in their empty state. I have never seen them injected; but I rely with the utmost confidence on the accuracy of the description and representation of them which has been given by MASCAGNI*.

Various small branches from both surfaces of the Heart, unite together into several trunks, which run along its anterior and posterior margins. The trunks on the anterior margin uniting together, form a larger one, which ascends upwards towards the root of the Pulmonary Artery; while those on the posterior margin uniting in the same way, run up in the groove between the Left Auricle and Ventricle, towards the root of the Aorta. The two sets soon after join together, as will be more particularly described in another part of the work.

MASCAGNI mentions that they are best brought into view in thin subjects, by injecting the Bloodvessels of the Heart with glue coloured with cinnaber. The glue passes into the Absorbents uncoloured, and makes them turgid. But they may, also, be injected about the Apex with Mercury; and if the Mercury be forced backwards towards the smaller branches on every side, the whole may be filled to the utmost degree of minuteness.

All the branches now described lie between the Serous and the Muscular Coat.

In very thin subjects, a plexus of slender *Nerves*, may be seen through the Serous Membrane, accompanying the two Coronary Arteries throughout the whole of their course; or they may be more distinctly brought into view by peeling off the Serous Coat. They are easily distinguished from Bloodvessels or Absorbents by their whitish or

* Vasor. Lymph. Histor. p. 56.

yellowish colour; but if there is much Fat between the Outer and Muscular Coat, it is difficult to detect them at all.

They ramify with the ramifications of the Arteries, and at last penetrate with them, between the Muscular Fibres of the Auricles and Ventricles.

The plexus which accompanies the Posterior Coronary Artery, and which is chiefly distributed on the Left Ventricle and Auricle, is always larger, and composed of thicker Nervous Filaments than the anterior Plexus accompanying the Anterior Coronary Artery.

The Nervous branches which unite to form these two Plexuses, from which all the Nerves that are perceptible in the Heart are derived, will be described afterwards.

THE Heart of the Female differs from that of the Male, only in being a little smaller.

I HAVE not yet had an opportunity of observing, so fully as I could wish, the different peculiarities of the Heart before and after Maturity; and on consulting the numerous dissertations which have been written on this subject by other Anatomists, I find little on which I am disposed to rely. I shall therefore content myself at present with stating all that I have yet seen; hoping to be able to render the description more complete at some future time.

The only material difference which seems to exist in point of shape between the Heart of the Fœtus and the Adult, is what results from the greater proportional size of the Tips of the Auricles in the former. In a Fœtus of three or four months, these are so large that they almost come into contact over the Anterior part of the root of the Pulmonary Artery. As the Fœtus grows older, however, they gradually diminish proportionally; and after Birth, much difference in this respect from the Adult Heart is not perceptible.

The colour of the Heart is in general lighter the younger the subject. Perhaps this is chiefly owing to the thinness of the Serous Coat in the earlier periods of life. The Heart of the Fœtus never exhibits any white patches or bands, being always completely destitute of Fat.

I think I have observed that the Heart in old people generally acquires a deeper purple hue than it has at the period of Maturity.

In the Auricles of the Heart of a Fœtus, there is a very striking peculiarity. There is a hole in the Septum between them, occupying exactly the situation of the Oval Fossa of the Adult Heart, and denominated the *Oval Hole.*

The communication between the Auricles, however, through this hole, is not direct. For if we examine the Heart of a Fœtus about the fourth month, we shall find, that there is a thin, pellucid, Membrane, laid over the Oval Hole, like a Valve, on the side next the Left Auricle. The insertion of this Valve below, is into the very edge of the lower third of the Oval Hole itself; but above this, its attachment is into the surface of the Septum next the Left Auricle; extending farther and farther out from the margin of the Hole as it ascends, until it gets on a level with the upper extremity of the Hole, when it begins to incline inwards again, and after running a short way, ceases, leaving a free floating straight edge, turned upwards and a little to the left. This margin looks a little to the left, because the insertion of the Valve is continued a little farther up on the right side than on the left.

As this Valve then is longer than the Oval Hole, it is obvious that if it were stretched tight across it, like the parchment of a drum, it would prevent all communication between the Auricles at this point. But it is not disposed in this manner. On the contrary, it is twice as broad as the space included within the line of its insertion; so that it admits of being pushed a considerable way towards the cavity of the Left Auricle, from the Septum and the Hole. When this is done, a short canal is formed, between the upper part of the Valve and the portion of the Septum immediately above the Oval Hole, opening into the Left Auricle by an Orifice, of which the floating edge of the Valve forms fully two thirds. Through this canal, of course, the Auricles may communicate; but I have been much pleased to observe, (*Physiology* makes the application of the fact,) that the axis of this canal corresponds exactly, in every instance, with the axis of the Inferior Cava Vein; and that the Valve forms as it were the posterior side of this Vein continued.

Whether there be any period prior to the fourth month, at which the Oval Hole exists in the Heart of the Fœtus without the Valve, or at which the Valve is smaller, I have not yet had satisfactory means of ascertaining. But HALLER* mentions, that his friend BERGEN had found no Valve in a Fœtus of two months: And SENAC † believes that there is none prior to this at least; and expresses himself certain, that, if its rudiments exist at two months, they are extremely small. After this period, however, according to him, it grows by degrees, and its margin approaches nearer and nearer to the upper border of the Hole.

It is very probable that this description is correct; but as I have found, that the Valve even in the fourth month is very easily broken down, unless the Heart be dissected with great care, nothing but actual observation will satisfy me on this point.

The Hole and the Valve remain pretty nearly in the state

* Elem. Physiol. VIII. pars. 1. p. 375.

† Traité, &c. I. p. 281.

we have described, until about the commencement of the ninth month; when a remarkable change begins to take place in them. The Valve not only becomes gradually tighter, and its floating edge, of course, shorter, but its insertion approaches nearer and nearer to the margin of the Oval Hole; until, at the period of Birth, the attachment of the Valve corresponds almost exactly to the edge of the Hole; the Valve is stretched tight across the Hole like the parchment of a drum; and a small oblique *Slit* only is left at the upper end, by which the Auricles still communicate with each other.

The anterior surface of the Valve now forms the bottom of the Oval Fossa described in the Adult Heart. In the course of a few months after Birth, the *Slit* at its upper part diminishes so as only to admit the point of a probe, and in this state, it would seem, in general, to remain for the whole of after life, as was formerly remarked; though certainly, in a great many instances it is entirely closed.

The Eustachian Valve is subject to as much variety almost in point of size, in the Fœtal, as in the Adult Heart; in general, however, it is larger proportionally.

That the cavities of the Auricles in the Foetus, are larger, in proportion to the Ventricles, than in the Adult, is obvious to the eye; and this, no doubt, arises from the greater size of the Tips of the Auricles in the former. But the comparative capacities of the cavities on the Right and on the Left side at this period are not so easily ascertained. SENAC* says that those on the Right are larger, as in the Adult; and that about the sixth or seventh month, the Right Ventricle is even twice as large as the Left; but this is certainly incorrect. I confess they have generally appeared to me to be pretty nearly alike in point of size; or if there

* Traité, &c. I. p. 227.

was any difference between them, I have rather thought the superiority was with the Left.

In the Heart of a Foetus, still-born, before the Full Time, LE GALLOIS* found that the Right Ventricle held only 34 *grammes* of Mercury, while the Left contained 37; and in another, still-born, about the seventh month, he found that the Left Ventricle held 34 *grammes* of Mercury, and the Right only 23. But I do not rest much on these experiments; as it is doubtful whether they were performed in a satisfactory manner.

I think SENAC† is right when he says that the Auricles are proportionally thicker and stronger in the Fœtus than afterwards; but I doubt whether he be equally correct in stating, that between the third and fourth month the sides of the left Ventricle are thinner than those of the Right. They have always appeared to me thicker, as they are in the Adult; though less, in proportion, in the earlier months than towards Birth.

The Serous Membrane in the Fœtal Heart is so thin, that the course of the fibres in the Muscular Coat below, and of the superficial Bloodvessels and Nerves, is easily seen through it. The Muscular Coat itself is softer, and lighter coloured.

The Valve of the Oval Hole is said by many to consist of a doubling of the Inner Membrane of the Auricles; but I suspect it would not be easy to demonstrate this, by separating its two laminæ distinctly from each other. It is similar, however, to this membrane in structure; and in general does not exhibit any of those Muscular Fibres which are seen in the Oval Fossa of the Adult Heart.

* Diction. des Sciences Médicales, V. p. 440.
† Traité, &c. I. p. 227.

SECTION II.

OF THE ANATOMY OF BLOODVESSELS IN GENERAL.

THE tubes denominated Bloodvessels are of two kinds, *Arteries* and *Veins*.

OF THE ARTERIES.

THE whole Arterial System of the Human Body may be compared to the trunks and branches of two trees. One Trunk, denominated the Pulmonary Artery, arises from the Right Ventricle of the Heart, and the other, called the Aorta, springs from the Left. Both of these, at their root, are about an inch and a quarter in diameter, and their sides are about a twelfth of an inch thick. Immediately after their origin, they send off branches, which are distributed by successive ramification, to all parts of the Body, and divide at last into Vessels much smaller than the finest hair.

The branches as well as the trunks of Arteries, are in general of a cylindrical shape; but where an Artery divides into two large branches, we always observe that it swells out a little at the point of division.

The modes of ramification are very various. Sometimes an Arterial Trunk runs on for a considerable length, giving off branches in every direction, and yet not undergoing any diminution in size. At other times, and this is by far the most common mode, the Vessel ends by dividing into two or more large branches. These branches are sometimes equal, sometimes unequal, in diameter; but whatever be their relative size, it is invariably found, that their combined area is greater than the area of the trunk from which they spring. As to the ratio of this excess, I perfectly agree with SENAC*, that it is absurd to attempt ascertaining it with precision. It seems to vary in almost every instance.

The angles formed by Arterial branches and their trunks, are of all sorts. The acute angle, however, is the most common, and the obtuse the rarest.

Two arteries, derived from different trunks, often meet and are lost in each other; and this kind of connection is called *Inosculation* or *Anastomosis*.

Sometimes, though rarely, instead of simply passing into each other, they form a new trunk by their union.

After the Arteries have ramified to a certain degree of minuteness, they become so thin and transparent, that it is impossible to see them either with the naked eye or with the microscope. Sometimes, indeed, particularly in transparent parts, when the Blood happens to stagnate in them, after Death, we can trace them a little farther than when they are empty; but this does not often happen. In order, therefore, to render these minute capillary branches of the Arterial System visible, we are obliged to inject into them, through the larger trunks, some thin coloured fluid, such as a weak solution of glue mixed with Vermilion; and from injections of this sort, all our knowledge of the ultimate ramifications of the Arteries has been derived.

These ramifications are, of course, always best seen, in parts which are naturally transparent; but they may often be traced, also, to a very great degree of minutenes, on the surface of opaque parts, or in thin slices of these parts, rendered transparent by drying.

The varieties in the mode of their distribution, which we thus discover, depending on differences in the number, or length, or diameter, or curvature, or connexion of their little branches, are almost infinite. Every different Texture in the Body seems to have a mode of distribution of its own.

* Traité, &c. I. p 244.

At last, however, after gradually diminishing as they divide, all the capillary Arteries are seen to terminate in one or other of two ways; they either pass distinctly into the capillary branches of Veins, or end abruptly, unconnected with any other Vessel. Whether in this latter case, however, the Arteries do really terminate where they seem to do, is very doubtful. Perhaps they are continued much farther, and yet are imperceptible from their minuteness, even by the most powerful microscopes. But it is the province of Physiology, to state the various theories connected with this subject; we must confine ourselves, at present, to what is capable of demonstration.

The termination, then, of Arteries in Veins is the only one admitting of being satisfactorily demonstrated. I am aware, that some Anatomists* of very great reputation, have conceived, that they have seen the Arteries, in certain organs of the Body, distinctly terminating in a set of Vessels called *Excreting Ducts;* but although I have, at present, no doubt whatever that they do often end in this manner, I do not think that the point is sufficiently established, in the way of actual observation.

An Artery viewed externally, after it has been emptied of its contents, is of a whitish colour, and has a loose, flocculent appearance. Its inner surface, is every where perfectly smooth, like the surface of the Ventricles of the Heart; in the larger Arterial Trunks it is yellowish; in the middling Vessels, of a pinkish or flesh-colour; and in the smaller branches, whitish, like the outer surface.

The sides of an Artery are always thinner than the sides of the Artery from which it arises; but the ratio of the thickness of the sides to the area of the Vessel, in Arteries of the same external diameter, is very different in different parts of the System. It seems to me, for example, that the

* See in particular, RUYSCH, Opera II. Thes. Anat. Sext. No. LXXIII.

branches of the *Internal Carotid Artery*, have much thinner sides, in proportion, than the branches, corresponding in size, of the *External Carotid*.

Arteries are remarkable for their Elasticity. They are elastic both longitudinally and transversely. Whether they be uniformly more elastic in one direction than in another, has not been ascertained; but I have found, in some experiments on the Common Carotid, immediately after Death, that a force which extended this Vessel nearly one third transversely, stretched it only about a fifth in the longitudinal direction.

Mr. Hunter* was of opinion that the elasticity was proportionally greater in the large than in the small Arteries; but I am not disposed to place much reliance on his experiments relative to this point.

It is owing to their elasticity, that we never find the larger Arteries folded or collapsed after Death, even though empty. When cut out from the Body, they always appear as open cylindrical tubes.

Being desirous of forming some notion of the strength of an Artery, I cut out about two inches of the *Common Carotid* of a Man, twelve hours after Death, and inserting a bit of wood into each extremity of the tube, I secured the Artery to them with a waxed thread. One of the pieces of wood was then made fast, by means of a vice screwed to a table, and weights were suspended to the other, so that the Artery was stretched between them. It bore a weight of 30 lbs. Avoirdupois, before it gave way, which it did, close to the upper stick, where I have no doubt it was considerably weakened by the application of the thread.

A portion of the External *Iliac Artery* of a full grown man, tried in the same way, bore upwards of 48 lbs. before it broke. Like the former, however, it gave way close to

* Treatise on the Blood, &c. p. 124.

the extremity of one of the rods to which it was attached; so that in all probability, had it not been injured by the thread which fastened it, it would have sustained a much greater weight.

A transverse section of the vessel used in the first experiment, about three fourths of an inch long, and an eighth of an inch broad, when tied to rods of wood in the same manner, bore a weight of 5 lbs. before it broke. It gave way, however, exactly in the middle.

In general, I believe, Arteries are weaker the thinner their sides; but whether according to any uniform ratio, is very doubtful. WINTRINGHAM*, indeed, conceived he had established by experiment, that the trunks of Arteries were always weaker proportionally than the branches; but his experiments are not satisfactory.

All the Arteries in the Body which are not smaller than the twelfth of an inch, may be distinctly seen to be composed of three *Coats*.

The *Inner Coat* resembles exactly the Inner Membrane of the Ventricles of the Heart. It is equally thin, and perfectly transparent and colourless; and its inner surface is smooth. No Vessels or Nerves have yet been seen in it. It may be peeled off from the Middle Coat, which it lines internally, by means of a dissecting forceps; but it is too tender to separate in large patches. It differs from the Inner Membrane of the Ventricles in being a good deal more elastic.

The *Middle Coat* of an Artery is the thickest; being about twice the thickness of the *Outer* one; and this proportion, it seems to me to maintain, in the smaller as well as in the larger vessels.

It consists of a stratum of slender fibres laid closely together, side by side, without any intermediate connecting

* Experimental Inquiry, &c.

matter; and placed uniformly in a circular direction, surrounding the Artery, and in a plane perpendicular to its axis.

Those which are more internally situated, may be easily seen through the transparent Inner Coat of the Artery, by slitting open the Vessel. If this Coat be peeled off, the fibres of the Middle one may then be easily raised by the forceps in successive strips, all of which separate in a transverse or circular direction, exactly like the outer bark of a birch-tree.

In the large Arterial trunks the fibres are firmer in their consistence, and of a yellowish or straw colour; but as the Vessels diminish to a middling size, they become gradually softer and more flesh-coloured, and then resemble very much the Muscular Fibres of the Heart.

The Middle Coat of an Artery is abundantly supplied with small Bloodvessels. They are often seen turgid with Blood after Death; and they easily admit of being injected with coloured Size or Turpentine. I cannot say that I have ever seen either Absorbents or Nerves in this Coat.

No connecting medium can be perceived between the Middle Coat of an Artery and the Inner one. They are merely laid over each other, as the Inner Membrane of the Ventricle is laid over the Muscular Coat of the Heart.

The *External Coat* of Arteries differs extremely from the other two. It consists of slender white, shining fibres, like the fibres of cotton, very dense and tough, closely compacted together, and interwoven in every direction.

It is best dissected by slipping the Artery over a glass rod, so as to make it quite tight, and then tearing off the fibres with a pair of forceps, from without inwards. It requires considerable force to separate them; and no art will make them peel in any uniform direction. We judge that we have got through the whole of the Coat, when we come to a stratum of fibres of a yellowish or flesh-colour, soft and separating uniformly in a transverse direction; these are the fibres of the Middle Coat.

Between the two Coats there seems to be no connecting medium; but yet they adhere very firmly. The Middle Coat, however, is so much softer than the Outer, particularly in Vessels of a middling size, that if we slit up an Artery, and strip it through between the finger and thumb, we may scrape off the whole of the Middle Coat from the External, merely by pressing a little with the edge of the nail.

Numerous small Bloodvessels may be seen, every where, ramifying through the External Coat of Arteries, and sending branches inwards to supply the Middle Coat. Small branches of Absorbents, also, and minute twigs of Nerves, may sometimes be observed running along its outer surface; but it is difficult to trace them far into its substance.

The thickness of this Coat, varies much more than that of the other two. In some vessels, as in the *Vertebral Arteries* and the branches of the *Internal Carotid*, it is as thin almost as silk-paper.

It is greatly stronger than either the Middle or Inner Coat, and considerably more elastic. To call this, however, or any of the other Coats in particular, the Elastic Coat of an Artery, as has been done by some*, is obviously incorrect. They all possess this property in a considerable degree; else stretching an Artery, should always tear them asunder.

Mr. Hunter's† description of the structure of Arteries is rather vague. Bichat‡ describes the Inner Coat under the name of *Membrane Commune du Système à Sang Rouge*; the Middle one, he calls *Membrane Propre des Artères*; and the External, *Tissu Cellulaire*. His de-

* See Mr. Hunter, Treatise on the Blood, &c. p. 120.

† Same Book, p. 118.

‡ Anat. Gener. II. p. 277.

scription, though objectionable in several points, is much superior to any that had been given before him.

It is usual to describe the Arteries as possessing, what is called a *Cellular Coat*, external to all the others. But there seems no more reason for admitting the *Cellular Substance* which surrounds an Artery, to be a part of that Artery, than there is for considering the *Cellular Substance* which is often laid over a Muscle, as a part of that Muscle. Besides, the three Coats which have been described, are constant; whereas, a Cellullar covering, is found only on some of the Arteries. In general, I suspect, the true External Coat is confounded with this Celular covering, and so, in reality, overlooked altogether. Bichat, however, although he calls the Outer Coat of an Artery *Tissu Cellulaire*, distinctly states that it is not cellular in its structure.

When an Artery becomes smaller than the twelfth of an inch, it is not easy to distinguish the different parts which compose it. There is every reason to believe, however, that a similar structure is continued into the minutest branches. Microscopic observation, as far as it goes, is in favour of this opinion.

I am not acquainted with any peculiarity, in the structure of the Arterial System of the Female.

The only well established difference in the general Anatomy of the Arterial System, previously to the period of Maturity, is, the much greater absolute size of the capillary branches. This is always the more remarkable, the younger the subject.

The reverse is the case, in the Decline of Life; for then the capillary vessels become gradually smaller than in the Adult. At this period too, all the Arteries in the Body seem to suffer a diminution both in their strength and elasticity.

OF THE VEINS.

The distribution of the *Venous System*, like that of the *Arterial*, may be compared to the ramification of a tree. In describing this System, however, it is usual to invert the order observed in the former, and to consider the trunks, as successively formed by the union of the branches.

All the *Veins* of the Body, therefore, are said to arise from the minute capillary branches of the *Arteries*, and uniting one with another, to form, at last, seven principal trunks. Three of these, the two Cavæ and the Coronary Vein, open into the Right Auricle of the Heart; and the other four, viz. the two Right, and the two Left Pulmonary Veins, open into the Left Auricle.

The Coronary Vein, at its entrance into the Auricle, is about a third of an inch in diameter, the Inferior Cava about an inch, the Superior about two thirds of an inch, and the four Pulmonary Veins about half an inch each.

The Veins in general, throughout the Body are, like the Arteries, of a cylindrical shape; but they deviate from this form, much more frequently than the Arteries do. They often swell out into sinuses; and small swellings of this sort are so constant, in all those Veins which are provided with certain *Valves* afterwards to be described, that where these Valves are numerous, the Vessel puts on a knotted appearance.

The commencements of the Veins are, every where, so minute, that they are seldom perceptible by the naked eye. The same means must be employed to bring them into view, as is necessary in tracing the terminations of the capillary Arteries.

When we apply the microscope, then, to a part properly injected, we can distinctly trace every capillary Vein which is visible, into some corresponding capillary Artery. All the Veins appear to be continuations of the Arteries; if they have any other origin, it has not yet been satisfactorily demonstrated.

It is impossible, however, in any instance, to fix the precise point, at which the Artery ends and the Vein begins; they pass insensibly into each other. Sometimes a sudden change in the direction of a capillary Artery enables us to judge that it has passed into a Vein; but in general we cannot be certain of this, until we see the Vessel uniting successively with other similar Vessels, and thus forming a larger tube.

The appearance of the capillary Veins of a part is as various as that of the Arteries.

Throughout the whole Venous System, the same circumstances may be observed, in the union of the branches one with another, as is observed, though in an inverse order, in the ramification of the Arteries Sometimes a small Venous branch runs into a larger one, without increasing its size in the slightest degree; at other times, two Veins of equal or unequal diameter, unite together, and form a trunk which is larger than either of them separately. Invariably, however, in this latter case, the combined area of the branches is greater than the area of the trunk; not according to any uniform ratio, but often in the proportion almost of two to one.

Inosculation or Anastomosis between large branches, is much more common in the Venous than in the Arterial System.

In this System, too, there is a mode of distribution, which occurs much more frequently, than the reverse of it does in the other; and that is, the separation of a Venous Trunk into branches, in a direction towards the Heart. In general, this kind of ramification does not extend beyond a single division; but there is a remarkable exception in the *Portal Vein* of the *Liver*, which is fairly resolved in this manner, within the substance of that organ, into capillary branches. In the

Arterial System, however, as has been already remarked, the reunion of branches so as to form a trunk, is very rare.

The Venous trunks of middling size, throughout the Body, are both more numerous and longer, than the Arterial Vessels of the same diameter. In general, too, it is very apparent, that, whether arising from the greater diameter, or length or number of the branches, the combined area of all the Veins of a part, is greater than the combined area of all its Arteries. It is obvious, therefore, that the area of the whole Venous System must be greater than that of the Arterial. HALLER* is inclined to think, that the ratio is about as nine to four; and this, probably, is as near the truth, as it is possible to arrive, in a point where the elements of the calculation are so various and so difficult to be ascertained.

Veins, like Arteries, are whitish and flocculent without, and smooth and pale coloured within.

Many of the larger Veins, and those of middling size, are provided with *Valves*. These are Membranes of a semilunar or parabolic shape, perfectly transparent and colourless, and though scarcely the thickness of a hair, yet very dense and strong. They are attached by the whole of their curved margin to the inner surface of the Vein; and this margin is uniformly turned towards the branches of the Vein, while their free, straight, edge, looks towards the trunks. They are inserted into the sides of the Vein in such a manner, as to be in a certain degree loose within the tube; and accordingly when any fluid is forced from the trunks towards the branches, they are pushed away from the sides of the Vessel, and pressed inwards towards its axis. They vary very much in their dimensions, even in Vessels of the same caliber. Sometimes they occur single, particularly in the smaller Vessels; sometimes, though very rarely, three are found together; but in general they

* Elem. Physiol. I. p. 133.

are disposed in pairs, one exactly opposite the other. The degree of obstruction which they present, to the passage of a fluid from the trunk towards the branches of the Vein, depends on their size, if they are single, and on their size and adaptation to each other, if they are double or triple; for both the Valves of a pair are not always of the same dimensions. They are very seldom so large, or so precisely adapted to each other, as to shut up the tube of the vessel completely. The number of them occurring either singly or in pairs, within any given extent, is very various in different Veins. They are found at all intervals, from four or five inches, to a quarter of an inch, or even less. In general they are most numerous in Veins of small size.

Opposite to each Valve, the Vein swells out a little, so as to form a small sinus, of a parabolic shape. When the Vessel is distended, these sinuses form corresponding eminences externally, and often give the Vein a knotted or jointed appearance.

I do not know any Vein in the Body, of which the sides are thicker than a sixteenth part of an inch. In the Venous, as in the Arterial System, the sides of the branches are always thinner than those of the trunks; but the thickness is not always proportional to the caliber of the Vessel, even in Veins of the same external diameter.

WINTRINGHAM's* experiments are often referred to, as proving that the sides of a Vein possess greater density than the sides of an Artery; but they do not seem to me at all conclusive.

Veins are elastic, but not so much so as Arteries. HALLER†, and BICHAT‡, maintain that they possess more elas-

* Experimental Inquiry, &c.

† Elem. Physiol. I. p. 128.

‡ Anat. Gener. II. p. 414.

ticity than Arteries, in the transverse direction; but the grounds of this opinion are not satisfactory.

It is owing to their inferior elasticity, that we always find the Veins in a collapsed state, after they have been emptied of their contents. This appearance of itself, almost, is sufficient to distinguish a Vein from an Artery in the Dead Body, provided the Vessel be not too minute.

Whether the Veins be stronger or weaker than the Arteries, does not yet appear to be sufficiently established. The experiments of WINTRINGHAM* indeed, so often appealed to in points of this sort, have generally been regarded as demonstrative of their being stronger; but it seems to me, that they do not warrant the conclusions that have been drawn from them. From a few experiments which I have myself made, I am rather inclined to suspect, that the Veins are considerably weaker than the Arteries.

In all Veins that are not less than the twelfth of an inch in diameter, two Coats can be distinctly seen; and in some, there is a third texture which intervenes, at particular parts, between these two.

The *Inner Coat* of Veins is transparent, like the Inner Coat of Arteries. It is a little thicker, however, than this Coat, and greatly stronger; and it differs from it also, remarkably, in this, that with the forceps we can distinctly separate it into slender, dense, fibres. I have never seen either Bloodvessels, Absorbents, or Nerves in it.

The Valves are generally regarded as being formed of duplicatures of this Coat; and they certainly do resemble it more than any other substance. But they differ from it, in having a number of little white bands running through them in every direction; and as to their consisting of two layers, I suspect this is rather supposed, than demonstrat-

† Experimental Inquiry, &c.

ed; for, I have often tried to split them into laminæ, but in vain.

The *Outer Coat* of Veins has the same structure as the Outer Coat of Arteries. It is thinner proportionally, however, and its fibres are not so close. Its attachment to the Inner Coat is very firm; the fibres of the one appearing to be a good deal interwoven with those of the other.

In almost all the trunks and larger branches of Veins, a substance is found intervening between these two Coats. Sometimes this substance surrounds the Vein entirely; but, in general, it occurs in patches of different sizes. It varies a good deal in its thickness; being as thick in some parts as the Outer Coat, and only half as thick in others. It seems to be of a nature between the External and Middle Coat of an Artery; the fibres being softer, darker coloured, and not so close, as those of the External Coat, and yet firmer, whiter, and less regularly disposed, than those of the Middle One. When we hold a piece of Vein containing this partial Middle Coat between the eye and the light, it seems as if it were arranged into longitudinal fasciculi; but when we come to dissect it with the forceps, we do not find that its fibres separate more readily in the longitudinal direction than in any other.

For about an inch before the entrance of the two Cavæ into the Right Auricle, a stratum of scattered fibres, exactly resembling the Muscular fibres of the Auricles, may in general be seen in each of these Vessels, between the Outer and the Inner Coat.

With respect to the Cellular Coat which is so generally ascribed to Veins, the same remark will apply to it, as to the Cellular Coat of Arteries; viz. that there is, properly speaking, no such Coat; and that including it among the tunics of the Veins, only leads us to overlook the true Outer Coat of these Vessels.

Bichat's* description of the structure of Veins, is not so good as that which he has given of the Arteries; yet it approaches nearer to accuracy than any I have seen. He calls the Outer Coat *Tissu Cellulaire*, observing at same time, however, that it is very different from common *Cellular Substance*. The Inner Coat he describes under the name of *Membrane Commune du Sang Noir*; and the Texture mentioned, as intervening between the Outer and Inner Coats, at certain parts, he calls *Membrane Propre aux Veines*.

There seem to be no Peculiarities in the *Venous System* of the Female, more than in the *Arterial*.

Previously to Maturity, I believe it to be sufficiently established, that the Veins of the Body in general, are smaller in proportion to the Arteries than afterwards; and that the difference is greater the younger the subject. But the increase in the proportional size of the Venous System, which is conceived by some to take place during the Decline of Life, is, I apprehend, more apparent than real.

Before concluding the consideration of the Anatomy of Bloodvessels in general, it may be proper to mention, that when the Arteries or Veins of any part of the Body happen to be either longer, or wider, or more numerous, than those of any other part, the former part is said to be more *Vascular* than the latter.

* Anat. Gener. II. p. 398.

CHAPTER II.

THE ANATOMY IN GENERAL OF THE ABSORBENT SYSTEM.

In the *Absorbent System* of the Human Body, there are two things to be considered, viz. the *Absorbent Vessels*, and little bodies called *Absorbent Glands*, through which all these Vessels seem to pass, in some part of their course.

SECTION I.

THE ANATOMY OF THE ABSORBENT VESSELS IN GENERAL.

The *Absorbent Vessels* are a system of tubes, distributed throughout the Body in the manner of the Arteries and Veins. In describing them, the same order is observed, as in the description of the distribution of the Veins.

They are too minute at first to be perceptible to the naked eye; but they unite one with one another into vessels successively increasing in size, until at last they form two trunks, each about a quarter of an inch in diameter, which open into the *Subclavio-Jugular Veins*, one on each side of the Neck. The Left Trunk is denominated the *Thoracic Duct*.

Very often, instead of two trunks, they form three; and sometimes, though rarely, we find four or five. These varieties, however, will be described more minutely afterwards.

In shape, an *Absorbent Vessel* may be compared to a portion of a Vein containing a great many pairs of Valves; it has a notched or jointed appearance. The notches are so frequent, that it often resembles a number of little vesicles joined together, or a string of beads.

The smaller Absorbent Vessels are pretty uniform in their diameter; but the larger branches are subject to much greater variety, in point of size, than even the Veins. Nothing is more common, than to see them swelling out, suddenly, into a sinus three or four times their diameter at other parts.

Sometimes we find the Absorbent Vessels of particular parts, so filled with a reddish or whitish fluid after Death, that we can not only see all the larger branches easily with the naked eye, but, with the microscope, can trace some of the smallest to their very beginnings. Without some natural or artificial injection of this sort, however, these Vessels are so thin and colourless, that even their larger branches are imperceptible with the most powerful glasses.

The fluid best adapted for injecting into the Absorbents with this view, is Quicksilver. With proper management, this substance may be made to fill the smaller Absorbent Vessels, to a degree of minuteness altogether inconceivable to those who have not seen it. Of course, however, it is only in transparent parts, or on the surfaces of opaque organs, that the minute ramifications of the System, are capable of being demonstrated.

In no organ in the Body, is it possible to trace the Absorbents, to their beginnings, with the naked eye; and there is only one part, in which their origins have been seen, even with the miscroscope, viz. the surface of the *Small Intestine*. Cruikshank* was fortunate enough, in one case, to find the Absorbents belonging to this part of the *Alimentary Ca-*

* Anatomy of the Absorbing Vessels, p. 56.

nal, so turgid with a milky substance after Death, that with the microscope, he could distinctly trace hundreds of them to their origins, by circular orifices, on the surfaces of the *Villi*.

On examining the capillary Absorbents of other parts in the same manner, after a minute injection, many of these little Vessels may be seen disappearing; but as no orifices are perceptible at the points where they vanish, we cannot be certain, that these are their origins.

The distribution of the capillary Absorbents, like that of the capillary Bloodvessels, seems to vary in almost every Texture of the Body. In general, however, Anastomosis appears to be more frequent among them, than among either Arteries or Veins; and in consequence of this, their distribution, upon the whole, has a greater resemblance to a net-work.

Three things remarkably distinguish the distribution of the middle-sized Absorbents, from that of the corresponding parts of the Arterial and Venous System. In the first place, when two of these Vessels unite together into one, the trunk which they form, is seldom or never larger than either of them separately; secondly, their Anastomoses with each other are continual; and thirdly, they seldom run any great way, without first dividing into branches, and then re-uniting into trunks.

This kind of Anastomosis and division into branches, is very common, too, among the larger branches and the trunks of the Absorbents; but when two of these run together into one, we generally find that the trunk which they form is, as in the Arteries and Veins, larger than either of them taken separately.

The outer surface of an Absorbent Vessel is flocculent; the inner, smooth, like that of Bloodvessels.

All the Absorbents in the Body, apparently, are provided with *Valves*. These are thinner than the Valves found in

Veins; but, in proportion to their thickness, they are equally strong; and they have precisely the same form, and mode of attachment to the inside of the Vessel. They are generally found in pairs. Sometimes where a large branch runs into a trunk, or where a trunk opens into a Vein, there is only a single Valve. Three are never found together. The two Valves of a pair are usually of the same size; but I suspect that they are never so perfectly adapted to each other, or to the caliber of the Vessel in which they are placed, as entirely to prevent such fluids as air or mercury, from passing from the trunk towards the branches. I have never seen an Absorbent Vessel, in which I could not, by means of a steel syringe, force quicksilver in this direction, without any apparent injury to the Valves. At all events, the resistance which they oppose to fluids passing towards the branches, seems to be considerably less in the capillary, than in the large vessels.

Opposite to each Valve, the Absorbents swell out a little, as the Veins do; and it is to this they chiefly owe their notched or jointed appearance. These notches enable us to ascertain the existence of Valves, in Absorbents which are too minute to admit of being easily dissected.

In Absorbent Vessels of middling size, a pair of Valves will be found at every twentieth of an inch almost. Towards the larger branches and trunks, they are somewhat less frequent; and towards the capillary branches, rather more. According to Cruikshank*, however, there is great variety in the distribution of the Valves, in different bodies. "The Thoracic Duct, for example," says he, "in some bodies, has perhaps only three or four pair of Valves: in others, I have seen it crowded with Valves throughout its whole length. I have seen a lymphatic vessel run six inches, without a single Valve appearing in its cavity. Sometimes the

* Anatomy of the Absorbing Vessels, p. 66.

trunks are more crowded with Valves than the branches, and sometimes I have seen the reverse of this."

The Absorbent Vessels which have the thickest sides, are the two Trunks of the System; and yet I have never seen these exceed a sixtieth part of an inch. The other Vessels seem to be thinner, in proportion as they are smaller.

That Absorbent Vessels possess considerable elasticity, is shewn by the experiment of puncturing them after they have been moderately distended with Mercury; great part of the Mercury is immediately forced out. Judging, however, from the Thoracic Duct, I should think that they are a good deal less elastic than Veins.

All Anatomists are agreed, in pronouncing the Absorbents to be much stronger, in proportion to their size, than Veins. This is proved by the much greater weight of Mercury which they will bear, before they are ruptured.

In the sides of the Thoracic Duct, I cannot perceive distinctly more than one Coat. This resembles the Inner Coat of Veins; and the Valves appear to be merely prolongations of it. From the observations of MASCAGNI*, however, it would seem that the Valves sometimes contain a small quantity of a fine *Adipose Substance.*

The other Absorbent Vessels are almost all too small to admit of being easily dissected; but I conclude that they have a similar structure.

SHELDON† having found what he conceived to be three distinct Coats in the Thoracic Duct of a Horse,—an *Inner* one like the Inner Coat of Veins, an *Outer* like the *Pleura* or *Peritonæum*, and a *Middle* one consisting of *Muscular fibres* running chiefly in a circular direction,—concluded without hesitation that the same tunics existed in the Absorbent Vessels in Man. The accuracy, however, of his observa-

* Vasor. Lymph. Histor. p. 27 & 66.

† History of the Absorbent System, p. 26.

tions on the Thoracic Duct of the Horse is doubtful, and their application, at all events, to the Human Absorbent System, is not conformable with observation.

The External Coât ascribed to Absorbents by MASCAGNI, is obviously a mixture of common *Cellular* and *Adipose Substance.*

It is not easy, to discover from CRUIKSHANK's* description, whether he regards the Absorbents as consisting of one Coat or of two.

No peculiarities have yet been observed in the Absorbent Vessels of the Adult Female; nor in those of either Sex, before or after Maturity.

SECTION II.

THE ANATOMY OF THE ABSORBENT GLANDS IN GENERAL.

CRUIKSHANK† affirms, that he has injected the Thoracic Duct, from Absorbent Vessels on the back, without injecting any *Absorbent Gland.* But MASCAGNI is far better authority on a point of this sort; and from his numerous investigations‡, I have no doubt whatever, that there is no Absorbent Vessel in the Body, which does not pass through one *Absorbent Gland* at least, before it joins the Absorbent Trunks. Many Absorbent Vessels, it is well kuown, pass through several *Glands* in their progress.

The *Absorbent Glands* are of various shapes and sizes. Some are oval, others globular, and others flat. Some are about an inch in diameter, and others scarcely a quarter of

* Anatomy of the Absorbing Vessels, p. 60.

† Anatomy of the Absorbing Vessels, p. 79.

‡ Vasor. Lymphat. Histor. p. 25.

an inch. They are smooth on the surface, and of a greyish-pink colour, in general; some, however, are blueish, and a few almost jet black.

We may consider them as consisting of two parts; a peculiar *Substance*, and a thin *Membrane* surrounding this, like a Capsule.

The *Substance* of the Absorbent Glands, seems chiefly composed of ramifications of Absorbent Vessels, closely compacted together.

The Absorbent Vessels which enter a Gland, are called the *Vasa Inferentia*; those which come out of it, the *Vasa Efferentia*. These are easily distinguished from each other, by the direction of their Valves. The free margins of the Valves in a *Vas Inferens*, always look towards the Gland.

The number of Absorbent Vessels which enter a *Gland*, is exceedingly various; sometimes there is only one, at other times, more than thirty. The number of the Vasa Inferentia and the Vasa Efferentia seldom correspond. In general, the former are more numerous. CRUIKSHANK* says he has injected fourteen Vasa Inferentia belonging to one Gland, and yet to all these, only one Vas Efferens corresponded. Very often, however, the Vasa Efferentia are more numerous than the other.

In general, towards the trunks of the Absorbent System, the Vasa Efferentia are larger than the Vasa Inferentia. But in other parts, it is sometimes the one set of Vessels, and sometimes the other, which is largest; and very often they are exactly equal in size.

My own observations on the arrangement of the Absorbent vessels within the *Substance* of the Glands, have hitherto been very few. I have investigated this piece of Anatomy, however, enough to be satisfied, that the de-

* Anatomy of the Absorbing Vessels, p. 80.

scription of it given by the indefatigable Mascagni*, is the most correct which we yet possess.

According to him, in order to shew the structure of the more superficial parts of the Gland, the whole Gland must be injected with quicksilver, by the Vasa Inferentia. When this is done, the Vasa Inferentia may be seen, just before entering the Gland, dividing into branches. Some of these penetrate directly into the central parts of the Gland, while others are distributed towards the surface. Of these, the larger branches may be distinctly seen bent, convoluted, and interwoven, in every direction; communicating freely with each other; becoming suddenly narrow at some parts, and at others swelling out into little cells, which are so numerous, that when they are distended with Mercury, the whole outer surface of the Gland seems covered with little rounded eminences. The smaller branches again are seen, subdividing and forming a net-work on the surface, and then disappearing, some of them by dipping down between the cells of the larger ones, and others by opening into these cells.

Arising directly out of these cells, on the other hand, or ascending from between them, various other small Vessels are seen, which after winding about on the surface, run together into larger branches, and then uniting with similar Vessels coming out of the central parts of the Gland, form the Vasa Efferentia.

In order to shew the disposition of the Absorbent Vessels in the central parts of the Gland, a different sort of injection is necessary. The Vessels must be filled with fluid wax, or glue, or gypsum; and when the fluid has become hard by rest or cooling, the more superficial parts of the Gland dissected away. In this manner the deeper seated

* Vasor. Lymphat. Hist. p. 30.

Vessels are brought into view; and it will be found, that they have precisely the same distribution, as those already described on the surface.

Sometimes the Absorbent Vessels of a Gland, preserve a pretty uniform diameter throughout, so that there is little or no appearance of cells in any part of it.

Within the Glands, the Absorbent Vessels seem to have the same structure as elsewhere.

By means of a proper injection of Size and Vermilion, small Bloodvessels may be traced into the substance of the Glands, following the convolutions of the Absorbent Vessels every where, and forming an intimate net-work round each of the cells.

No Nerves have yet been demonstrated accompanying either of these sets of Vessels.

The only other substance detected within the Glands, besides these Vessels, is a delicate sort of *Cellular Substance*, which unites the Vessels together.

The *Capsule* of Absorbent Glands, inclosing the Internal Substance, is a thin, pellucid, and colourless Membrane. Maceration resolves it into a number of fine, whitish, fibres. It is very vascular; and MASCAGNI seems to have injected Absorbents in it. Its nerves have not been traced. It is connected to the parts within, by a fine *Cellular Substance.*

I KNOW of no difference betwixt the Absorbent Glands of the Female and those of the Male.

IN young persons the Glands are in general rounder and more turgid. HALLER* and various Anatomists before and since his time†, have described a fluid of the colour and consistence of milk, as existing in the cells of the fine

* Elem. Physiol. I. p. 184.

† See, in particular, since HALLER's time, CRUIKSHANK, Anatomy of the Absorbing Vessels, p. 74; and BICHAT, Anat. Gener. II. p. 608.

Cellular Substance of the Glands, at an early period of life, and gradually disappearing towards Maturity. I have no doubt, however, that MASCAGNI* is right in maintaining, that this matter is not contained in the Cellular Substance surrounding the Vessels, but in the Vessels themselves, and chiefly in the little cells which they form.

In old Age, the Absorbent Glands, become smaller, flatter, and drier; but they never entirely vanish, as has been asserted by some.†

CHAPTER III.

OF THE ANATOMY IN GENERAL OF THE NERVOUS SYSTEM.

THE *Nervous System* may be regarded as consisting of two parts; a *Central Mass*, and a set of Cords called *Nerves* connected with this *Mass*.

SECTION I.

OF THE CENTRAL MASS OF THE NERVOUS SYSTEM.

THIS is divided into two parts; an organ called the *Brain* or *Cerebrum*, lodged in a cavity in the Head; and a cord-like prolongation from this organ, contained chiefly in a canal in the *Spine*, and usually denominated the *Spinal Mar-*

* Vasor. Lymph. Hist. p. 34.

† Among others by HALLER, Elem. Physiol. Tom. vii. Pars. I. p. 214.

row. We shall call this prolongation, in future, the *Spinal Cord*.*

I agree with SOEMMERRING† and BICHAT‡, in placing the commencement of the *Spinal Cord*, at the lower margin of the *Annular Protuberance*. Many still continue to include a portion of its upper extremity along with the Brain, under the name of *Medulla Oblongata*; but this arrangement is neither precise nor natural.

OF THE BRAIN.

The Brain consists of a peculiar substance, embraced by thin membranes.

Its weight and volume are different in different persons; but these varieties do not seem to observe any relation to the weight or stature of the individual. In general, it weighs, when its Bloodvessels are quite empty, from two and a half, to three pounds Avoirdupois.

We shall examine its *Substance* first, and then the *Membranes* which cover it.

In order to expose the *Substance* of the Brain completely, the *Membranes* must be carefully peeled off. We have then to attend, in the first place, to its general divisions, and the appearance of its surfaces external and internal; and secondly, to its structure.

* No apology, I trust, is necessary to Anatomists for this innovation. The term *Spinal Marrow* seems to have continued in use, solely, because no other less objectionable happens to have been suggested. I have employed the term *Spinal Cord*, for several years in my Anatomical Lectures, and have reason to believe that it is pretty readily adopted by all classes of Students.

† De Corp. Hum. Fab. tom. IV. p. 75.

‡ Anat. Descrip. tom. III. p. 127.

The Brain is usually divided into two parts; an upper portion, denominated the *Brain Proper*, and a lower which is considerably smaller, called the *Cerebellum.*

Suppose a plane to pass through the *Cerebrum*, bounded by the upper margin of the *Annular Protuberance* before, and by the lower edge of the *Inferior Corpora Quadrigemina* behind; all above this plane may be considered *Brain Proper*, and all below it, *Cerebellum.*

The *Brain Proper* weighs in general from 35 to 45 oz. Avoirdupois. Its greatest length is from $6\frac{1}{4}$ to $6\frac{1}{2}$ inches; its greatest breadth, from $5\frac{1}{4}$ to $5\frac{1}{2}$ inches; and its greatest depth, from $2\frac{3}{4}$ to 3 inches.

Its form varies in almost every subject; but the varieties are extremely slight.

An imaginary straight line or parallel plane, dividing the Body into two halves, right and left, has been denominated by some modern Anatomists, the *Median Line* or *Median Plane.* We may apply the same term to any similar line or plane, which separates any particular organ of the Body into two portions, nearly or exactly alike; and for the sake of brevity, we shall call all those parts of the Body which are capable of being divided in this manner, *symmetrical parts.*

Now according to this acceptation of the term, the *Brain Proper* is *symmetrical*, and its Median Plane corresponds exactly to the Median Plane of the Body.

Its two halves, right and left, are denominated *Hemispheres.*

These are separated from each other to a considerable depth all round, except towards the middle of the lower surface, by a *Longitudinal Fissure*, running exactly in the direction of the *Median Line.* This Fissure is from $1\frac{1}{2}$ to $1\frac{3}{4}$ inch deep, above and before; from $2\frac{1}{2}$ to $2\frac{1}{4}$ inches, behind; and towards the forepart of the lower surface, about an inch.

The greater part of the surface of the Hemispheres is formed into serpentine ridges called Convolutions, lying close to each other, and running in various directions. These are of various shapes and sizes. Some are nearly three quarters of an inch broad at particular parts; others scarcely a quarter of an inch. Some are of pretty uniform breadth throughout; others considerably broader at top than at the base. The *Fossæ* between them also, vary very much in their depth, some being quite superficial, and others almost an inch deep.

These Convolutions are seldom precisely alike, either in shape or size, in any two corresponding points of the opposite Hemispheres. In different Brains, I do not know that any two corresponding points, in either Hemisphere, have ever been observed exactly similar.

The Brain Proper, viewed from above, is convex and of an oval shape, the small end of the oval being turned forwards.

In the middle along the Median line, is seen the Longitudinal Fissure; which towards the fore-part is not more than a twelfth of an inch broad, but widens out gradually behind, as it opens on the surface, until it is the breadth of a quarter or half an inch.

The Hemispheres on each side of this are every where of a brownish colour*, and formed into Convolutions. These are rather smaller before than behind.

If the Hemispheres be gently separated from each other along the Longitudinal Fissure, the surface of each Hemisphere looking towards the Fissure will be brought into view, straight and flat, and formed into Convolutions like those on the outside; and at the bottom of the Fissure, part of the white, upper, surface of the *Corpus Callosum* will be seen

* The colour is almost exactly that particular species of *brown* which Mr. Syme, in his "*Nomenclature of Colours*," calls *Wood-Brown*; and which is very well exemplified in the *Hazel-Nut*.

In order to expose the whole superior surface of the *Corpus Callosum*, the Hemispheres must be cut away on each side, to a level with it.

It then appears of an oblong shape, and symmetrical lengthways, the Median line corresponding with the Median Line of the Brain Proper. It is arched from before backwards. Its anterior margin is convex, and its posterior concave. It swells out gradually from before backwards, until within a third of its posterior extremity, when it begins to taper again. The posterior margin, however, is wider than the anterior; the one being about three quarters, and the other about half an inch. Its long diameter taken on the Median Line is about three inches.

Two small Longitudinal Ridges run along the middle of this surface, one on each side of the Median Line. They are about a twelfth of an inch distant from each other before, and in general, though not always, a little farther apart behind. They are seldom exactly parallel to each other, but bend a little in their progress. The space between them is called the *Raphe*.

Slight Transverse Ridges may also in general be seen, extending outwards for a short way, from each of the Longitudinal ones, along the whole of their extent.

The whole of this surface of the *Corpus Callosum* is of a whitish colour.

On the inferior surface, or what is often called the Base of the Brain Proper, we remark, in the first place, on the Median Line, the Longitudinal Fissure, extending from the anterior margin, about two inches and a half backwards, and terminated by a smooth, white, perpendicular surface. The roof of this part of the Longitudinal Fissure, is formed by the lower surface of the anterior portion of the *Corpus Callosum*, which towards the fore-part is similar in its appearance to the superior surface of this body, but tapers to a point behind. It is about half an inch broad before, and three fourths of an inch long, and is slightly arched from before backwards. Its colour is white. Behind, it is continued into a narrow groove, about a quarter of an inch in length, of the same white colour. These parts may be brought into view, merely by separating the Hemispheres gently from each other; but they are better seen when the Hemispheres are cut away to a level with the bottom of the Fissure.

From the perpendicular surface terminating the Longitudinal Fissure behind, a smooth surface about a quarter of an inch in length, is continued downwards and a little forwards, to unite with the Commissure of the *Tractus Optici.* The colour of this surface is greyish, with white lines running from above, downwards and inwards.

The substance which I denominate the Commissure of the *Tractus Optici**, is of an oblong shape, having the *Tractus Optici* attached to its posterior corners, and the Optic Nerves to its anterior. Its long diameter, which is about half an inch, is placed across the Median Line; its breadth is about a fifth of an inch, and its thickness about an eighth. Its surfaces are flat; one looking upwards, and a little forwards, and the other in the opposite direction. Its margins are slightly concave; the anterior and lateral ones being free, while the posterior and upper is attached to the grey surface just mentioned, and the posterior and lower to the *Infundibulum.*

Immediately behind this Commissure, are situated the Pituitary Gland and *Infundibulum.*

The Pituitary Gland † is a substance somewhat of an oval shape, the long diameter of the oval being placed across the Median Line. Its upper surface is flat; the rest convex. It is about five twelfths of an inch long, a quarter of

* SYNONYMS. *Lat.* Decussatio Nervorum Opticorum. *Fr.* La Reunion, La Jonction, Le Concours, des Nerves Optiques.

† SYNONYM. *Lat.* Hypophysis.

an inch broad, and the same in thickness. In colour, it is a little darker than the Convolutions. In point of situation, it is the lowest part of the Brain Proper placed on the Median Line; its superior surface being below the level of the lowest margin of the Commissure of the *Tractus Optici*. It is altogether unconnected with any other part, except in the middle of its flat surface, where it is joined to the point of the *Infundibulum*.

The *Infundibulum** is a small projection of a conical shape, the base turned upwards and backwards, and the apex downwards and forwards. It is rather more than half an inch in length. Its colour is brownish like the Convolutions. Its basis is connected on the fore part to the Commissure of the *Tractus Optici*, and laterally and behind, to the *Tractus Optici* themselves, and to the Mammillary Eminences. Its apex is inserted into the middle of the upper surface of the Pituitary Gland.

Immediately behind the Mammillary Eminences, there is seen the upper end of a deep Triangular Furrow, three eighths of an inch in length and the same in breadth, which extends downwards and a very little backwards, and is terminated by the Annular Protuberance of the *Cerebellum*. The upper end of this Furrow presents a smooth, flat, surface, of a whitish colour, pierced with a number of small holes. The lower end projects downwards a considerable way, behind the Annular Protuberance of the *Cerebellum*, and forms a small *cul-de-sac*, shaped like the point of a writing-pen.

In describing the lower surface of the Brain Proper, I suppose the *Cerebellum* to have been cut away. Now, immediately behind the cavity just mentioned, and about a quarter of an inch lower down, the surface of the section is seen, which is made in removing the *Cerebellum*. This of course it is unnecessary to describe minutely.

* SYNONYM. *Fr.* La Tige Pituitaire.

Behind this, and about half an inch higher up, the posterior extremity of the *Corpus Callosum* appears; from which, the Longitudinal Fissure is seen extending backwards to the posterior margin of the Brain.

Such are the appearances on the Median Line of the lower surface of the Brain Proper.

On each side of the Median Line, we have to remark, in the first place, the Lobes of each Hemisphere. These are three in number, and are denominated the Anterior, Middle, and Posterior. Their surfaces are formed into Convolutions, similar in colour to those on the upper surface of the Hemispheres, but upon the whole, rather smaller and less serpentine, and having much shallower *Fossæ* between them.

The Anterior Lobe is the largest. It generally extends as far back as one half of the Hemisphere; sometimes, nearly two thirds. Close to the Longitudinal Fissure, it is formed into a sort of Ridge, and projects considerably farther downwards than the parts more to the outside, which are slightly concave and look a little outwards. This Ridge is formed by two Convolutions placed parallel to each other and to the Median Line; and in the surface of the *Fossa* between these, the Olfactory Nerve is always found lying.

The Middle Lobe is next in point of size. It is convex on the outer and lower surfaces, and partly convex, partly concave, above and on the inside. Its inner margin is divided into two portions, anterior and posterior, by a part which projects more inwards than the rest, and which I should be inclined to call its Inner Lobule.

The portion of the inner margin behind this Lobule, is always formed by a single Convolution, which arising immediately behind the posterior extremity of the *Corpus Callosum*, runs downwards and forwards, closely applied to the Peduncle of the Brain Proper, and is then lost in the

Inner Lobule. The inner and posterior surface of the Inner Lobule itself, however, is constantly formed by a Small Convolution about three quarters of an inch in length, which lies above and on the inside of the anterior extremity of the former; having its lower surface separated from it, by a fissure which is continuous with one under the *Tænia Hippocampi*, afterwards to be described*.

The Middle Lobe lies under the posterior part of the Anterior, below the level of which it projects, nearly three quarters of an inch. Between the two, there is a deep Fissure, called the Fissure of SYLVIUS, which varies in its length in different subjects, and even in the opposite Hemispheres of the same Brain. It is seldom wider however, than the *Fossæ* between the Convolutions; and, therefore, the surfaces of the two Lobes, are closely in contact along the whole of its extent, except towards the fore-part, where they are nearly a quarter of an inch asunder.

The boundaries between the Middle and Posterior Lobes are not very well marked; they pass insensibly into each other. Let us suppose, however, a line drawn across the lower surface of the Brain Proper, immediately behind the posterior extremity of the *Corpus Callosum*, and at right angles to the Median Line; the portion of the surface behind this line, may be called the Posterior Lobe.

The lower surface of this Lobe is slightly concave, and looks a little inwards. Very often its posterior extremity is notched instead of being pointed, as it generally is.

The posterior extremity of the *Fossa* between those two parallel Convolutions already described as forming a Ridge

* VICQ D'AZYR (Traité, &c. p. 46.) calls the former of these Convolutions "*La Circonvolution du Grand Hypocampe*," and the latter, which he considers as a part of the former, "*Le Crochet de cette Circonvolution*." The representation, however, which he has given, in Plate XVI, of the origin of the first of these, is far from being correct; nor can I agree with him, that there is such uniformity as he describes, in the form and direction of those Convolutions which are situated external to this one.

on the Anterior Lobe, is shut up by a little Eminence, shaped like a three-sided pyramid. Its base is turned upwards and backwards, and its point in the opposite direction. One side of it looks downwards and a little backwards; the other two, are concealed in the *Fossa* between the Convolutions, into which the sharp anterior angle is inserted like a wedge. Its colour is brownish, like the Convolutions, but three streaks of a whiter colour are in general seen extending backwards from its lower surface. Of these the outermost, is the longest, which extends as far back as the most anterior part of the Fissure of SYLVIUS, on the surface of a small Convolution of the Anterior Lobe, and forms a gentle curve concave outwards. The middle one follows nearly the same direction, but is placed more towards the Median Line, and is considerably shorter. The Internal streak, which is the shortest, but broader than the other two, bends gently backwards, upwards, and inwards, towards the posterior extremity of the Longitudinal Fissure. The number of these streaks does not always correspond on the opposite sides of the same Brain; and they differ a good deal in number, and size, and direction, in different persons. In some there are but two, in others only one, and sometimes several lesser streaks are seen running into the larger ones.

To the point of this Pyramidal Eminence just described, the Olfactory Nerve is attached.

Immediately behind this Eminence, there is an oblong flat surface, extending outwards and backwards, from the Longitudinal Fissure to the Fissure of SYLVIUS, and bounded by the *Tractus Opticus* on the inside. It is about three quarters of an inch long, and a quarter of an inch broad. There are a number of small holes in it; some of which towards the Fissure of SYLVIUS are large enough to admit a common pin. Its colour is greyish white. When the parts are in their natural position, only the anterior third of it is seen; the rest being concealed by the Inner Lobule of the Middle Lobe. To bring it wholly into view, this Lobule must be cut away.

The *Tractus Opticus** is a cord-like ridge, extending from the posterior corner of the Commissure already described, at first, backwards, outwards, and a very little upwards, and then, in the form of a curve, backwards, and inwards. The anterior part is more rounded than the posterior, and is attached to the parts above, only by about a third of its surface. As it proceeds backwards, however, it becomes gradually flatter and less prominent, and is at last merely a superficial band. Its whole length is about an inch and a quarter. It is about a sixth of an inch in diameter before, but towards its posterior extremity, swells out gradually to about a quarter of an inch. Its colour is white. On the fore-part, it is attached to the *Infundibulum*, and behind, to the Peduncle of the Brain Proper; and its posterior extremity is continuous externally, with the Outer *Corpus Geniculatum*, and, internally, is separated, by a slight groove, from the inner prominence of the same name. In the natural situation of parts, only about a quarter of an inch of its anterior extremity is seen; the whole of the rest of it being concealed by the Inner Lobule of the Middle Lobe, which is placed immediately under it, and which must either be cut away or pulled outwards, to bring it fully into view.

Continuous with the base of the *Infundibulum*, and close to the Median Line, there is a little projection called the Mammillary Eminence †. Its inferior surface is smooth, circular, and convex, and looks a very little backwards. Its inner surface is, in general, flat, and its outer margin projects but very little beyond the level of the base of

* Synonym. Described by many, as a part of the Optic Nerve.

† Synonyms. *Lat.* Corpus Albicans, Tuber Candicans, Eminentia Candicans. *Fr.* Tubercule Mamillaire.

the *Infundibulum*. It is about a quarter of an inch in diameter, and of a white colour. On the inside, its flat surface is closely in contact with the corresponding surface of its fellow on the opposite Hemisphere. Towards the outer and fore-part, it is about a sixth of an inch distant from the *Tractus Opticus*, and behind, it is almost in contact with the Peduncle of the Brain Proper. The whole of it may be seen, without either displacement or dissection of the surrounding parts.

Behind the Mammillary Eminence, a broad ridge is seen extending from above, downwards, inwards, and a little backwards, and terminating in the plane which divides the Brain Proper from the Cerebellum. This is what is called the Peduncle of the Brain Proper*. That part of its surface which looks towards the Median Line, before, is almost quite flat: The rest is convex, and most so above. Measured along the middle of its outer and anterior surface, it is rather more than half an inch in height; but towards the anterior and posterior margins, it is only about a third of an inch. It is wider above than below; the transverse diameter, in the middle, being three quarters of an inch. The convex part of its surface is, in general, slightly grooved, in a direction from above, downwards and a little forwards; the depth, however, and the number of the furrows vary exceedingly in different subjects; in some they are scarcely perceptible. Various transverse ridges are often found crossing these grooves at right angles, strongest and most numerous towards the lower and back part. The whole of the surface of the Peduncle is white. On the fore-part, along the Median Line, its flat surface is continuous with the corresponding surface of the Peduncle of the opposite Hemisphere; and these two surfaces together, form the sloping

*SYNONYMS. *Lat.* Pedunculus Cerebri; Crus Cerebri; Crus Cerebri Anterius; Processus Medullæ Cerebri. *Fr.* Jambe du Cerveau; Prolongement Antérieur ou Cérébral de la Protubérance Cérébral.

sides of the Triangular Furrow formerly described in this region. It is to this surface of the Peduncle, about a twentieth of an inch from the bottom of the Furrow, and the same distance from the Annular Protuberance of the *Cerebellum*, that the Third Cranial or *Oculo-motor* Nerve is attached. The Peduncle is bounded above and before, by the Mamillary Eminence and *Infundibulum*; above and without, by the *Tractus Opticus*; behind and above, by the Inner *Corpus Geniculatum*; and behind and below, by a smooth, triangular, white, surface. By its lower extremity it is joined to the *Cerebellum*, as will be afterwards more particularly described. When the parts are in their natural situation, the anterior, flat, surface of the Peduncle, and a very small portion towards its lower extremity all round, are alone visible; the rest is entirely concealed by the inner and posterior surface of the Inner Lobule of the Middle Lobe. The whole of it, however, may be easily exposed by pushing the Middle Lobe outwards, and a little upwards.

When the Brain proper is viewed from before; we observe, in the first place, on the Median Line, the Longitudinal Fissure, passing down from the upper to the lower surface, and separating the Anterior Lobes of the two Hemispheres from each other. At the bottom of this Fissure, the anterior extremity of the *Corpus Callosum* is brought into view, either by separating the Hemispheres gently, or by removing the Anterior Lobes altogether. It is convex, and measures about three eighths of an inch in height or thickness; and its surface presents the same appearance as above. On each side of the Median Line, we remark the convex, obtuse, extremities, of the Anterior Lobes. Here the convolutions are narrower than at any other part of the Brain Proper, but they are less flattened than on the Base, and the *Fossæ* between them are not so shallow.

On the posterior aspect of the Brain Proper, we observe, in the first place, on the Median Line, the Longitudinal

Fissure, separating the two Posterior Lobes, and on each side of this, the convex upper surface of these Lobes; on which, we may in general remark, that the Convolutions become a little smaller towards the lower margin than above. Very often the surface of these Lobes looking towards the Longitudinal Fissure, instead of being straight from one end to the other, is formed into a slight concavity towards the apex, about half an inch in breadth, and sloping outwards and downwards.

At the bottom of the Longitudinal Fissure, and on the Median Line, is seen the posterior extremity of the *Corpus Callosum*, rounded like the anterior one, and a very little higher or thicker. To bring this into view, however, the Posterior Lobes must be entirely removed to a level with it.

Immediately underneath this extremity of the *Corpus Callosum*, and on the Median Line also, there is a small Oblong Passage, about a quarter of an inch broad, and half as high, leading horizontally forwards, and formed by the *Corpus Callosum* above, the Superior *Corpora Bigemina* below, and the *Thalami Optici* on each side. The tip of the Pineal Gland may be seen towards the lower and anterior part of this Passage.

From the lower margin of this Passage behind, a Longitudinal Furrow, about three eighths of an inch long, is continued downwards and backwards, along the Median Line, separating the *Corpora Bigemina* of the opposite Hemispheres from each other; and in the bottom of the lower extremity of this Furrow, there is a little white ridge, called the *Frenulum*, triangular in its shape, about a fifth of an inch long, with its base looking directly downwards, and its apex, upwards and forwards.

This Longitudinal Furrow is crossed at right angles about the middle, by a Transverse one, half an inch in length, which separates the Upper *Corpus Bigeminum* on each side from the Lower.

On each side of the Median Line in this region, we observe, in the first place, immediately underneath the *Corpus Callosum*, and separated from it only by a Fissure afterwards to be described, an oblong, convex, surface of the mass called *Thalamus Opticus**. This stretches from behind, forwards, outwards, and a very little downwards, in the form of a curve, with the concavity inwards ; and it looks backwards and outwards. Its posterior extremity projects in the form of a *papilla*, which we may call the Posterior Tubercle of the *Thalamus Opticus;* while the anterior, forms a lesser prominence, varying a good deal in its shape, and denominated the External *Corpus Geniculatum.* The length of this surface is about an inch ; and its colour is white, like the *Corpus Callosum.* At the Median Line, the Posterior Tubercle is separated from the corresponding process of the opposite Thalamus, by the Oblong Passage just described. Except this Tubercle, there is none of this surface of the *Thalamus* visible, when the parts are in their natural connexion ; it is concealed by the inner part of the Middle Lobe, from which it is separated only by a Fissure. This part must be cut away, therefore, in order to bring it completely into view.

Underneath the middle of this surface, is seen a slight convexity, called the Inner *Corpus Geniculatum.* The shape of this prominence is generally oval, the long diameter inclining from within, outwards, forwards, and a little downwards, but its dimensions vary exceedingly in different subjects. It is always less than the Posterior Tubercle of the *Thalamus Opticus*, and generally larger than the Outer *Corpus Geniculatum.* Sometimes, however, the two *Corpora Geniculata* are exactly equal in size, and at other times, the outer one is the largest. The surface of the inner *Corpus Geniculatum* is smooth and white. It is separated, by a slight

* SYNONYMS. *Lat.* Colliculus Nervi Optici.

furrow, from the surrounding parts; above, from the *Thalamus Opticus*, which projecting considerably farther backwards, overhangs it; on the inside, from the Upper *Corpus Bigeminum*; below, from the Lateral Ridge of the Lower *Corpus Bigeminum*, and from the Peduncle; and on the outside, from the extremity of the *Tractus Opticus*. In the natural situation of parts, it may be seen on the inside of the Middle Lobe; but this Lobe must be cut through, in order to expose it completely.

Close to the Median Line, under the Posterior Tubercle of the *Thalamus Opticus*, and on the inside of the Inner *Corpus Geniculatum*, are situated two eminences, one above the other, denominated the *Corpora Bigemina**.

The surface of the *Upper Corpus Bigeminum*†, looks upwards and a little backwards. It is convex and oval-shaped, the long diameter running from within, outwards, and forwards; its convexity, however, varies, and in some it is more rounded than in others. There are slight varieties, also, in its dimensions; but in general it is about three eighths of an inch long, and two and a half broad. Its surface is perfectly smooth, and of a white colour, though a little darker than the *Thalamus Opticus*. On the inside, it is separated from its fellow of the opposite Hemisphere, above, by a smooth triangular surface on which the Pineal Gland rests, and below, by a Longitudinal Furrow already described, as running downwards and backwards along the Median Line.

The Transverse Furrow already mentioned, as crossing this last at right angles, separates it from the Lower *Corpus Bigeminum*; and on the outside, there is a narrow groove between it and the *Thalamus Opticus*, and the Inner *Corpus Geniculatum*. Towards the inner and fore-part, it forms a

* Synonyms. Including those of both sides, *Lat.* Tubercula Quadrigemina, Nates et Testes. *Fr.* Tubercules Quadrijumeaux.

† Synonyms. Including that on both sides, *Lat.* Tubercula Quadrigemina Anteriora; Nates. *Fr.* Tubercules Quadrijumeaux Superieures ou Anterieures.

portion of the floor of the Oblong Passage. In its natural situation, only the posterior half of it can be seen; the rest must be exposed by removing the posterior part of the *Corpus Callosum*, with all that portion of the Middle and Posterior Lobes, which are behind this.

Sometimes a ridge of a whiter colour than the Upper *Corpus Bigeminum* itself, is seen extending outwards from the anterior extremity of this Eminence, exactly in the place of the groove which is usually found between the *Thalamus Opticus* and the Inner *Corpus Geniculatum*. I have not found this ridge taken notice of by any author. At its origin it is about a twentieth of an inch in breadth, and it gradually tapers to a point, in the little hollow between the two *Corpora Geniculata*. We may call it the Lateral Ridge of the Upper *Corpus Bigeminum*.

The surface of the Lower *Corpus Bigeminum* * looks backwards and outwards. It is convex and oval shaped; about three eighths of an inch long and two broad, with the long diameter placed almost horizontally. Its shape and dimensions, however, vary a little. A Lateral Ridge, about three eighths of an inch long and one broad, but varying in its height in different subjects, is always found extending from its upper margin close to its anterior extremity horizontally forwards. Both the prominence itself, and this Lateral Ridge, are quite smooth and of a white colour.

Excepting the Lateral Ridge, the whole of the Lower *Corpus Bigeminum* is posterior to the Upper one. It is separated from this, and from its fellow on the opposite Hemisphere, by the Transverse and Longitudinal Furrows already described; there is a slight groove between the ex-

* SYNONYMS. Including that on both sides. *Lat.* Tubercula Quadrigemina Posteriora; Testes. *Fr.* Tubercules Quadrijumeaux Inferieures ou Posterieures.

tremity of its Lateral Ridge, and the Inner *Corpus Geniculatum*; and below, it is attached to the Vieussenian Valve.

Under the Lateral Ridge of the Lower *Corpus Bigeminum*, there is a smooth white surface, which has received no name. It is triangular in its shape, slightly convex towards the back part, and bounded before, by the posterior margin of the Peduncle of the Brain Proper.

The Brain Proper, viewed from the side, presents a convex surface, every where formed into Convolutions. Here we have little to remark, but the length to which the Fissure of SYLVIUS extends backwards, and the relative depths of the three Lobes. The most dependent points of the Anterior and Posterior Lobes are nearly on a level with each other; while the Middle Lobe projects a considerable way farther down than either.

Such are the appearances to be observed on those surfaces of the Brain Proper which we may call External. We have next to examine those which are to be seen on the sides of a deep fissure, which penetrates from the outer surface, in various directions, into the Central parts of the Brain Proper, and which we shall call its Central Fissure *.

The opening of this Fissure is seen extending, from each side of the Oblong Passage under the posterior extremity of the *Corpus Callosum*, at first directly outwards, between the Thalamus Opticus and the *Corpus Callosum*, and then in a curved direction downwards and forwards, close to the outer surface of the *Thalamus*, until it meets the Fissure of SYLVIUS about a quarter of an inch anterior to the Outer *Corpus Geniculatum*, where it terminates. In order to expose it fully, the innermost Convolution of the Middle Lobe must be cut away; but a small portion of it on each side of the Oblong Passage, may be seen without any dissection.

* SYNONYM. Called by BICHAT, who seems to have been the first to view it in its proper light, *Grande Fente Cérébrale*.

The Central Fissure may be regarded as consisting of five portions; a large Middle Part, occupying chiefly the middle regions of the Brain Proper; and four lesser Lateral Parts prolonged from the posterior corners of the Middle one, two from each. Of the Lateral Parts, one on each side, is continued forwards into the Middle Lobe, and may be called Anterior; while the other extends backwards into the Posterior Lobe, and may be named Posterior.

The Middle Part of the Central Fissure is precisely symmetrical, its Median Line corresponding with the Median Line of the Brain Proper. It communicates by its posterior margin with the external surface, under the whole extent of the posterior extremity of the *Corpus Callosum*. From this it extends forwards, forming a slight convexity upwards in the longitudinal direction, and a slight concavity in the transverse. On the Median Line, it sends down a prolongation of a triangular form, which extends along the Median Plane, and has its apex turned downwards and forwards, while its posterior angle is continued into a Canal which runs downwards and backwards, and opens into the Central Fissure of the *Cerebellum*. We shall call this the Vertical Prolongation of the Middle Part. Two other prolongations, which may be called Anterior, are continued from the Middle Part, forwards and downwards, one on each side of the Median Line. These form a convexity looking inwards, upwards, and forwards.

The Middle Part of the Central Fissure measures about an inch and a half, from side to side; about an inch and a quarter on the Median Line; and along the outer margin, on each side, about two inches and a quarter. The depth of the Vertical Prolongation in the middle is about half an inch. We shall consider the width of the Middle Part at different points, after we have described the appearances which are to be seen on the surfaces which form its sides.

On the lower surface of the Middle Part, we observe in the first place on the Median Line, the body called the Pineal Gland*. This is a substance of which the form and dimensions vary a good deal; but in general it is of a conical shape, the base being turned directly forwards, and the apex backwards; and has two flattened surfaces, of which the one looks upwards, and the other downwards. Its length is from a quarter to three eighths of an inch, its breadth about a quarter, and its thickness an eighth. It is always of a greyish colour.

It is unconnected with the surrounding parts, except at its base. To the upper border of its base, a narrow white plate is attached, which is continued at each extremity into a ridge on the *Thalami Optici*, called the Peduncle of the Pineal Gland; while the lower border sends off another and a much broader white *lamina*, also connected laterally with the *Thalami*, but extending downwards and forwards, and then suddenly turning backwards, to be continued into the Connecting Plate of the Upper *Corpora Bigemina*. The anterior surface of this lower *lamina* is quite smooth; and cannot be seen without removing the *Thalami Optici* to a level with it. From the doubling which it forms, it looks from before like a little white cord. The posterior surface is generally formed into slight transverse furrows, and is best exposed by turning the Pineal Gland forwards.

It is the lower portion of this *lamina*, which is usually described under the name of the Posterior Commissure of the Brain Proper. This name, however, may be given to the whole of it; for there is, in truth, no distinction among its parts.

Immediately underneath the Pineal Gland, and supporting it, there is a smooth, triangular, and slightly concave, surface, with its base turned forwards and its apex backwards. This is the upper surface of a thin *lamina* which is

* SYNONYM. *Lat.* Conarium.

stretched across between the two Upper *Corpora Bigemina*, and continued into these prominences on each side, and which, therefore, we shall call their Connecting Plate. Its base joins with the Posterior Commissure. Its colour is white; but very often numerous small lines of a brighter white than the other parts, may be seen extending across it, throughout the whole of its extent. The Posterior surface of the Posterior Commissure is applied to it, but not connected with it; they form between them a sort of *cul-de-sac*, about a sixth of an inch deep, the mouth of which looks upwards and backwards, and which may be seen by turning the Pineal Gland forwards.

The rest of the Median Line anterior to the Pineal Gland, is occupied by the opening of the Vertical Prolongation of the Middle Part. This opening, in the middle, is a mere slit, the sides of which are closely in contact; it enlarges however, at each extremity, into a triangular orifice, one immediately before the Pineal Gland, about an eighth of an inch wide at its base, and another immediately behind the anterior extremity of the *Fornix*, a little wider.

The Vertical Prolongation is not an uninterrupted fissure from above downwards; its sides are continued into each other in the middle, a little way from the opening above, for a space of about three eighths of an inch long, and a tenth of an inch thick. This connection is called the Commissure of the *Thalami Optici**. It varies in its dimensions a good deal; and it is said to be sometimes altogether awanting, though I confess, I have never found it so. In the natural situation of the *Thalami*, it has scarcely any breadth; but when these bodies are pulled a little asunder, it takes the form of a thin plate, of a greyish colour, stretched across the fissure like a bridge.

The sides of the Vertical Prolongation around this Commissure, are formed by the inner, flat, surfaces of the *Tha-*

* SYNONYM. *Fr.* Commissure Médiane.

lami, which are here of a greyish colour, and closely applied to each other. On the forepart, and a little below these surfaces, two white, rounded, smooth, ridges, are seen, one on each side, running upwards, forwards, and a very little inwards, for about a quarter of an inch, and then uniting with each other on the Median Line. These are called the Anterior Pillars of the *Fornix* *.

The bottom of the Vertical Prolongation slopes, from behind, downwards and forwards. At its posterior extremity, it communicates, under the Posterior Commissure, with a Canal about a twelfth of an inch in diameter, and half an inch in length, called the Aqueduct of *Sylvius*. This canal runs backwards and downwards on the Median Line, under and before the *lamina* which connects the *Corpora Bigemina* on each side to each other, and which has the Longitudinal Furrow on its upper and posterior surface; and opposite to the inferior extremity of this Furrow, or to the *Frenulum*, it opens into the Central Fissure of the *Cerebellum*.

The bottom of the Vertical Prolongation projects at its anterior extremity into a *cul-de-sac*, of which the lower portion is of a conical shape, and penetrates half way to the point of the *Infundibulum*; while the upper, of a triangular figure, has its apex turned downwards and forwards; and has for its anterior side, a thin *lamina*, the outer, grey, surface of which has been already described, above the Commissure of the *Tractus Optici*; and for its posterior, the superior surface of this Commissure itself. I do not find, that this latter portion of the Vertical Prolongation, has been taken notice of, by any author. It measures, at its base, about an eighth of an inch from before backwards, and nearly a sixth of an inch from side to side; and the length of its anterior surface, in the middle, is fully a quarter of an inch.

* SYNONYMS. *Lat.* Crura Anteriora Fornicis. *Fr.* Productions Antérieures du Triangle Médullaire.

Immediately underneath the junction of the two Anterior Pillars of the *Fornix*, there is stretched across the anterior part of the Vertical Prolongation, a smooth, white, rounded ridge, denominated the Anterior Commissure of the Brain. I imagine, that in the natural situation of parts, this Commissure is seldom more than a tenth of an inch in length. It is placed anterior to the Pillars of the *Fornix*, and seems, as it were, to unite them together.

These are the appearances to be seen, on the Lower surface of the Middle Part of the Central Fissure, and on the Median Line.

On each side of the Median Line on this surface, we observe, in the first place, a prominence of a pyriform shape, called *Corpus Striatum*, of which the large extremity occupies the whole of the Anterior Prolongation of the Middle Part, while the small end, extends along the outer border of this Part, to its posterior corner. Its inner margin forms a slight curve, of which the concavity looks inwards. Measured in the middle, it is about two inches and a half long, and its transverse diameter at the widest part before, is about an inch; but its dimensions vary. Its surface is quite smooth, and every where of a brownish grey colour.

On the inside of the posterior half of the *Corpus Striatum*, and separated from it by a furrow, which is pretty deep before, but becomes shallow behind, is seen the superior surface of the *Thalamus Opticus*. The outline of this surface approaches to a triangular form; the apex being turned forwards, and the base backwards. The inner border, which is about an inch and a quarter in length, runs parallel and close to the Median Line, on the forepart; but within a quarter of an inch of its posterior extremity, it inclines a little outwards. The outer border, which looks towards the *Corpus Striatum*, extends from before, backwards and outwards, and is about an inch and a half in length. The base in general forms a right angle with the inner side, and measures about five eighths of an inch. All these dimensions, however, are subject to variety, and, as far as my observations have hitherto gone, they bear no fixed proportion to the dimensions of the *Corpus Striatum**. The apex is a little rounded ; as also the inner and posterior angle, which is formed by the Posterior Tubercle.

This surface of the *Thalamus* is convex both from before backwards, and from side to side. Towards the apex there is a small space which is more prominent than the rest, and which is called the Anterior Tubercle.

A narrow ridge runs along the inner border, beginning at the apex, and enlarging a little as it proceeds backwards, which is at last continued into the upper white *lamina* attached to the base of the Pineal Gland. This ridge is called the Peduncle of the Pineal Gland.

The upper surface of the *Thalamus* is of a white colour, and in general quite smooth ; but sometimes a rough line is seen on it, extending, diagonally, from the apex, over the top of the Anterior Tubercle, to the outer and posterior corner. This is occasioned by the attachment of a Vascular Membrane, afterwards to be described.

A ridge runs along the bottom of the Furrow between the *Corpus Striatum*, and the upper surface of the *Thalamus Opticus*, which is called *Tænia Semicircularis*†. It begins at the Anterior Pillar of the *Fornix*, where it is more than an eighth of an inch in breadth, and tapers as it proceeds backwards. Sometimes, it seems to terminate at the posterior extremity of the *Corpus Striatum ;* but in general, it is continued down into the Anterior Lateral Part of the Central Fissure, where we shall afterwards take notice of it. Its surface is smooth. Towards the forepart, it is of a greyish colour, like the *Corpus Striatum*, with, sometimes, an

* This was the result, also, of many measurements made by Vicq d'Azyr, Traité d'Anatomie, &c. p. 36.

† Synonyms. *Lat.* Geminum Centrum Semicirculare, Stria Cornea. *Fr.* Bandelette Striée.

appearance of white lines, running, lengthways, from its anterior extremity, for about half an inch backwards. Towards its posterior end, it is altogether white, like the surface of the *Thalamus Opticus.*

Such are the appearances to be observed on the lower surface of the Middle Part of the Central Fissure.

On the superior surface or roof of this Part, we remark, in the first place, on the Median Line, a surface of the form of a triangle with the angles at the base cut off, projecting downwards a little below the level of the other parts, and having its apex turned forwards. This is denominated the *Fornix**. It is concave from behind forwards, and convex from side to side. Its base, which is formed by the lower surface of the posterior extremity of the *Corpus Callosum*, is smooth and rounded, and measures about an inch and a half. Two white ridges, called the Anterior Pillars of the *Fornix*, have already been described, in the Vertical Prolongation of the Middle Part of the Central Fissure. The point where these unite into one, forms the apex of the *Fornix*, and this is about a quarter of an inch broad. From the Apex to the middle of the base, measures about two inches. The lateral parts of the *Fornix* are quite detached from the surface above, so that they form a kind of cornice on each side, gradually increasing in depth from the apex towards the base, where they are a quarter of an inch deep. Close to the apex, these borders or cornices are rounded and smooth, but at all other points they present a sharp edge. Their length is about an inch and three quarters. At the Posterior angles they are usually called the Posterior Pillars of the *Fornix* †; and here they are continued, on each side, into the *Hippocampus*, an appearance to be described in the Anterior Lateral Part of the Central Fissure.

* SYNONYMS. *Fr.* Voûte à trois piliers; Triangle Medullaire.

† SYNONYMS. *Lat.* Crura Posteriora Fornicis. *Fr.* Productions Posterieures du Triangle Medullaire.

The whole surface of the *Fornix* is of a white colour. In general, a slight furrow may be seen, extending from the junction of the Anterior Pillars, for about half way backwards along the Median Line, and then vanishing. Extremely delicate grooves, too, are commonly perceptible, running along the lateral borders; and sometimes, towards the base, there is an appearance of similar *striæ* and ridges inclining from the sides towards the Median Line, and more or less forwards. It is to this last appearance, when it occurs, that the name of the Lyre* has been given.

On each side of the Median Line, on the roof of the Middle Part of the Central Fissure, there is a concave surface, almost precisely the reverse of the convex surfaces of the *Corpus Striatum* and *Thalamus Opticus*, below. The portion of this concave surface anterior to the apex of the *Fornix*, and corresponding to the most prominent part internally of the *Corpus Striatum*, is formed by the surface of a narrow partition called *Septum Lucidum*. This *Septum* is interposed on the Median Line, between the Anterior Prolongations of the Middle Part of the Central Fissure; and is continuous behind, with the Anterior Pillars and Apex of the Fornix. At its base, it is fully a quarter of an inch thick, but towards its Middle and Upper part, scarcely more than an eighth.

The surface of the *Septum*, and also a small part of the surface above and before it, is of a grey colour, though not so dark as the *Corpus Striatum*. The rest of the concave upper surface of the Middle Part, is white and glossy.

Of these surfaces forming the roof of the Middle Part, the portion called the *Fornix* rests on the *Thalami Optici*, with the intervention, only, of a thin vascular membrane, afterwards to be described. It is not large enough however, to cover them altogether. If we suppose the upper surface of these prominences to be divided into two, by a line drawn

* SYNONYM. *Lat.* Psalterium.

from their apex to the outer angle at their base, the *Fornix* will cover only the inner portion of each. The middle part of the base of the *Fornix*, is stretched across the space between the Posterior Tubercles of the *Thalami*, and forms the roof of the Oblong Passage; while the apex of the *Fornix*, forms an arch, over the small triangular orifice leading to the Vertical Prolongation. The outer half of the *Thalami Optici* is covered by a Vascular *Plexus*, which will be described along with the Membranes of the Brain. When the Central Fissure contains no Serous Fluid, there is reason to believe, that the surface of this *Plexus* and of the *Corpus Striatum* below, are closely applied to the surface of the *Corpus Callosum* above.

We now proceed to describe the Lateral Parts of the Central Fissure; and first the Anterior Lateral Parts.

The Anterior Lateral Part of the Central Fissure, is the same in both Hemispheres. It is prolonged from the posterior corner of the Middle Part, downwards and forwards into the Middle Lobe, in the form of a curve, of which the concavity looks inwards and forwards. It is about two inches long; and its breadth at its origin above, is about half an inch; but it becomes gradually broader as it descends, so as to be nearly three quarters of an inch at its anterior extremity, where it is of a rounded shape.

Along the whole of its inner edge, excepting about an inch from its anterior extremity, it communicates, uninterruptedly, with the external surface of the Brain; the opening being continuous with that by which the Middle Part of the Central Fissure communicates with the same surface, under the posterior extremity of the *Corpus Callosum*. The anterior extremity, beyond this opening, forms a *cul-de-sac*, within the substance of the Inner Lobule of the Middle Lobe.

Its inner and lower surface exhibits a large, white, smooth prominence, denominated the *Hippocampus**. This begins above at the posterior Pillar of the *Fornix*, of which it is in

* SYNONYMS. *Lat.* Pes Hippocampi; Cornu Ammonis.

fact a continuation, and runs along the whole of the Fissure to its anterior extremity. It preserves almost exactly the shape of the cavity of which it forms the floor; only it is rounded along its outer margin, so that between this and the side of the cavity, there is a small triangular canal which runs from one end to the other. At its anterior extremity, its surface exhibits several irregular depressions, which vary a good deal in their number and size. To its inner, concave, margin, a sort of fringe is attached, beginning at the posterior Pillar of the *Fornix*, which seems as if plaited inwards to form it, and terminating on the upper and posterior part of the Small Convolution of the Inner Lobule already described. This is what is called the *Tænia Hippocampi**. It is about a fifth of an inch broad at its upper extremity, but tapers a little below. Its surface is quite smooth, and of the same white colour as the *Hippocampus* itself. Between it and the upper surface of the Inner Convolution of the Middle Lobe, there is a fissure about an eighth of an inch deep, which is continued into the fissure between this Convolution and the Small Convolution of the Inner Lobule, formerly mentioned. The surface of this fissure, formed by the Inner Convolution of the Middle Lobe, exhibits the appearance of a superficial ridge, of a grey colour, with a number of slight, transverse, indentations. This ridge, at its upper extremity, where it is continuous with the posterior angle of the *Corpus Callosum*, is as broad as the *Tænia Hippocampi*. As it proceeds downward, however, it becomes gradualy narrower, and is entirely concealed by the *Tænia Hippocampi*, which must be pushed gently outwards in order to bring it into view. It tapers to a point, about the middle of the fissure under the Small Convolution of the Inner Lobule. We shall call this ridge, the Indented Band†.

* SYNONYMS. *Lat.* Corpus Fimbriatum. *Fr.* Bandelette de l'Hypocampe.

† This Band was described by *Vicq d'Azyr* in the Mem. de l'Acad. Roy. des Sciences 1781, under the name of *Borde interne et dentelé de la Corne*

The opposite surface of the Anterior Lateral Part of the Central Fissure, presents a concavity corresponding to the convexity of the *Hippocampus ;* and in general, corresponding to the slight furrow between the *Hippocampus* itself and the *Tænia Hippocampi*, there is a narrow ridge, continuous with the *Tænia Semicircularis* in the Middle Part of the Central Fissure. The whole of this surface is smooth, and of a white colour. Between it and the *Tænia Hippocampi*, and the inner half of the *Hippocampus* itself, a vascular *plexus* is interposed, which will be described afterwards. To what distance it is separated from the outer half of the *Hippocampus*, in the healthy state of the Brain, is uncertain : Along the outer margin of the *Hippocampus*, there is obviously a distinct canal, which is always open ; but at other parts, I rather suspect, that the opposite surfaces of this portion of the *Central Fissure* are nearly, if not actually, in contact with each other.

The Posterior Lateral Part * of the Central Fissure, like the Anterior, is precisely the same in both Hemispheres. It is prolonged from the posterior corner of the Middle Part, almost horizontally backwards into the Posterior Lobe, forming a curve of which the convexity is turned outwards. It varies a good deal in its dimensions ; but in general its length is about an inch and a quarter, and its breadth about a quarter of an inch, except at its posterior extremity, where it is slightly pointed. Its inner surface is smooth, white, and convex, but much more prominent to-

d'Ammon. It is represented, (though it must be confessed not very accurately) in Plates XV. and XX. of his Traité d'Anatomie. In the explanation of these Plates and of Plate XVI. he calls it, "*La portion grise, corticale, interne, godronnée, de la* Corne *d'Ammon.*"

It is somewhat singular, that this description of *Vicq d'Azyr's* seems to have escaped the notice of *Bichat.* After mentioning, shortly, the situation of the Indented Band, he observes, "Les Auteurs l'ont negligé, quoiqu'il soit aussi remarquable que le corps frangé, &c." Anatom. Descript. III. p. 94.

* SYNONYMS. *Fr.* Ancyroide, Cavité Digitale.

wards the forepart, than at the Apex. It is to this convex surface that the term *Colliculus** has been applied.

The opposite surface of the cavity is smooth, white, and concave; but whether the two surfaces are in contact, in the healthy state of the Brain, or are separated to a slight distance from each other, is not yet ascertained.

As both the Anterior and the Posterior Lateral Parts of the Central Fissure, arise from the posterior corners of the Middle Part, all these Parts communicate at this point with each other; and the sort of area where they meet, immediately behind the Posterior Pillars of the *Fornix*, is about a quarter of an inch in diameter.

Such are all the circumstances worthy of notice respecting the different portions of the Central Fissure of the Brain Proper. The division of this Fissure into compartments called Ventricles, will be considered afterwards, when we come to treat of the Membranes of the *Cerebellum*.

We have now to examine, according to the same order, the circumstances relating to weight, dimensions, form, and colour, in the *Cerebellum*.

The *Cerebellum* weighs in general from five to eight ounces Avoirdupois.

It approaches to an elliptical shape, the long diameter lying horizontally, and at right angles to the Median Line of the Body. Its inferior surface is convex; its superior, prominent in the middle and towards the forepart, and slightly concave behind and at the sides.

Its long diameter measures from three and three fourths to four inches; its transverse diameter, in the middle, about an inch less; and its greatest height, or depth, or thickness, is from an inch and three fourths to two inches.

Like the Brain Proper, it is symmetrical, its Median Line corresponding with the Median Line of the Body; and its two halves are denominated Hemispheres.

* SYNONYMS. *Lat.* Unguis caveæ posterioris Ventriculorum lateralium. *Fr.* Ergot.

The greater part of its external surface is formed into what are called Convolutions, but which in truth resemble the Convolutions of the Brain Proper, in nothing but in colour. They ought rather to be denominated the *Laminæ* of the *Cerebellum*. They have the appearance of *strata* or layers, from a sixth to a twelfth of an inch thick, lying close to each other, though actually divided by Fissures varying in depth from the twentieth part of an inch to an inch ; and when these layers are gently separated from each other, the surfaces of each of them, are found to exhibit the same laminated appearance. This is one of those pieces of structure, however, which it is impossible to convey any accurate idea of, by words.

When we view the *Cerebellum* from above, we observe in the first place, on the Median Line, and on the forepart, the surface of the section by which it is separated from the Brain Proper. It is sufficient to remark with respect to this surface, that it is heart-shaped ; and that the receding angle at the base which looks forwards, is formed by the lower surface of the extremity of the Triangular Furrow, between the Peduncles of the Brain Proper, already described ; while close to its apex, a small triangular hole is seen, which is a cross section of the lower end of the Aqueduct of SYLVIUS. The posterior half of this heart-shaped surface is bounded by a Semilunar *Fossa ;* and immediately behind this *Fossa*, there is an eminence which I should be inclined to call the *Mons Cerebelli*. The anterior surface of this eminence rises, perpendicularly, to the height of a quarter of an inch, above the level of the heart-shaped surface just decribed ; while behind, and on each side, it passes by a gradual declivity into the Median *Fossa*, and into the slight concavities which present themselves, on the upper surface of each Hemisphere. It is composed of *Laminæ* of which the general direction is transverse to the Median Line, but with certain irregularities, which it would be difficult to describe. The remaining part of the Median Line, between the *Mons Cerebelli* and the posterior margin of the *Cerebellum*, is occupied by the posterior extremity of the Median *Fossa*, which varies in its length from three quarters of an inch to an inch, and in its breadth from a quarter of an inch to a half.

On each side of the Median Line, the upper surface of the *Cerebellum* presents a slightly concave, and regular surface; exhibiting *Laminæ*, of which the general direction, is from the Median Line outwards and forwards in the form of a curve, with the convexity turned outwards and backwards. The parts of each Hemisphere which are seen, in this view of the *Cerebellum*, separated by the posterior extremity of the Median *Fossa*, may be called the Posterior Lobes; and we propose to call the Anterior Lobes, those parts of each Hemisphere which are placed anterior to a line, drawn from the anterior margin of the *Mons*, to the outer and anterior corner of the *Cerebellum*.

The Semilunar *Fossa* bounding the *Mons Cerebelli* before, has its concavity turned directly forwards. It measures directly across from one horn to the other, about an inch and an eighth; and its width is not greater than that of the Fissures between the Convolutions of the Brain Proper. When the parts forming its anterior sides are removed, so as to expose its posterior surface, we find that this surface is formed in the middle, by a ridge continuous above with the perpendicular surface of the *Mons Cerebelli*, and which inclining backwards and downwards, forms a curve, convex downwards and forwards. This ridge is about half an inch long, and a quarter broad; rounded on its surface; and presenting *Laminæ* which lie chiefly in a horizontal position. To it we shall restrict the term Superior Vermiform Process. The surface of the Semilunar *Fossa*, on each side of this Process, is formed by a sloping face of the Anterior Lobes, which looks inwards, forwards, and a little downwards; and which exhibits *Laminæ*, running, some from behind forwards, and others from below upwards.

When the parts just described are cut away, so as to bring into view the anterior side of the Semilunar *Fossa*, we observe, in the first place, on the Median Line, a slightly concave surface, extending down from the lower extremity of the Longitudinal Furrow between the *Corpora Bigemina* of the Brain Proper, to the root of the Superior Vermiform Process. This is the posterior surface of what has been denominated the Vieussenian Valve*. Its concavity corresponds exactly to the convexity of the Vermiform Process to which it is closely applied, and of which it follows the direction. It consists of two parts. The upper portion is about a fifth of an inch high, and a sixth wide; white and smooth; attached by its upper margin, to the *Frenulum* in the middle, and to the lower border of the Inferior *Corpus Bigeminum* on each side; and continuous laterally with the Pillars of the Vieussenian Valve. The lower portion, which extends from the upper to the root of the Vermiform Process, and which is also continuous with the Pillars of the Valve laterally, is from a third to half an inch in height; and as it gradually widens as it proceeds downwards, it is about a third of an inch wide at its base. Its surface presents a very singular appearance. It is divided into four horizontal bands, of a brownish colour, and varying in breadth from a twelfth to an eighth of an inch. The furrows between these, are not wider than a hair; and as they do not extend entirely across the surface, the bands are united along their extremities. The upper band is a little rounded; and the lower ones increase successively in length, in proportion as the surface across which they are placed widens; so that the outline of the whole appearance is parabolic. Va-

* SYNONYMS. *Lat.* Velum Interjectum. *Fr.* Valvule de l'Aqueduc de Sylvius; La Lame Medullaire Moyenne du Cervelet.

rieties, however, not unfrequently occur in the breadth and inclination of the bands ; and, very often, they are crossed at right angles, by a slight fissure running along the Median Line, from top to bottom, and dividing them into two halves, right and left.

On each side of this posterior surface of the Vieussenian Valve, and continuous with it, there is a smooth, white, rounded ridge, called the Pillar of the Vieussenian Valve*, which runs upwards and forwards, forming a gentle curve, of which the concavity looks upwards and backwards. It arises close to the root of that sloping surface of the Anterior Lobe, already described on each side of the Vermiform Process ; and is connected above to the Lateral Ridge of the Inferior *Corpus Bigeminum*, and to the outer and lower border of the *Corpus Begiminum* itself. A furrow, pretty broad below, but narrow above, separates its outer border from the Peduncle of the *Cerebellum*. Its length is about three fourths of an inch ; but owing to the conical shape of the Vieussenian Valve, it is narrower below than above. At its broadest part, which is just under the Inferior *Corpus Bigeminum*, it is about half an inch. Immediately under the middle of the Lower *Corpus Bigeminum*, and about an eighth of an inch from the Vieussenian Valve, the Pathetic or Fourth Cranial Nerve is attached to it.

Not unfrequently two or three brownish coloured bands, precisely similar to those of the Vieussenian Valve, and partly continuous with these, partly with the Middle *Laminæ* of the Upper Vermiform Process, are found crossing it close to its root.

External to the Pillar of the Vieussenian Valve on each side, is seen the upper surface of the Peduncle of the *Cerebellum* ; but we shall reserve the description of this, until we come to view the other aspects of the Peduncles.

* Synonyms. *Lat.* Processus ad Testes. *Fr.* Colonnes ou Pédoncules de la Lame Medullaire.

The lower surface of the *Cerebellum* presents, in the first place, on the Median Line, and on the forepart, an eminence denominated the Annular Protuberance*. This eminence is convex both from above downwards, and from side to side. It is quite symmetrical, and its Median Line corresponds to the Median Line of the *Cerebellum*. Its upper border slopes downwards a little on each side, and its lower is nearly horizontal; but in the middle of each margin there is a slight notch. The notch of the upper one is continuous with the lower surface of the *cul-de-sac*, which terminates the Triangular Furrow between the Peduncles of the Brain Proper; and that of the lower, is continuous with the roof of a similar *cul-de-sac* at the top of the Spinal Cord. Between these two notches there runs a groove, similar to the impression of a goose-quill, which is denominated the Basilar Furrow.

Along its upper margin, the Annular Protuberance is connected with the Peduncles of the Brain Proper; and here its transverse diameter measures from an inch to an inch and an eighth. By its lower border, it is joined to the Spinal Cord; but its transverse diameter at this part is only about three quarters of an inch. It is connected laterally to the Peduncles of the *Cerebellum;* and as there is no distinct natural boundary between it and these prolongations, on the anterior part, I shall consider them as separated from each other, by an imaginary straight line, drawn from the forepart of the attachment of the Trigeminal Nerve, to the forepart of the attachment of the Facial Nerve of the same side. Along this line, the Protuberance measures about three quarters of an inch; but towards its middle, close to the Basilar Furrow, its height is fully an inch.

* SYNONYMS. *Lat.* Pons Varolij; Nodus Encephali. *Fr.* Protuberance Cérébrale.

The whole surface of the Annular Protuberance is marked by slender furrows, most of which lie horizontally, though sometimes towards the Trigeminal Nerve, they are a little inclined. They are of various lengths; none of them extending completely across from one side to the other. They are deepest and most numerous towards the sides of the Protuberance; but there is scarcely the breadth of a twelfth of an inch, on any part of its surface, which is entirely without them.

Besides these furrows, numerous little holes are seen upon it, as if it had been pricked with the point of a pin. Into these, small Bloodvessels enter, from the Membranes afterwards to be described.

From the lower margin of this surface of the Protuberance, about a sixth of an inch on each side of the Basilar Furrow, the *Abductores Oculorum* Nerves take their origin. Their attachment does not exceed the fifteenth part of an inch.

Immediately under the Annular Protuberance, there is a large sinuosity, of a conical shape, with the base turned upwards, which lodges the top of the Spinal Cord, and which, therefore, may be called the Spinal *Fossa* of the *Cerebellum*. The lower surface of the Annular Protuberance, or that which is made by cutting away the Spinal Cord, overhangs this *Fossa*. This surface is horizontal, and in shape somewhat like two crescents, joined by their convexities towards their anterior horns; consequently, it has a small sharp notch in the middle before, and a large and wide one in the middle behind. The greatest transverse diameter of this surface, measures about an inch; and the largest diameter from before backwards, about five eighths of an inch. In the angle between its posterior margin and the posterior surface of the *Fossa*, there is a slit, about a sixth of an inch wide in the middle, but tapering to about a twelfth of an inch on each side, which leads into the Central Fissure of the *Cerebellum*.

The posterior and lateral surfaces of the Spinal *Fossa*, are formed by the Sub-peduncular and Spinal Lobules of the *Cerebellum*; but we shall defer the description of these, until we come to view the parts on each side of the Median Line.

The posterior surface of the Spinal *Fossa* is divided into two halves, right and left, by a fissure, which beginning here, extends, on the Median Line, along the whole of the remaining part of the lower surface of the *Cerebellum*, and penetrates to the superior surface between the two Posterior Lobes behind. This may be called the Median *Fossa* of the *Cerebellum*. It varies a good deal in its shape and dimensions; but in general, it is so narrow opposite the Spinal Lobules, that the inner surfaces of these Lobules are in contact with each other. Above and behind this part, however, it is about a quarter of an inch wide, and exposes the superior and posterior portions of the Inferior Vermiform Process, which runs along the bottom of it.

Of the Inferior Vermiform Process, it would hardly be possible to convey any idea by words. It is a sort of ridge, varying in length from an inch and a quarter to an inch and a half, convex from before backwards, and formed of *Laminæ*, which lie chiefly at right angles to the Median Line. Two fissures much deeper than the rest, divide it into three parts, an anterior, middle, and posterior. The posterior portion, is that, which in the natural situation of parts, appears behind the Spinal Lobules. It is the largest of the three, and of a pyramidal shape, with the apex looking backwards. The middle portion is of an oblong shape, and almost entirely concealed by the Spinal Lobules, which must be removed to bring it completely into view. The fissure which separates it from the posterior part, is in general half an inch deep, though the surfaces of the two portions are closely in contact. Laterally, it passes gradually into a white concave surface, which rests on the upper convex part of the Spinal Lobules. The anterior portion, which, for the sake of brevity, we shall call the Head* of the Inferior Vermiform Process, and which is the smallest of the three, is square shaped The fissure separating it from the Middle Part, is about a third of an inch deep. Its lower surface, which looks towards this fissure, is flat and laminated; its upper surface, which is turned towards the Central Fissure of the *Cerebellum*, is smooth, white, convex, and undivided.

Two extremely delicate parts are connected with it laterally, which may be called the *Alæ* or Wings of the Inferior Vermiform Process . These are somewhat of a semilunar shape, the concave margin being turned forwards and inwards, and the convex one in the opposite direction. Their breadth, in the middle, is from a quarter to three eighths of an inch, and their concave edge measures about three quarters of an inch. They are thinnest towards the anterior part, and no where thicker than silk-paper. Their inferior surface is white, smooth, and concave, and rests on the Spinal Lobules; their superior is smooth, white, and convex, and forms the floor of the Central Fissure. The whole of their anterior concave margin is free, and of their posterior convex one, attached. Their inner *cornua* are connected to the anterior angles of the Head of the Vermiform Process, and, at this part, are in general split into two *laminæ* for the extent of about an eighth of an inch. Their outer extremities are joined to the inner surface of the Sub-peduncular Lobules.

The parts to be observed on each side of the Median Line, on the lower aspect of the Cerebellum, are the following.

* SYNONYM. *Vicq d'Azyr* includes this and the middle part under the name of " Eminence Mammillaire du *Vermis Inferior*."

† SYNONYMS. *Lat.* Valvulæ Semicirculares Inferiores et Posteriores. *Fr.* Les Lames Semi-lunaires de l'Eminence Mammillaire du Vermis Inferior. *Ger.* Die Halbmond-förmigen Seitentheile des Hinteren Marksegles.

Proceeding from before backwards, we observe in the first place, a *Fossa* beginning at the Semilunar *Fossa* on the inside, and extending downwards and outwards for nearly an inch and three fourths, in the form of a curve, with the concavity upwards. The sides of this *Fossa* touch each other, and are formed above by the extremities of the *Laminæ* of the Anterior Lobe, and below by the extremities of those belonging to the Sub-peduncular Lobule and inferior Lobe. In the middle, it is nearly half an inch deep, but shallower at each end. At the bottom of it, appears the Peduncle of the *Cerebellum*; and on that account, I shall distinguish it by the name of the Peduncular *Fossa*.

The Peduncle*, is a portion of the *Cerebellum* which extends from the lower and lateral part of the Annular Protuberance, outwards, backwards, and a little downwards.

One surface of this Peduncle, is smooth, white, and slightly convex, and looks upwards and backwards. We already had occasion to take notice of it, when describing the Semilunar *Fossa*, lying on the outside of the Pillar of the Vieussenian Valve. The extremities of the inner *Laminæ* of the Anterior Lobes rest upon it, and conceal it entirely from our view in the natural situation of parts. In the direction from the Pillar of the Vieussenian Valve outwards, it measures about half an inch, but scarcely more than a quarter of an inch from before backwards. The upper portion of the Trigeminal Nerve is attached to it, at its most anterior point, just where it is passing into the Annular Protuberance.

Another surface of the Peduncle looks forwards and outwards. This is continuous with the lateral surface of the Annular Protuberance, and is the surface which presents itself at the bottom of the Peduncular *Fossa* just described.

* Synonyms. *Lat.* Pedunculus Cerebelli; Crus Cerebelli; Crus Cerebelli Posterius. *Fr.* Prolongement Posterieur ou Cerebelleux de la Protubérance Cérébral.

Close to the Protuberance, its height is about five eighths of an inch, but in the *Fossa*, it is scarcely more than an eighth. It is convex, smooth, and of a white colour. At its uppermost point, and just where it is continued into the Protuberance, the lower portion of the Trigeminal Nerve is attached to it. The attachment occupies an elliptical space about a fifth of an inch in length, and in general bounded both above and below by a slight ridge; and the uppermost half of this ridge always intervenes between the attachment of the upper and the lower portion of the Nerve. The Facial Nerve is attached to the lowermost point of this surface, close to its junction with the Protuberance; the connection, occupying a circular space scarcely a twelfth of an inch in diameter. And an eighth of an inch from this, in a direction outwards, backwards, and downwards, is seen a space about twice the size of the former, which serves for the attachment of the Auditory Nerve.

Lastly, there is a small surface of the Peduncle which looks directly downwards. This is bounded, before, by the surface just described; behind, by the Spinal Cord; on the inside, by the Protuberance; and without, by the Sub-peduncular Lobule. It is of an oblong shape, measuring about a quarter of an inch in length, and a fifth in breadth. Two white ridges are seen on it, running, from the spaces described on the former surface as giving attachment to the Facial and Auditory Nerves, backwards and inwards.

Attached to the lower part of the Peduncle, immediately to the outside of the connection of the Auditory Nerve, is the small eminence which I have called the Sub-peduncular Lobule*. This, in general, is about three quarters of an inch in length, and from a quarter to a third of an inch in breadth at its outer end, which is the largest. The upper

* Synonym. *Fr.* Le Lobule du Nerf Vague.

half of its inner extremity presents a smooth, white, convex surface, bounded below by a ridge of the breadth of a hair, which extends forwards and outwards, and is the connection and continuation of the Wings of the Inferior Vermiform Process. At all other parts it consists of small *Laminæ*. Below, it rests upon the Spinal Lobule from which it is separated by a fissure; it forms a part of the Peduncular *Fossa* by its upper surface, and a portion of the Spinal *Fossa* by its inner extremity.

Under the Sub-peduncular Lobule, is that portion of each Hemisphere which we have denominated the Spinal Lobule*. Of this, one side looks downwards and is convex, forming the most prominent part of the lower surface of the *Cerebellum;* another, turned forwards and inwards, is concave, and constitutes almost one half of the Spinal *Fossa;* a third, which is much rounded, looks upwards and backwards, and supports the Wings of the Inferior Vermiform Process: a fourth is quite flat, and forms part of the side of the Median *Fossa*, coming so close to the corresponding part of the opposite Hemisphere, as to conceal from our view the middle portion of the Inferior Vermiform Process. Its greatest height and breadth is about an inch. All its surfaces exhibit *Laminæ*. Those on the lower aspect form a curve, with the concavity looking forwards and inwards, and have their upper extremities terminated, by the fissure which separates this Lobule from the Sub-peduncular Lobule.

We may call that part of the lower surface of each Hemisphere, the Inferior Lobe, which is bounded behind by the Posterior Lobe; before, by the Anterior Lobe, and the Peduncular *Fossa;* and on the inner and forepart, by the

* SYNONYMS. *Lat.* Tubercula Lateralia Anteriora Inferiora Cerebelli. *Fr.* Le Lobule de la Moëlle Alongée.

Spinal Lobule. It has a uniform and pretty considerable convexity; and consists of *Laminæ*, of which the general direction corresponds to a curve, with the concavity looking forwards and inwards.

The lower surface of the Posterior Lobe of the *Cerebellum* is slightly convex, and consists of *Laminæ* which are continued from those on the neighbouring surface of the Inferior Lobes.

In the *Cerebellum*, as in the Brain Proper, there is a fissure, which penetrates from the outer surface into the central parts, and which therefore may be called the Central Fissure of the *Cerebellum*.

The opening of this Fissure is the slit already described at the upper and back part of the Spinal Fossa, immediately behind the lower and posterior margin of the Annular Protuberance. The Fissure itself is of a conical shape, the plane of its base being nearly horizontal, and its apex, which is turned upwards and forwards, communicating with the Aqueduct of SYLVIUS, and consequently with the Central Fissure of the Brain Proper. It is symmetrical, and its Median Line corresponds with that of the *Cerebellum*. At its base, it measures from side to side, about an inch and a quarter, and from before backwards, between half an inch and three quarters. At its apex, it is about an eighth of an inch, in both these directions.

The floor or lower side of this Fissure, is formed by the upper surface of the Head and *Alæ* of the Inferior Vermiform Process, already described.

The upper and posterior side is smooth, and of a white colour. Towards the lower part, it is concave and closely applied to the floor of the Fissure; but as it ascends, it forms a gentle curve, with the convexity looking downwards and forwards. In this upper convex portion, we may distinguish a middle, and two lateral parts. The middle part is the anterior surface of the Vieussenian Valve, and is white, smooth, and convex. The two lateral parts are the anterior surfaces of the Pillars of this Valve, and are inclined a little inwards. They have the same smoothness and colour as the middle part, and are of a triangular figure.

The anterior side of the Fissure, is of a browner hue than the other two, particularly towards the lower part. A narrow groove* about a twelfth of an inch deep, runs along its Median Line, beginning within the Aqueduct of SYLVIUS above, and continued below into the Spinal Cord, where we have afterwards to take notice of it. On each side of this furrow, the surface is slightly rounded and cord-like, and is in general a little more prominent at the lower part than above.

Such are the appearances which present themselves on the various surfaces, external and internal, of the Substance of the Brain. We have next to consider the structure and composition of this substance.

It consists almost entirely of a peculiar matter, which we shall call Nervous Matter. Of this there are two sorts, one usually denominated Medullary, the other Cineritious. It is better, however, to distinguish them by the terms White and Brown Nervous Matter. We shall consider of each of these separately.

The White Nervous Matter is of different shades, in different parts of the Brain. In most parts, it resembles in colour, a mixture of Orange-White and Wine-Yellow†; and this sort, we shall call, Orange-White. In other parts, it approaches more closely to the Wine-Yellow; and this species may be distinguished by the term Yellowish-White.

* SYNONYM. *Fr.* Sillon Longitudinal et Moyen du Ventricule du Cervelet.

† See SYME's *Nomenclature of Colours.*

It is difficult to convey any accurate idea of the consistence of the White Nervous Matter. It varies a little in different parts. In general it is less elastic than Jelly, but somewhat more glutinous or viscid.

When we make a section of it in any direction, with a sharp scalpel, the surface of the section is perfectly smooth, and of a uniform colour. There is no appearance of any cells, or globules, or fibres whatever. Here and there, only, we observe a few reddish points and *striæ*, which are obviously occasioned by the transverse or longitudinal division of small Bloodvessels.

This substance seems to have been subjected to very minute microscopical examination by Prochaska*. When he took a small portion of it, either from the Brain Proper or *Cerebellum*, and spread it out on a very thin plate of glass, so that it became pellucid, and then examined it with a powerful microscope, he found that it resembled a sort of pulp, consisting of innumerable globules, or particles of a roundish form. A little water added to this pulp divided it into a number of *flocculi*; but he observed that each *flocculus* was still composed of a number of globules. He very rarely found one globule by itself, or even two, floating in the water, apart from the rest. Maceration in water, even for three months, was insufficient to separate them from each other. He concluded therefore, that they were united by means of a very delicate and pellucid Cellular Substance, insoluble in water, and formed partly of blood-vessels, and partly of prolongations of the *Pia Mater*. The globules, he observed, were not all of the same size; but varied a little in dimension, even in the same part of the Brain. In general, however, he found them, both in the Brain Proper, and in the *Cerebellum*, to be more than eight times smaller than a globule of the Blood. Respecting their structure, the most

* Oper. Min. Pars. I. p 342.

powerful microscopes did not enable him to discover any thing satisfactory.

These microscopical observations have, within these few years, been prosecuted on a much more extensive scale, by JOSEPH and CHARLES WENZEL*; and these Anatomists have uniformly found, that the White Nervous Matter seemed as if entirely composed of extremely small globules, or corpuscules of a roundish form, putting on the appearance of little cells, filled with proper Medullary Substance. No estimate is given of the dimensions of the globules; but they are described as being exceedingly minute, and as being all pretty nearly of the same size. They seemed to adhere closely to each other, and no fluid, or connecting medium, could be observed between them. The globular appearance continued distinctly perceptible, in portions of the substance, which had been long exposed to the action of rectified Spirit of Wine and Muriatic acid; nor was it even destroyed, by steeping the matter in Alcohol, and then drying it for several months.

White Nervous Matter possesses considerable vascularity. The Arterial branches, however, which supply it, are seldom much larger in diameter than a common pin. Veins of an eighth of an inch in diameter are found running through it, in some parts of the Brain; but in general these vessels are as small as the Arteries.

It is the division of small Bloodvessels, either transversely or longitudinally, which produces the appearance of red points and red *striæ*, in this Matter, when incisions are made through it. When portions of it, too, are torn asunder, Bloodvessels are drawn out between the separated surfaces, in the form of red-coloured threads.

* De Penitior. Struct. Cerebri, p. 24.

A fine injection of size and vermilion, brings a great many little Vessels into view, which were before invisible.

Absorbent Vessels have not yet, so far as I know, been distinctly traced into this Matter.

When a portion of White Nervous Matter is plunged for a few minutes into boiling oil, or steeped for a few days in Alcohol, Diluted Muriatic or Nitric Acids, Mixtures of Alcohol and Acids, or a solution of Corrosive Sublimate, its consistence is greatly increased: and if we now endeavour to tear its parts asunder, we find that every portion of it, may, by laceration in one direction or another, be made to exhibit a fibrous appearance.

From the fibrous surfaces thus exposed, slender white threads may be raised, with the point of a pin, almost as fine as a hair; and the whole seems to be formed of such delicate fibrils, placed closely together, without any connecting medium. Different *fasciculi* of these fibrils, often intersect each other, or are interwoven; but all the fibrils of a *fasciculus* are laid parallel or concentric to each other.

The delicacy of the fibrils, and the closeness with which they are compacted together, render it impossible to ascertain their actual length, or even to form a conjecture as to the dimensions of the smallest one.

Whether the White Nervous Matter in all parts of the Brain, be capable of exhibiting this fibrous appearance, does not yet seem to me satisfactorily established; but in all those portions of the organ in which it has been observed, it has been found, that each portion has a particular arrangement of fibres, which it preserves pretty uniformly in all subjects.

May we conclude from these observations, that the White Nervous Matter in such portions of the Brain, actually consists of fibres in the living Body, which are too minute and too soft to maintain their form in sections and lacerations of this substance after death, unless they have been strengthened by such chemical agents as those already mentioned? It is in favour of this supposition, that many of those parts, when torn asunder in a recent state, and without any chemical preparation, separate much more readily in the direction which their fibres exhibit when coagulated, than in any other.

White Nervous Matter when dried, acquires a yellowish, horny appearance; and thin slices of it become semi-transparent. It recovers its white colour on being plunged into water.

In none of the analyses which have hitherto been made of the Nervous Matter, does the White species of it appear to have been examined apart from the Brown. The chemical facts therefore, which I have now to state, must be regarded as strictly applicable, only to a mixture of the two kinds of this substance.

1. VAUQUELIN* found, that Nervous Matter, when dried over a water bath, was reduced in weight 80 *per cent.*

2. FOURCROY† ascertained, that when triturated in a mortar with cold water, it formed a whitish-coloured homogeneous emulsion, which might be passed through a filter; and that heat, alcohol, or acids added to this emulsion, produced *coagula* in it, of a substance resembling Albumen. VAUQUELIN has since found, that when this emulsion is left at rest, Albumen and a peculiar Fatty Matter separate from it together; and that Osmazome and a small portion of Albumen remain in solution in the water.

3. VAUQUELIN ascertained that when Nervous Matter is repeatedly digested in alcohol, part of it is dissolved, and the remaining part assumes the form of greyish-white flocks,

* Annales de Chimie, tom. LXXXI. p. 37. Transl. in THOMSON'S Annals of Philosophy, May, 1813.

† Same work, tom. XVI.

in appearance like fresh cheese. This remaining part, forms about 7 *per cent.* of the substance employed, and is perfectly identical with Albumen.

The alcohol employed in the digestion, deposits on cooling, a substance, white and solid, but soft and of a pitchy consistence; having a brilliant and sattiny appearance, a greasy and glutinous feel, and staining paper in the same manner as oils do. It resembles tallow or fat more than any other matter; but differs from common fat principally in its solubility in alcohol, its capacity of chrystallizing, its viscidity, its inferior fusibility, and the black colour which it assumes in melting. It forms about 4½ *per cent.* of the Nervous Matter analysed.

If the Alcohol after depositing this Fatty Matter be evaporated, it leaves a yellow aqueous liquor, at the bottom of which is an oily substance, of a reddish brown colour.

This oily substance differs from the Fatty Matter deposited from the Alcohol on cooling, only in having a darker colour, less consistence, a greater tendency to chrystallization, and a slight taste of boiled meat; differences which VAUQUELIN thinks are owing to its being mixed with a small quantity of Osmazome. The Nervous Matter analysed, yields about 0.70 *per cent.* only of this Fatty Matter.

The Yellow Aqueous liquor, at the bottom of which this reddish Fatty Matter is found, has the taste of the juice of meat with a little sweetness; reddens litmus; and is precipitated by lime water and infusion of nutgalls.

The precipitate obtained by adding lime-water to this liquid, is Phosphate of Lime.

After this precipitation has been completed, if the remaining liquor be evaporated to dryness, a matter will be obtained of a reddish-brown colour, and semi-transparent; and having the taste and smell, and all the chemical characters, of the substance called, by ROUELLE, the Saponaceous Extract of meat, and, by THENARD, Osmazome. About 1.12

per cent. only of this substance, is obtained, from the Nervous Matter analyzed.

4. According to Fourcroy, when Nervous Matter from the Brain, is triturated with diluted sulphuric or nitric acid, part is dissolved, and part separated in the form of a coagulum; the acid liquor remaining transparent and colourless.

5. Fourcroy observes, that when pure concentrated potash is added to Nervous Matter from the Brain, complete solution takes place, accompanied with the disengagement of a great quantity of ammonia. Bichat *, however, affirms, that a considerable proportion of White Nervous Matter always remains undissolved in the alcalis.

Brown Nervous Matter, like the former species, varies a little in its hue in different parts of the Brain. Its prevalent colour is Wood-Brown †; but, sometimes, it resembles a mixture of Wood-Brown and Lead-grey. This latter, we shall call Greyish-Brown.

The Brown Nervous Matter is always softer than the White.

When divided with a sharp scalpel, the surfaces of the section are quite uniform, presenting no appearance either of fibres or *laminæ*. Little points and streaks of a bright red colour, are seen on them, just as in the dissection of a portion of White Matter; but these are obviously owing to the division of Bloodvessels.

By examination with powerful Microscopes, Prochaska and the Wenzels have discovered a similar appearance of roundish particles or globules, in this kind of Nervous Matter, as in the other; and there is reason to believe from their observations, that the globules are nearly, if not exactly the same, in the two kinds of Matter, both in point of shape and magnitude.

* Anatom. Gener. I. p. 149.

† See Syme's *Nomenclature of Colours*.

The Brown Nervous Matter in certain parts of the Brain, is much more vascular than the White. Such, for example, is the coating of it, which covers the outer surface of the Convolutions of the Brain Proper, and of the *Laminæ* of the *Cerebellum*. These parts, it is true, do not contain any Bloodvessels, which are absolutely larger than some, that are to be found in White Nervous Matter; but their capillary branches are, proportionally, so much wider and more numerous, that when they are filled with a fine injection of size and vermilion, they give a bright red colour to the whole substance through which they are distributed. If a piece of this substance be macerated after such an injection, or examined with a powerful microscope, it will appear as if almost entirely composed of Bloodvessels. ALBINUS*, however, affirms, that even after the most minute injection, he could still discover something more than Bloodvessels in this Matter.

Whether the Brown Nervous Matter be more vascular than the other species, in all parts of the Brain, does not yet seem to have been ascertained.

Absorbents have not yet been traced into this kind of Nervous Matter, more than into the White species.

When a portion of the Brown Nervous Matter which forms a covering to the Convolutions of the Brain Proper or the *Laminæ* of the *Cerebellum*, has been exposed to the action of Alcohol, or Acids, or Boiling Oil, and is then torn asunder, it exhibits a fibrous appearance similar to that already described in the White Matter. Whether the Brown Matter in all parts of the Brain be susceptible of this sort of fibrous laceration, I have not yet ascertained, in a manner satisfactory to myself.

When macerated in cold water, the Brown Nervous Matter becomes softer, swells out a little, and loses a good

* Annot. Acad. Lib. I. cap. 12.

deal of its brownish tinge. Alcohol, Acids, and Solutions of Corrosive Sublimate, while they increase its consistence, also render it whiter. Of these, the Corrosive Sublimate has most influence on its colour.

Its chemical properties, when unmixed with the White species, have not yet been investigated.

Of these two kinds, then, of Nervous Matter, almost the whole Substance of the Brain is composed: They are intermingled in various ways. In some parts, a covering of the one surrounds a mass of the other, as a capsule encloses a nucleus; in others, they are alternated in *laminæ* or *strata;* and in others, they traverse each other, in the form of cords or fibres, of various sizes. Yet notwithstanding this diversity in their arrangement in different parts, their disposition in each particular part, is observed to be remarkably uniform. The proportions and arrangement, therefore, of the two kinds of Nervous Matter, in the different regions of the Brain, form an important part of the Anatomy of this organ.

It is not my intention, however, to enter minutely into this subject at present. It would be difficult to communicate an accurate idea of the disposition of these two kinds of Matter by words, even if the limits of the different parts of the Brain were precisely fixed. But although Anatomists describe, on the surface of this organ, various eminences, such as Peduncles, and Commissures, and *Corpora*, they have traced merely the superficial boundaries of these elevations; leaving their more internal or central limits altogether undefined. This, it is obvious, must render mere verbal description, without the aid of coloured engravings, altogether inadequate to convey a minute knowledge, of the arrangement of the two species of Nervous Matter within. On the present occasion, therefore, I shall content myself with a few general observations merely on this department of the structure of the Brain; aiming at nothing more, than to afford a little assistance to those, who may be disposed to study the subject by dissection for themselves*.

All the convolutions of the Brain Proper, are formed of a stratum of Orange-White Matter, covered with a coating, from an eighth to a tenth of an inch thick, of Wood-Brown Matter.

The Corpus Callosum consists chiefly of Orange-White Matter, with a slight intermixture of Greyish-Brown. This latter is distributed in exceedingly fine layers, which run across the Corpus Callosum, at right angles to the Median Line, and are most distinct towards the forepart.

The Fornix consists entirely of Orange-White Matter. Each of its Anterior Pillars is continued into a Cord of Orange-White Matter, similar in shape to the Pillar itself, which runs in a curved direction downwards and backwards, the concavity of the curve looking upwards, and terminates in the Mammillary Eminence of the corresponding side. Each cord is surrounded by Greyish-Brown Matter, which penetrating into its substance, divides it at many parts, into fine threads.

* Vicq d'Azyr has endeavoured, in the folio work to which I have already so often referred, to represent the whole Anatomy of the Brain in a series of coloured engravings; and this is the only attempt of the kind, worthy of notice, which has hitherto been made. The chief merit, however, of this work, consists in the minute explanations and details, which accompany the engravings. The engravings themselves, are seldom entitled to the praise of accuracy, either in point of form or colouring.

A work was published a few years ago by Gall and Spurzheim, entitled *Anatomie et Physiologie du Systeme Nerveux en General et du Cerveau en Particulier*, in which they endeavoured, in a series of plain engravings, to represent the surfaces and internal arrangement of the Substance of the Brain. They have omitted, however, several important parts altogether; others are represented very indistinctly; and there is scarcely a plate in the series, in which there are not considerable inaccuracies.

The surface of the Hippocampus in each Hemisphere, is formed of a layer of Orange-White Matter about a twentieth of an inch thick. This layer is continuous on the inside, with the Tænia Hippocampi, which is also composed entirely of Orange-White Matter; and both are connected above, with the Substance of the Fornix and Corpus Callosum. Under it, is a stratum a little thicker, of Greyish-Brown Matter, which beginning at the Indented Band, extends at first outwards, and then turning downwards and inwards, is continued into the Brown coating of the innermost Convolution of the Middle Lobe. In the doubling of this last stratum, again, another layer of Orange-White Matter, thinner even than the first, is situated; and this may be traced, beyond the Indented Band, over the outer surface of the Brown coating of the Convolution just mentioned, where it gradually becomes thinner and darker in colour, and disappears.

The Colliculus, in the Posterior Lateral Part of the Central Fissure, is composed entirely of Orange-White Nervous Matter.

The Septum Lucidum, consists of a thin lamina of Orange-White Matter, lined on each side, opposite the most convex part of the Corpora Striata, with a thin stratum of Greyish-Brown Matter. The White middle stratum, is in general split into two layers towards the upper and forepart, by a cavity or slit, close at all points, about a quarter of an inch in length, somewhat of a triangular shape, and placed exactly in the Median Plane. This cavity has been called, the Sinus of the Septum Lucidum*. What width it has in the natural state of the Brain, has not been ascertained; but in most instances, it is found to contain a small quantity of a watery fluid.

From the lower edge of the Septum Lucidum, a band of Orange-White Matter extends downwards, on the inner sur-

* SYNONYM. *Lat.* Fossa Sylvii.

face of the Anterior Lobe of each Hemisphere; forming a part of the perpendicular plane formerly described, as stretching downwards from the inferior surface of the Corpus Callosum, towards the Commissure of the Tractus Optici. Having reached the lower margin of the Longitudinal Fissure, it turns outwards, and acquiring more and more of a Yellowish-White colour, extends as far nearly, as the Inner Lobule of the Middle Lobe.

Between this band and the cord prolonged from the Anterior Pillars of the Fornix into the Mamillary Eminence, there is a stratum of Greyish-Brown Matter, which is bounded above, by the Anterior Commissure of the Brain Proper, and attached below, to the Commissure of the Tractus Optici.

The Anterior Commissure of the Brain Proper, is continuous on each side with an Orange-White cord, about an eighth of an inch in diameter, and an inch in length; which extends through the Corpus Striatum, first outwards and a little forwards, then downwards and a little outwards and backwards, and terminates in the stratum of Orange-White Matter which supplies the Convolutions of the Middle Lobe, close to the Inner Lobule of that Lobe.

The Tractus Optici and their Commissure, are formed entirely of Orange-White Matter.

The sides of the Infundibulum consist wholly of Greyish-Brown Matter; and it is this Matter, which surrounds and conceals the prolongation from the Anterior Pillars of the Fornix into the Mammillary Eminences.

The Mammillary Eminences are formed of Greyish-Brown Matter, surrounded completely by a layer, about a twentieth of an inch thick, of Orange-White Matter. It is to this White layer, that the prolongations from the Anterior Pillars of the Fornix already described, are attached. It sends off also from its upper surface, a cord about a sixth of an inch in diameter, which runs upwards and outwards into the Thalamus Opticus for the length of half an inch, describing first a curve forwards and then backwards, and gardually tapering to a point. The outer stratum of the Eminences is continued behind, into the White Matter of the Peduncles of the Brain Proper.

The composition of the Pituitary Gland is peculiar, and requires to be farther investigated. It is a good deal firmer than the other parts of the Brain, and seems to be intersected by a texture different from common Nervous Matter. When it is pressed between the fingers, the Nervous Matter appears as if it were forced out of a spunge. In general, two distinct masses may be perceived in it; one occupying the forepart, approaching rather to purple in its colour, and another behind, softer in its consistence and of a lighter hue.

The Peduncles of the Brain Proper, are composed of Orange-White Matter, with a very slight intermixture of Greyish-Brown. This White Matter seems arrranged into very fine laminæ and threads, which run upwards and a little outwards, gently curved towards the Median Plane.

The Peduncles are continuous in each Hemisphere, with a stratum of Orange-White Matter, from a fourth to a fifth of an inch in thickness, which runs upwards and outwards external to the Thalamus Opticus, forming a gentle curve towards the Median Line; and then expands into an arch or vault, which penetrates through the middle of the Corpus Striatum from one end of it to the other, and at last joins the Central White Mass of the Convolutions, along the whole border of the Corpus Callosum. The concavity of this vault looks downwards and outwards, and as it follows the inclination of the Corpus Striatum, it is also arched from before backwards. Its two anterior thirds nearly, are formed into large cords, by the interposition of strata of Greyish-Brown Matter, and all the cords extend outwards in the general direction of the vault. A number of fine threads too, of White Matter, may be seen, shooting from a variety of points on the superior surface of these cords, into the Greyish-Brown substance of the Corpus Striatum, and there gradually disappearing without reaching its surface. The posterior third of this vault, is composed entirely of White Nervous Matter; but from the upper surface of this portion of it also, short and slender filaments are found extending, into the Brown Matter forming the posterior extremity of the Corpus Striatum.

Immediately within the Peduncles of the Brain Proper, there is, on each side, a stratum about an eighth of an inch thick, of a very singular looking substance. In some spots it is almost as dark coloured as soot, in others, of a white and dark-brown hue. Its consistence too I think is firmer than the common Nervous Matter. It stretches across, with a slight concavity inwards, from the Anterior to the Posterior margin of each Peduncle; and corresponds exactly to the Peduncles in height*.

In contact with this dark coloured substance on the forepart, and nearer to the Median Line, there is, on each side, an oval nodule of Nervous Matter, in colour somewhat between Wood-Brown and Yellowish-White, surrounded by a coating of Orange-White Matter.

The substance immediately between and below these nodules is chiefly Orange-White Matter; but towards the Median Plane, there is a slight intermixture of Greyish-Brown; and if the substance be divided symmetrically, by an incision parallel to the Median Plane, the White Nervous Matter will appear on the surface of the section, in the form of fine lines running directly backwards.

The whole of that portion of the Brain Proper, which lies immediately behind the parts now described, may be regarded as belonging to the Corpora Bigemina. Both these prominences, together with their Lateral Ridges, are formed externally of a thin layer of Yellowish-White Matter, which

* Synonmys. Vicq d'Azyr describes this substance under the name of Tache Noire, or Locus Niger Crurum Cerebri.

is continued across from the prominences on one side to those on the other, forming the Connecting Plate of those Bodies and the Frenulum. But the surface of this Plate, and of the Corpora, looking towards the Aqueduct of Sylvius, is lined with a fine coating of a matter having a somewhat redder hue. The remaining parts of the Corpora Bigemina, appear to be composed of a substance intermediate in colour between Yellowish-White and Wood-Brown, and rather firmer in its consistence than common Nervous Matter. I have sometimes seen, running through the middle of this substance in the Upper Corpus Bigeminum, a thin stratum of a paler coloured matter, which seemed to be continuous with the Posterior Commissure of the Brain Proper before, and formed a slight concavity downwards.

Two white Laminæ were formerly described (p. 97.) as connected with the base of the Pineal Gland; an upper one, continued at each extremity into the ridges called the Peduncles of this Gland, and a lower, usually denominated the Posterior Commissure of the Brain Proper. Both of these are composed of Orange-White Matter. The latter extends outwards into the substance of the Thalamus Opticus, on each side, for about a twelfth of an inch.

The Pineal Gland itself, is composed of two substances. The substance of which there is most, seems to be a species of Brown Nervous Matter; only it is softer in its consistence than that matter generally is: The other substance is in the form of small particles like grains of sand, very hard, semitransparent, of a yellowish colour, and varying a little in size, but never larger than the head of a pin. Sometimes these particles are grouped together upon the upper surface of the Gland, close to its base, making a little Acervulus, as Soemmerring * has called it; at other times they form a sort of chain or ridge along its margin; and at other

* De Corp. Human. Fab. IV. p. 63.

times again, they are irregularly scattered through its substance. There is the greatest variety in their number. In two or three instances, after the strictest search, I have not been able to find more than a single particle within the whole Gland. The Specific Gravity of this sandy-looking matter seems considerable; it sinks to the bottom in water very quickly. Its chemical properties have not yet been satisfactorily ascertained; but I am inclined to think, from the following experiments, that it resembles Osseous Substance very closely.

1. I placed two particles of it, of the largest size, on a red-hot iron plate; and they both became brown immedidiately, and then gradually black, emitting the smell of burnt horn. When exposed to a stronger heat they burnt, and left a pure white brittle residuum.

2. I placed a large particle in the middle of a drop of pure Muriatic Acid, on a plate of glass. An immediate and pretty copious effervescence took place; and in the course of an hour, the whole particle had become soft, opaque, and slightly elastic, at the same time enlarging a little, and acquiring a paler hue. This soft residuum, when placed on a red-hot plate of iron, burnt completely away, emitting a smell of horn; and when a drop of pure Ammonia was added to the drop of Muriatic Acid in which the particle had been softened, a thick white cloud was immediately produced, exactly similar to that which is caused, by the same means, in Muriatic Acid in which a piece of Bone has been steeped.

In these experiments, it is presumed that the soft residuum was similar to the Albuminous Part of Bone; that the effervescence was caused by Carbonic Acid; and that the white flaky precipitate, consisted of Phosphate of Lime.

I have seen one instance, in which the Pineal Gland contained a sinus, such as SOEMMERRING * has described, open-

* De Corp. Hum. Fab. IV. p. 63.

ing at the base, between the two white Laminæ already mentioned; and in two instances, I have found it quite hollow, and without any external orifice.

In the Thalami Optici, there is an intermixture of White and Brown Nervous Matter, which it is very difficult to describe. Each Thalamus, however, is surrounded at all points by a coating of Orange-White Matter. This coating is exceedingly thin, on the side which looks towards the Vertical Prolongation of the Central Fissure; so thin indeed, that unless the Brain be examined in a very recent state, it may escape notice altogether; yet it seems to me to be a good deal tougher than the White Matter in other parts of the Brain. On the other surfaces of the Thalamus, the coating is considerably thicker, but not uniformly thick at all points; it is deepest where it forms the ridge called the Peduncle of the Pineal Gland. Along the whole inner margin of the Corpus Striatum, it is connected with the stratum of Orange-White Matter already described as continuous with the Peduncles of the Brain Proper; this stratum forming, in a manner, the boundary between the Thalamus and the Corpus Striatum.

On the side of the Thalamus next the Median Plane, the thin covering of White Matter just described, is laid over a layer about a twelfth of an inch thick of Greyish-Brown Matter. It is this stratum, which, shining through the former, gives the whole of this surface its dark colour; and it seems to be a portion of this too, which, continued into the corresponding part of the opposite Thalamus, forms what has been called the Commissure of the Thalami Optici.

Under the superficial white covering in each of the Tubercles of the Thalami, there is a nodule of Nervous Matter of a colour between Wood-Brown and Yellowish-White.

The Stratum of Orange-White Matter continued from the Peduncles of the Brain Proper, and bounding the Thalami on the outside, sends off a great number of White laminæ and threads into the substance of the Thalamus, where they gradually disappear. The inclination of these is chiefly from above downwards and inwards. They are all as fine as hairs, and are separated from each other and surrounded, by Greyish-Brown Matter. None of them seem to reach the opposite side of the Thalamus; but vanish before they get even to the layer of Brown Matter already described on that side.

In the lowest part of the Thalamus, and about its middle, above and to the outside of the nodule described p. 133, there is a similar nodule of Brown Matter, only a little larger, the white capsule of which below, forms the inferior boundary of the Thalamus.

In addition to all these parts in the Thalami Optici we have to remember that there is the White Cord described at p. 131, connected with the Mammillary Eminences.

The Tænia Semicircularis, consists of a ridge of Orange-White Matter, connected with the white covering of the Thalamus Opticus, and, by its anterior extremity, with the Anterior Pillar of the Fornix. This white ridge, however, towards the forepart, is always covered by a layer a twelfth or a tenth of an inch thick, of a semitransparent Greyish-Brown Matter.

The whole superior surface of the Corpora Striata, seems to be covered with an extremely thin layer of Yellowish-White Matter, similar to that which lines the Median side of the Thalami Optici, and like it, a little tougher than the White Nervous Matter in other parts of the Brain. This coating is best seen in a section of the Corpus Striatum; for it is so fine, that the Brown Matter underneath obscures it very much when viewed from above.

Both the Corpora Geniculata, are composed of White and Brown Matter. The Outer Corpus Geniculatum contains a nucleus of Wood-Brown Matter, surrounded by a covering about a thirtieth of an inch thick of Orange-White, The Inner one incloses a similar nucleus, but it is considerably smaller and paler in colour.

Closely connected with the inferior surface of the White stratum, which is prolonged from the Peduncles of the Brain Proper on each side (see p. 132), there is a mass of a substance, apparently composed of plates and fibres of Orange-White and Greyish-Brown Nervous Matter, intimately intermixed and closely compacted together. This mass extends, from opposite the posterior margin of the Peduncles behind, to the Anterior Commissure of the Brain before. The Tractus Opticus runs along its inferior surface, towards the Median Plane, and external to this, it is only separated from the Anterior Lateral Part of the Central Fissure, by a layer of Orange-White Matter, about a fortieth part of an inch in thickness. The laminæ and filaments of Orange-White Matter which are found in this mass, have all a direction upwards and outwards, some on the forepart inclining at the same time forwards, and others behind running backwards. Neither its anterior nor its posterior extremity, however, seems to contain any White Matter, but to consist of Nervous Matter, intermediate in colour between Wood-Brown and Yellowish-White. Its outer and upper surface too, which forms an arch convex outwards, is lined with a layer about a fortieth of an inch thick, of the same sort of Matter; and corresponding in curvature and thickness exactly with this layer, but situated about a sixth of an inch farther inwards, there is another arched stratum of the same kind. In a transverse section of this part of the Brain, the cut edges of these two layers, have the appearance of concentric curved lines of a white colour.

From the outer and upper surface of the mass just described, innumerable fine laminæ and fibres of Orange-White Matter, diverge into the Greyish-Brown Substance of that part of the Corpus Striatum, which lies under the stratum described at p. 132, all at the same time inclining upwards and outwards. They vary a good deal in their length, few or none of them penetrating entirely across the Corpus Striatum, but disappearing gradually in its Brown Matter. The mass from which these fibres and plates are derived, and the portion of the Corpus Striatum into which they shoot, are easily distinguished from each other in a transverse section of the Hemisphere by their colour; the former being considerably paler than the latter.

The whole remaining parts of the Hemisphere, may be regarded as forming a centre or nucleus, from which the White strata of all the Convolutions project, and which therefore, for the sake of brevity, I shall call the Central Mass of the Convolutions. This Mass is connected all round with the Corpus Callosum, and with the prolongations from this body and from the Fornix, denominated the Hippocampus and the Colliculus. The stratum of white matter also, which is prolonged from the Peduncles, and the cord called the Anterior Commissure of the Brain, are continued into it. The portion of it which supplies the Convolutions of the Posterior Part of the Anterior Lobe, sends down a stratum almost parallel to the Median Plane, and immediately on the outside of the Corpus Striatum, to join the portion which supplies the Convolutions of the Middle Lobe. This stratum is about a sixth of an inch in thickness above and before, but nearly a quarter of an inch below and behind; and it is split throughout into two laminæ by an intervening layer of Greyish-Brown Matter, which is the only portion of this kind of Matter which occurs in the whole Central Mass of the Convolutions. It is from this stratum, that the small Convolutions situated at the bottom of the Fissure of Sylvius, are supplied.

The Laminæ of the Cerebellum, like the Convolutions of the Brain Proper, are all formed of a layer of Orange-White

Matter, covered with a coating of Wood-Brown, from a tenth to a twelfth of an inch in thickness.

It is necessary, before endeavouring to give a general idea of the Nervous Matter in the Annular Protuberance, to fix the limits of this Protuberance behind, a little more precisely. A heart-shaped surface was formerly described when viewing the Cerebellum from above, formed by the section which separates the Cerebellum from the Brain Proper. If a line be drawn, on each side, from the point of the receding angle which was taken notice of on that surface, backwards and outwards, to the groove which divides the Annular Protuberance from the Pillar of the Vieussenian Valve, these two lines will mark the boundaries of the Protuberance on this surface behind. Again, if from this boundary above, a section be supposed to be made, downwards to the inferior margin of the Protuberance, with the same degree of curvature nearly as the anterior surface of the Protuberance has, but curved in an opposite direction, all the parts cut off by this imaginary section before, may be regarded as belonging to the Annular Protuberance.

Now the Nervous Matter of this Protuberance is chiefly if not entirely of the White kind; the quantity of Brown, I believe, will be found to be exceedingly small. The White Matter in it, however, is of two kinds; one sort appears Orange-White when divided vertically, but Greyish when cut in the horizontal direction; the other is Orange-White only in a horizontal section, and Greyish when divided vertically. It is this dark colour of certain sections of the White Matter, I have no doubt, which has led to the idea, that the Protuberance contains so large a proportion of Brown Matter.

Of the kind of White Matter which appears brightest in horizontal sections, there is, in the first place, a layer, varying in thickness from a tenth to an eighth of an inch, which covers the whole anterior surface of the Protuberance. Secondly, there is a stratum scarcely more than a fiftieth of an inch thick, which extends on the Median Plane from before backwards, and also from the top of the Protuberance to the bottom with a few interruptions, so that it divides the Protuberance symmetrically*. Thirdly, there are various laminæ which run across from one side of the Protuberance to the other, intersecting the stratum last decribed, and having a slight convexity forwards. Some of these seem to extend from top to bottom of the Protuberance; others are narrower and of various breadths. They vary also in their thickness, some being as fine as a hair, others nearly an eighth of an inch thick; and often the same stratum is thicker at one part than at another. There are usually from ten to twelve of these, and one of them occupies exactly the place of the imaginary section, by which the Protuberance was bounded behind. Fourthly, various lesser strata are seen running obliquely between these laminæ.

The other kind of Matter, that which appears of an Orange-White colour when divided vertically, is arranged in plates or fibres which are much more difficult to trace than those of the former. They all seem to arise, from a small mass or nucleus of the same kind of matter, occupying the lowest part of the Protuberance on each side of the Median Line. From this they extend upwards and a little outwards; some towards the anterior part bending forwards in their course, like the strata of the former kind of matter; others towards the middle running almost directly upwards; and others again, behind, forming a curve convex backwards. They do not remain single throughout, however, but often split or subdivide into lesser plates or fibres, giving an appearance of ramification, in vertical slices

* VICQ D'AZYR calls this, "Raphé de la Protuberance Annulaire."

of the Protuberance. Whether there be any of them that do not reach the top of the Protuberance, but only penetrate a certain way into it; or whether some do not begin at the top of the Protuberance and stretch only a certain distance downward; or lastly, whether there may not be some which are neither connected with the top nor bottom, I have not yet been able to satisfy myself. I have never seen any of them situated nearer to the Median Plane than a tenth of an inch; so that they are completely divided into two sets, one on the right side and another on the left. Laterally, however, they extend as far as the outer boundary of the Protuberance. Some of them, particularly towards the lower part, and one close to the boundary of the Protuberance behind, seem to stretch from the outside inwards in one continued plane; others are so narrow and so often interrupted, that they have more the appearance of fibres than strata. In point of thickness, those towards the forepart exceed the layers in the middle and behind; some of the former being a sixth of an inch thick nearly, while the middle ones are as thin as hairs, and those behind scarcely more than a fifteenth or a twelfth of an inch.

These two kinds of White Matter are closely interwoven throughout the whole Protuberance; and it is only at a very few points that there is any appearance of Brown Matter. Even in these few points, the quantity of it is so small, that it is just perceptible and no more.

The substance immediately continuous with the Annular Protuberance behind, and forming the anterior surface of the Central Fissure of the Cerebellum, is composed of matter which is rather Reddish-White than Yellowish-White. A plate of Yellowish-White matter, however, runs through it exactly in the Median Plane, continuous with the layer of White Matter, in the same situation, in the Annular Protuberance.

The Pillars of the Vieussenian Valve, which are also continuous with the Annular Protuberance, are formed entirely of Orange-White Matter, except a thin coating of Reddish-White on the surface next the Central Fissure.

The upper part of the Vieussenian Valve, consists of a plate of Orange-White Matter, lined next the Fissure with a very thin covering of Reddish-White. This covering is continued down over the inner surface of the lower portion of the Valve, the outer surface of this portion being formed of a layer of Greyish-Brown Matter, divided into bands as formerly described.

In the angle between the anterior and posterior sides of the Central Fissure of the Cerebellum, close to its apex, there is a small portion of the same dark-coloured matter apparently, which is found on the inside of the Peduncles of the Brain Proper. It lies parallel to the edge of the Fissure, and is usually from an eighth to a quarter of an inch long, and about a twentieth of an inch thick. A very thin stratum only of Reddish-White Matter separates it from the Fissure internally, and accordingly it is generally seen shining through that stratum. This substance does not seem hitherto to have been taken notice of.

The Peduncles of the Cerebellum consist of Orange-White Matter; and the Alæ of the Inferior Vermiform Process are composed entirely of the same substance.

The whole remaining parts of the Cerebellum may be regarded as forming a Central mass from which all the Laminæ derive their White Matter. When the whole of these Laminæ are removed, this Central mass remains, somewhat of the form of the whole Cerebellum. It is symmetrical, its Median Plane corresponding to that of the Cerebellum, and it consists of two Lateral Parts, one on each side, and a Middle Part joining these together.

Each of the Lateral Parts measures from before backwards nearly an inch and a quarter, and is about the same in breadth; but they are only from half an inch to three quarters of an inch thick before, which is their thickest part, and taper from this backwards, and on each side. On the forepart, they are connected with the Peduncles of the Cerebellum, and with the Pillars of the Vieussenian Valve; and the Alæ of the Inferior Vermiform Process are attached to their lower surface.

The Middle Part is continuous with the inner White stratum of the Vieussenian Valve. It is about seven eighths of an inch in length, and about a quarter of an inch in breadth. In thickness it measures about a twelfth of an inch before, and tapers to nearly a fiftieth of an inch behind.

The whole of the Central Mass is composed of Orange-White matter, except one portion in each Lateral Part. This portion is denominated the Corpus Dentatum*. It consists of a nucleus of Orange-White Matter, contained in a capsule of Wood-Brown Matter, not more than a fiftieth part of an inch in thickness. It varies in its dimensions a little; but in general it measures, from before backwards, from three quarters of an inch to an inch; from side to side, about half an inch or three quarters; and in heighth or thickness, from an eighth to a sixth of an inch in the middle, gradually tapering towards the edges. Its outline is sometimes quadrangular, sometimes elliptical; and it sends off a number of processes from its surface, so that in whatever direction it is divided, the outline of the section appears jagged or serrated, and hence has arisen the name of Corpus Dentatum. It is lodged in the substance of the Lateral Part of the Central Mass; its margin upon the inside, coming within a sixth of an inch of the inner boundary of this Part. On the forepart, where it rests, as it were, on the roof of the Central Fissure of the Cerebellum, the lower part of its capsule seems

* SYNONYMS. *Lat.* Corpus Serratum. *Fr.* Corps Dentelé ou Rhomboïdal; Substance Rhomboïdale; Noyau Central des Pédoncules.

wanting altogether; so that at this point, the White Matter forming its nucleus, is connected directly, with the White Matter belonging to the Pillar of the Vieussenian Valve on the same side. I have invariably found the nucleus of this body composed of pure Orange-White Matter, not differing in colour in the slightest degree from that of the Central Mass in general. Its Venous Vessels, however, are considerably larger than they are in this matter in other parts; and I have no doubt, that it has been the accidental tinge communicated to it by the division of these Vessels, or by the transudation of Blood from them, which has led some Anatomists, to describe the nucleus as being intermixed with Brown Matter. The capsule appears to differ, in no respect, from the Wood-Brown Matter found in other parts of the Brain, except that it is rather firmer in its consistence.

Strata of Orange-White Matter arise from all parts of this Central Mass, except the portion of it which appears at the bottom of the Peduncular Fossæ, and which has been already described as continuous with the Peduncles. Immediately on leaving the Central Mass, they are lined on each surface, with a Coating of Brown Matter.

They may be divided into three orders.

Those of the *third order*, or the Ternary Strata, are the smallest, being no where thicker than a bristle. They arise, in general, from Primary or Secondary Strata, but sometimes directly from the Central Mass. They are distinguished from the others, by having their edges, as well as their surfaces, covered with Brown Matter, and so form the Laminæ which are seen on the Cerebellum externally.

Strata of the *second order*, or Secondary Strata, are such as arise from Primary Strata, and branch off into Ternary ones. They vary in their size, but are always at least double the thickness of the Ternary Strata, and seldom, on the other hand, exceed the sixteenth part of an inch.

Strata of the *first order*, or Primary Strata, are such as arise directly from the Central Mass, and either branch off into Ternary Strata alone, or both into Secondary and Ternary. They occur of all sizes, from the thickness of the smallest Secondary ones, to nearly a quarter of an inch.

It would be in vain to attempt describing all these Strata individually, and very useless if it could be done. They may be in part traced, externally, by means of the different Fissures on the surface of the Cerebellum. The shallowest Fissures, those which separate the Laminæ from each other, correspond to the Ternary Strata; the next in point of depth, to the Secondary; and the deepest of all, to the Primary ones. But this mode of tracing them is tedious and difficult, unless combined with sections of the Cerebellum. Every where, the different sets of Strata may be seen uniting with each other, Primary sometimes with Primary, at other times with Secondary or Ternary; Secondary sometimes with Secondary, at other times with Ternary, and so on. Some Strata are confined to the superior, some to the inferior surface of the Central Mass; others are placed chiefly on its margin; and others again run obliquely from one surface to the other. All the Strata arising from the Middle Part, are more or less intimately connected with those derived from the Lateral Parts.

A very good general idea of the situation, and connexions, and number of the Strata, may be obtained by the two following sections of the Cerebellum.

In the *first place*, by a section passing exactly through the Median Plane. The Middle Part of the Central Mass, and the Strata arising from it, when thus divided, resembles very closely the ramifications of a tree, and the appearance is usually denominated the *Arbor Vitæ*. From the upper surface of the Middle Part in this Section, five or six Primary Strata are in general seen arising. The most anterior one, which arises close to the anterior margin, is about half an inch in height, inclines upwards and forwards, resting on the Vieussenian Valve, and divides into Ternary Strata. The one behind this, is about the same height, has a slight inclination backwards, and divides into Secondary and Ternary Strata, some of which extend forwards, others backwards, and others directly upwards. Behind this are two smaller Strata, the anterior one about a quarter of an inch long, and the posterior about a third, both inclining backwards, and in general dividing into Ternary, sometimes into Secondary Strata. Behind these, is a Stratum scarcely an eighth of an inch in length, which divides into two or three Secondary Strata, inclining a little backwards. Sometimes, instead of this single Primary Stratum dividing into Secondary ones, there are two or even three Primary Strata dividing into Ternary ones. Besides these Primary Strata, there are one or two Ternary, which arise directly from the upper surface of the Central Mass towards the middle.

From the lower surface of the Middle Part of the Central Mass in this section, five Primary Strata are also in general seen arising. The most anterior one is about an eighth of an inch long and very thin; it inclines forwards and a little downwards, and is continued over the upper surface of the Head of the Inferior Vermiform Process, and of course is connected laterally to the Wings of this Process. It thus forms the middle part of the floor of the Central Fissure of the Cerebellum, and sends off Secondary and Ternary Strata which supply the Head of the Inferior Vermiform Process alone. An eighth of an inch behind this, another Stratum arises, about a quarter of an inch in length, which inclines downwards and a little backwards, and dividing into Secondary and Ternary Strata, supplies the middle portion of the Inferior Vermiform Process. Immediately behind this, a Stratum arises, fully three quarters of an inch long, which inclining downwards and backwards, divides into Secondary and Ternary Strata, and supplies the posterior portion of

2

the same Process. Very often those two last appear as Secondary Strata, arising from a common Primary one scarcely more than a twelfth of an inch long. About half an inch farther back, is a Stratum about a quarter of an inch in length, which divides only into Ternary Strata; and immediately behind this, is the last Primary Stratum arising from this surface, about half an inch in length, inclining downwards and backwards, and dividing into Secondary and Ternary Strata.

From this surface, also, two or three Ternary Strata are seen arising, generally about its middle.

From the posterior margin of the Middle Part of the Central Mass, only one Stratum arises, and in this section it is divided exactly in the middle. It is sometimes a Primary Stratum, about a third of an inch long, projecting directly backwards in the same plane with the Middle Part itself, and sending off two or three very small Ternary Strata; at other times it is merely a Ternary Stratum about a sixth of an inch in length.

Secondly, by a section begun on the superior surface of each Hemisphere, along a line running from the middle of its anterior to the middle of its posterior margin, and continued perpendicularly downwards through the Hemisphere, so as to divide it into two parts nearly equal.

From the superior surface of the Lateral Part of the Central Mass in this section, eight or nine Primary Strata are usually seen arising. Four, sometimes five, are in general found succeeding each other from before backwards, varying in height from an eighth to a third of an inch, the first inclining forwards a little, the third and fourth a little backwards, and the second stretching directly upwards; and dividing, some into Ternary Strata alone, others both into Secondary and Ternary. To these succeeds, immediately, a Stratum about an eighth of an inch in length and thickness, which divides into two Secondary Strata, each more than a quarter of an inch in length, and having a gentle inclination backwards. Immediately behind this, are seen two thin Strata about a third of an inch in length each, which divide only into Ternary Strata; and to these succeeds the last Primary Stratum on this surface, which is more than an eighth of an inch thick, is inclined backwards and a little upwards, and divides immediately after its origin into Ternary and Secondary Strata.

Besides these, there are also one or Two Ternary Strata seen arising from this surface.

The Primary Strata which are seen arising from the inferior surface of the Central Mass, in this section, are in general five in number. The most anterior one is very slender, about a sixth of an inch in length, and inclined downwards and a little forwards in a curved direction, with the concavity backwards, and giving off only two or three Ternary Strata from its posterior surface. It is this Stratum which forms the anterior and superior surface of the Sub-peduncular Lobules, supplies the Laminæ of these Lobules, and is connected to the Wings of the Inferior Vermiform Process internally. The Stratum immediately behind this, is a little thicker, about a quarter of an inch in length, inclined downwards and a little forwards, and divides into Ternary Strata. To this succeeds a Stratum about a tenth of an inch thick, which after projecting downwards directly, for about an eighth of an inch, and giving off one or two Ternary Strata on each side, divides into two Secondary Strata, one of which inclines forwards a good deal, and the other a very little backwards. Behind this, a Stratum always thinner, sometimes longer, sometimes shorter arises, which inclines downwards and backwards, and divides into two Secondary Strata, both of which have an inclination backwards, but the anterior one less than the posterior. Lastly, to this succeeds a Stratum about an eighth of an inch thick, which projects backwards and a very little downwards for about a fifth of an inch, sending off one or two Ternary Strata, from each surface, and then dividing into three Secondary Strata, the upper of which, stretches upwards a little, the lower a little downwards, and the middle almost horizontally backwards.

From the posterior margin of the Lateral Part of the Central Mass in this section, a single Ternary Stratum is in general seen arising. Sometimes, however, it is a small Primary one dividing into Ternary Strata.

I COULD wish to have been able to have stated here, the results of some experiments, made with a view to ascertain what parts of the Brain are rendered fibrous by coagulation ; and, if possible, to discover whether there be any uniform connection between the fibres of different parts, when the whole organ is coagulated. But I have still a good many trials to make, before I can be satisfied as to either of these points.

It has been affirmed of late years, by some Continental Anatomists, that a regular system of fibres may be shewn, even in an uncoagulated Brain, merely by laceration with the handle of a scalpel. This, however, I have always found to be impracticable*. I cannot help suspecting, therefore, that these authors have been deceived, as to this point.

HAVING thus described the Substance of the Brain, I proceed to its Membranes.

These I consider as two in number†, the *Pia Mater*‡, and the *Arachnoid Membrane*.§

* REIL, if I mistake not, found it so too.

† I exclude the Dura Mater here, because it seems a more natural arrangement, to regard it as forming a part of the sides or walls of the Cranium.

‡ SYNONYMS. *Lat.* Membrana Vasculosa ; Meninx Interior. *Fr.* La Lame Interne de la Méningine.

§ SYNONYMS. *Lat.* Meninx Media. *Fr.* La Lame Externe de la Méningine.

The *Pia Mater* is the more internal of the two. It embraces immediately the whole external surface of the Substance of the Brain, and extends into certain parts of its Central Fissures.

It varies very much in thickness, and strength, and general appearance, in different parts. In some parts, it is more than an eighth of an inch in thickness, in others, thinner than the finest hair. In certain situations, it is as delicate almost as cob-web; in others, loose and spongy; and in others again, exceedingly dense and firm, although thin. In some parts, it looks like a very fine net-work; in others, it has all the appearance of a Membrane of very close texture.

At most parts, its outer surface is so intimately united with the Arachnoid Membrane, that it is impossible to separate the one from the other without destroying both; but where this connexion is less intimate, the outer surface is in general pretty smooth. The internal surface, when the Membrane has been carefully peeled off from the Substance of the Brain, and then floated in water, is always hairy or villous.

After a minute injection, it is difficult to perceive any thing in it but Bloodvessels, which are interwoven with each other in every direction; and according to their number, and the closeness with which they are compacted together, seem to produce all the varieties in the thickness and density of the Membrane. I never could discover any appearance of Absorbents or Nerves in it; nor so far as I know, have these been seen by others. At certain parts, there is occasionally an appearance of very fine, dense, white threads in it, particularly where it is least connected with the Arachnoid Membrane; but I am still uncertain, whether a very minute injection might not show these apparent fibres to be in reality Bloodvessels. BICHAT* says expressly, that it contains a very delicate, loose, transparent, *Cellular Tissue*, by

* Anat. Descrip. III. p. 27.

which the Bloodvessels are bound together and interlaced; but I have looked for this *Tissue* in vain.

All the Arterial Vessels which enter into the composition of this Membrane, seem destined ultimately to supply the Substance of the Brain, and this Substance appears to derive Arterial Vessels from no other source. All the Veins too of the Pia Mater, are derived from the Substance of the Brain, and it seems to send all its Venous Vessels to this Membrane; so that we may regard the Pia Mater as a vascular covering, formed of Bloodvessels which are just about to penetrate the Nervous Matter of the Brain, and of Bloodvessels which have just emerged from it; of Arteries, which by repeated ramifications, are preparing themselves to enter the Substance of this organ, (for we have already seen that this Substance contains only Vessels of small size,) and of Veins which after having come out of it, are uniting into larger trunks.

In consequence of this, it will be found, that all the smaller, or Capillary, Arteries and Veins of the Pia Mater, are situated towards that surface of the Membrane, which is nearest to the Substance of the Brain, and all the larger branches, in the parts placed at a greater distance from it, or more externally. It is chiefly the close intertexture of the former, which gives to the Pia Mater its Membranous form; the larger Vessels are not so closely interwoven, nor so firmly attached to each other. In by far the greater number of parts, the delicate Arteries which penetrate the Substance of the Brain, and the Veins which come out, will be found entering and emerging at right angles to the surface of the part. This is easily seen in peeling off the Membranes from a recent Brain. In the angle between the Pia Mater and the part of the Substance of the Brain which it covers, an immense number of very delicate, semitransparent, threads, will be observed, stretching from the one to the other; and these are the fine Bloodvessels drawn out of the soft Nervous Matter. The separation of the Membrane from the Substance underneath, so as to shew this appearance, is facilitated, by previously plunging the Brain into any of these substances, which have the property of coagulating the Nervous Matter. The increased consistence which the Matter thus acquires, renders it less apt to be lacerated, and the little Vessels themselves are, at same time, made a little stronger. There seems to be no other connexion, between the Substance of the Brain and the Pia Mater, than by these Vessels; and it is they which give to this Membrane its hairy or villous appearance, when floated in water after its separation.

The portion of the Pia Mater which covers the Convolutions of the Brain Proper, presents the same general appearance over the whole of the Hemispheres. On the top or most external part of each Convolution, it is very thin, and inseparably connected with the Arachnoid Membrane. In the Fossæ between the Convolutions, on the other hand, it is thick and loose in its texture. The prolongations which dip down between the Convolutions, are thickest towards the surface, and taper as they proceed towards the bottom of the Fossæ. In most parts, the very opening of the Fossæ, between the tops of the Convolutions, is occupied by a large Vein; and immediately over this, and closely connected to it, is the Arachnoid Membrane.

Along the whole of that part of the Longitudinal Fissure, which is placed immediately below the anterior portion of the Corpus Callosum, the Convolutions of the opposite Hemispheres are joined together by Pia Mater, just as intimately as two contiguous Convolutions are, in either Hemisphere. There is a similar union also of the Convolutions in the same Fissure, immediately before the anterior extremity of the Corpus Callosum, and above its two anterior thirds; but even in front, where the union is most extensive, it does not reach farther from the bottom of the Fissure than half an inch at the utmost, and from this gradually tapers as it proceeds backwards, until it ceases altogether, and the sides of the Fissure are entirely separated from each other, by a process of the Dura Mater afterwards to be described.

The Anterior and Middle Lobes of each Hemisphere, are joined together by Pia Mater, along the whole extent of the Fissure of SYLVIUS.

The Pia Mater which covers the Corpus Callosum on all its aspects, is the same with that which joins the opposite Hemispheres together along the Longitudinal Fissure, and which lines the Convolution resting on the lateral parts of this body.

The parts situated between the Lobes of the two Hemispheres, in the basis of the Brain behind, are covered with Pia Mater which is continued from these Lobes. Here the Membrane is particularly dense and strong, having its outer layer composed of pretty large Arterial branches; and along the whole of that hollow which is formed by the Peduncles of the Brain Proper, the Tractus Optici, and the Inner Lobules of the Middle Lobes, it is connected very loosely to the Arachnoid Membrane.

A portion of the Pia Mater is prolonged into the Central Fissure of the Brain Proper, and is so attached to different parts of its surface, as to divide the cavity into different compartments, which have been called *Ventricles.* It consists of two parts, the *Choroid Membrane** and the *Choroid Plexus.* The former is the portion of it which is immediately continuous with the external Pia Mater, and adheres closely to the sides of the Central Fissure; the latter is its free border which, like a vascular fringe, projects into the cavity of the Fissure.

The *Choroid Membrane* may be traced entering the Fissure along the whole of its opening described at p. 95. One portion of it extends into the Middle Part of the Fissure, and another into the Anterior Lateral Part. The portion which is prolonged into the Middle Part, corresponds ex-

* SYNONYMS. *Lat.* Velum sive Plexus Choroïdeis Interpositus; Rete Choroïdeum; Tela Choroïdea; Rete Mirabile; Expansio Reticularis.

actly in shape and dimensions to the Fornix. Behind, it is continuous with the Pia Mater covering the posterior extremity of the Corpus Callosum, the Posterior Lobes of the Brain Proper, the Corpora Bigemina, and the Mons Cerebelli. By its superior surface, it is connected intimately, through the medium of very delicate Arteries and Veins, to the whole inferior surface of the Fornix. By its lower surface, it is attached in the same manner to the inner half of the upper surface of the Thalami Optici, being continued directly from one Thalamus to the other, over the opening of the Vertical Prolongation of this part of the Central Fissure, and over the Pineal Gland. The Pineal Gland, however, is further embraced by a doubling of this Membrane proper to itself. The attachment of the Membrane to the Thalami, is more intimate along its lateral margins than elsewhere; and it is this which gives rise to that appearance of a rough diagonal line taken notice of at p. 101, on the surface of the Thalami, when the Membrane is removed. The portion of the Choroid Membrane which extends into the Anterior Lateral Part of the Central Fissure, is continuous, behind and above, with the portion just described; and below, with the Pia Mater covering the posterior and inferior surface of the Thalami, the Corpora Geniculata, the posterior part of the Peduncles of the Brain Proper, and the Inner Convolution of the Middle Lobe. It is but a narrow strip, corresponding in length and breadth precisely to the Tænia Hippocampi, between which and the Thalamus Opticus it is situated, and to each of which it is intimately attached by means of fine Bloodvessels. Both portions of the Choroid Membrane resemble the external Pia Mater in structure; being composed chiefly if not entirely of Bloodvessels. They form a web of which the texture is very close. Some of the Veins belonging to the middle portion of it, are of considerable size, and will afterwards be taken notice of. In general too, there seems to be attached to the inferior surface of this portion, immediately above the angular recess formed on each side by the Posterior Tubercle of the Thalamus and the Pineal Gland, a small fringe of the same kind of texture as the Choroid Plexus. VICQ D'AZYR first observed this substance, and he has called it the *Plexus of the Pineal Gland**.

The *Choroid Plexus* differs very much in appearance and structure from the Choroid Membrane. When the Central Fissure is laid open in a recent Brain, it is usually distinguished by its pink or bright red colour. When floated in water, it has a flocculent or downy appearance; and sometimes little cysts or vesicles are seen in it; though these are rather to be regarded as morbid appearances. Injections seem to show that it is chiefly composed of minute Arteries much convoluted; but Venous branches are very apparent in it also. It has no attachments but to the margin of the Choroid Membrane, to which it is joined merely by fine Bloodvessels. Beginning at the very apex of this Membrane, immediately under the Anterior Tubercles of the Thalami Optici, it runs backwards on each side external to the margin of the Fornix, and then forwards along the outer border of the Tænia Hippocampi, to the extremity of the Anterior Lateral Part of the Central Fissure. At its commencement above and before, it is seldom much broader than an eighth of an inch, but it enlarges as it proceeds backwards, so as to fill the whole of the hollow between the edge of the Fornix and the Corpus Striatum; and when it descends into the Anterior Lateral Part, it is of sufficient size to cover the whole upper surface of the Hippocampus.

The attachments of the Choroid Membrane to the Substance of the Brain Proper, are so close, that the Central Fissure, before the removal of this Membrane, is a shut cavity, from which a fluid as thin even as water cannot escape to the surface of the Brain; and it is by means of the

* Traite d'Anatomie, p. 21.

same Membrane that this Fissure is divided into the compartments called *Ventricles*. For as the portion of it which extends into the Middle Part of the Fissure, is attached in the closest manner to the Fornix above, and to the Thalami below, all communication between the two halves of this Part, or between its Vertical Prolongation and either half, under the Fornix, is completely cut off. It will be recollected too, that the two Anterior Prolongations of the Middle Part of the Fissure, are separated from each other by the Septum Lucidum, which is impervious. So that the only communication subsisting in the recent Brain, between the opposite halves of the Fissure, or between these and the Vertical Prolongation, is by means of a small passage, which is left between the apex of the Choroid Membrane and the Anterior Pillars of the Fornix, and which leads also, to the anterior triangular opening of the Vertical Prolongation of the Fissure described at p. 98. This passage is never wanting; it was known to many Anatomists prior to the time even of HALLER, and has been described by WINSLOW*, under the name of the *Anterior Common Hole*. In a lateral view, it generally appears about an eighth of an inch wide, and a sixth of an inch high. It is bounded above by the Apex of the Fornix, before by its Anterior Pillars, and behind by the anterior extremities of the Thalami Optici.

In this manner the Central Fissure of the Brain Proper, is divided into three parts. The Vertical Prolongation forms what has been denominated the *Middle Ventricle* †; and the remaining portion of the Middle Part, together with the two Lateral Parts on each side, form the two *Lateral Ventricles*, ‡ *Right* and *Left*. Each Lateral Ventricle is de-

* Anat. Expos. II. p. 325.

† SYNONYMS. The Third Ventricle; the Anterior Ventricle. *Fr.* Ventricule des Couches Optiques.

‡ SYNONYMS. The Superior Ventricles; the Anterior Ventricles. *Lat.* Ventriculi Tricornes.

scribed as having three *Horns;* the Anterior Prolongation of the Middle Part of the Fissure forms the *Anterior Horn;* the Posterior Lateral Part of the Fissure, the *Posterior Horn* *; and the Anterior Lateral Part of the Fissure, the *Inferior Horn.*

The Pia Mater embraces the Laminæ of the Cerebellum, exactly in the same manner, as it does the Convolutions of the Brain Proper. It binds together the sides of the Semilunar Fossa, on the upper surface of the Cerebellum, and of the Peduncular Fossæ on the lower surface; and it unites the Inferior Vermiform Process to the Spinal Lobule and the Inferior Lobes, on each side. There is a small mass of a substance like the Choroid Plexus of the Brain Proper, only a little tenderer, which rests on the lower and anterior surface of the Sub-peduncular Lobules, without being attached to them, being connected with the parts more interiorly situated; and there is a narrow fringe of the same kind of substance, affixed to the Head of the Inferior Vermiform Process, and to the anterior margins of the Wings of this Process. The Pia Mater embracing the Annular Protuberance is denser and stronger than in any other part of the Brain; and here, as well as over the lateral and inferior surface of the Spinal Lobules, it is but very loosely connected to the Arachnoid Membrane. There is no prolongation of the Pia Mater into the Central Fissure of the Cerebellum.

All the Arteries which are ramified throughout the Pia Mater, and consequently all the Arterial Vessels which are distributed throughout the substance of the Brain, are derived from the *Internal Carotid*, the *Basilar*, and the *Vertebral Arteries.*

The *Internal Carotid Artery*, in each Hemisphere of the Brain, sends off the following branches. 1. The *Commu-*

* SYNONYMS. *Fr.* Ancyroide; Cavité Digitale.

incating Branch, which arises from the Vessel immediately on the outside of the Commissure of the Tractus Optici, and running directly backwards, terminates in the *Posterior Artery* of the Brain Proper. It sends off only very minute branches during its progress, and seldom exceeds a twelfth of an inch in diameter. 2. Two or three *Capillary Branches* to the Tractus Opticus and the lower extremity of the Choroid Plexus. 3. The *Anterior Artery* of the Brain Proper *, which is one of the Vessels into which the Internal Carotid divides when it terminates. It is about a tenth of an inch in diameter generally, and immediately after its origin inclines upwards and inwards in the form of a curve, anterior to the Commissure of the Tractus Opticus, and above the commencement of the Optic Nerve. It then penetrates into the Longitudinal Fissure between the Anterior Lobes, and ascending gradually, reaches the anterior Extremity of the Corpus Callosum, round which it turns, and then runs along, immediately above the superior surface of this body, until it terminates towards its posterior extremity. In its progress, it gives off branches to the Commissure of the Tractus Optici, to the Origin of the Optic Nerve, to the root of the Olfactory Nerve, and the oblong surface described p. 87. immediately behind this; it then sends off a branch called *Communicating*, about a sixth of an inch in length and a twelfth in diameter, which crosses the Longitudinal Fissure at right angles, and runs into the corresponding Artery of the opposite Hemisphere; and throughout the rest of its course, it sends ramifications of various sizes, in every direction, to the internal and inferior surfaces of the Anterior Lobe, to the two anterior thirds of the sides of the Longitudinal Fissure above the Corpus Callosum, and some twigs even emerge from this Fissure above, and anastomose with branches of the *Sylvian Artery* on the upper surface of the

* SYNONYM. *Lat.* Arteria Callosa.

Hemisphere. 4. The *Sylvian Artery* *, which is the other Vessel into which the Internal Carotid divides at its termination, and is a little larger than the former. Immediately after its origin, it inclines directly outwards, and entering the inner and anterior extremity of the Fissure of SYLVIUS, it runs along the whole of this Fissure, and terminates on the outer surface of the Posterior Lobe. During this course, it sends off branches, to the Pia Mater covering the oblong surface behind the origin of the Olfactory Nerve just alluded to; to the surface behind, of the Anterior Lobe; to the surfaces chiefly before, of the Middle Lobe; and some of its superior ramifications anastomose with branches of the Anterior Artery towards the Longitudinal Fissure.

The *Basilar Artery* is formed by the union of two other Arteries called *Vertebral*, a species of anastomosis which is very rare in the Arterial System. The Artery begins generally about the lower margin of the Annular Protuberance, and running along the middle of the anterior surface of this prominence, in the depression described p. 112. under the name of the Basilar Furrow, terminates about its upper border. It is about an eighth of an inch in diameter generally; and, besides innumerable capillary branches to the Pia Mater covering the anterior surface of the Protuberance, it sends off during its progress the following Vessels of greater size. 1. The two *Small Inferior Cerebellar Arteries*†, one to each side. These seldom arise exactly opposite to each other, but one generally comes off, close to the origin of the trunk, and the other about a quarter of an inch higher up. They rarely exceed the thirtieth or twenty-fifth part of an inch in diameter. Each of them extends at first directly outwards, and then inclining a little downwards, reaches the lower border of the Peduncular Fossa, and runs along this, to-

* SYNONYMS. The Middle Cerebral Artery; The External Branch of the Internal Carotid.

† SYNONYM. *Lat.* Ramus Cerebelli Inferior Alius.

wards the outer margin of the Cerebellum. In their course, they send many very minute Vessels, to the Pia Mater covering the parts over which they pass, and one pretty large one dips down into the Peduncular Fossa. 2. The two *Superior Cerebellar Arteries*, one on each side. These usually come off from the trunk, opposite to each other, about a tenth of an inch from its upper extremity; and are a little larger than the two last Vessels described. Each of them runs directly outwards, turns round the lateral border of the Annular Protuberance, over the anterior extremity of the Peduncle of the Cerebellum, into the Semilunar Fossa, and then ascending, gets to the upper surface of the Cerebellum, and extends on this surface to the posterior margin, or even over it, so as to anastomose with branches of the Large Inferior Cerebellar Artery. In this course, it gives off numerous small twigs to the Pia Mater of the Protuberance and Cerebellar Peduncules; a branch of considerable size*, which runs along the whole of the upper margin of the Peduncular Fossa, and at last terminates on the outer part of the Inferior Lobes; small twigs to the Choroid Membrane and to the Pia Mater of the Corpora Bigemina, and of the Vieussenian Valve and its Pillars; and numerous ramifications in every direction over the Laminæ of the upper surface of the Cerebellum. 3. The two *Posterior Arteries* of the Brain Proper, one on each side. It is into these that the Basilar Artery divides when it terminates above. Each of them is about half the diameter of the Basilar Artery. They ascend at first in a curved direction upwards and outwards, on the Protuberance; then leaving this prominence, they incline backwards upon the inferior surface of the Inferior Lobes of the Brain Proper, and terminate towards the posterior extremities of these Lobes. In their course they give

* SYNONYMS. *Lat.* Ramus Cerebelli Anterior. *Fr.* Rameau du Pédoncule du Cerveau.

off innumerable small twigs, to the Pia Mater lining the Triangular Furrow between the Peduncules of the Brain Proper; similar small branches to the Choroid Plexus in the Inferior Horns of the Lateral Ventricles; a branch of considerable size, which turning backwards and upwards round the Peduncles of the Brain Proper, is ramified chiefly on the Choroid Membrane and Plexus, and the Pia Mater covering the Corpora Bigemina; and numerous branches of various sizes, to the inferior surfaces of the Middle Lobes, and the inferior, inner, and outer surfaces of the Posterior Lobes. At about half an inch from their origin, they receive the Communicating Branch of the Internal Carotid; and thus by means of these Vessels, and of the Anterior Arteries of the Brain Proper with their Communicating Branch, an Arterial Circle is formed, which has been denominated the *Circle* of WILLIS.

The Arteries of the Pia Mater derived from the *Vertebrals*, are the two *Large Inferior Cerebellar Arteries*, one on each side. We shall have occasion to describe the origin of these, and their course with respect to the top of the Spinal Cord, afterwards. It is sufficient to observe here, that they join the Cerebellum generally towards the upper and outer part of the Spinal Lobules, and thence wind along the Inferior Lobes, and the inferior surface of the Posterior Lobes. Besides the branches which they send outwards and backwards in this course, they supply all the parts in the Spinal Fossa, and in the Median Fossa which is continuous with it.

The capillary Veins of the Brain, unite, in the Pia Mater, into a series of Venous Trunks, all of which terminate in the Sinuses of the Dura Mater.

The small Veins from the upper, convex, surface, and the inner, flat, or median, surface, of each Hemisphere of the Brain Proper, and from the lower surface of each Anterior Lobe, usually unite into ten or twelve Venous Trunks, which open into the Upper Median, or Longitudinal Sinus, of the Dura Mater. The course of these Veins is over the convex surface of the Hemispheres, towards their upper and inner margins, along which, they penetrate the Sinus. They occupy chiefly the tops of the Fossæ between the Convolutions, and at their entrance into the Sinus, have, most of them, a slight inclination forwards. Those in the middle incline most. They seldom or never correspond exactly, either in their course or their dimensions, in the opposite Hemispheres. They are small towards the Anterior Lobe, and largest about the middle of each Hemisphere. The largest is about a sixth of an inch in diameter, the smallest about a tenth.

The capillary Veins from the lower, anterior, and inner surfaces, of each of the Middle Lobes of the Brain Proper, usually unite into three or four small Trunks, which open, one of them sometimes into the anterior part of the Lateral Sinus of the Dura Mater on the corresponding side, the other two or three, always into the anterior part of the Cavernous Sinus.

The capillary Veins from the lower surface of each Posterior Lobe of the Brain Proper, uniting with a few from the outer, convex, surface, of the same, form, in general, four small Trunks, which penetrate the upper side of the Lateral Sinus of the Dura Mater, at equal distances from each other.

The delicate Venous Vessels of the Choroid Membrane and Plexus, unite successively with each other, to form two Trunks, denominated the *Galenian Veins.* The general direction of these, is from the apex of the Choroid Membrane to its posterior margin, close to the Median Line. They form a part of this Membrane. They are both pretty nearly of the same size; and beginning small before, gradually enlarge as they proceed backwards, until, at their termination, they are usually about an eighth of an inch in diameter. Towards the anterior part of the Membrane, they are closely in contact with each other; but behind, they separate to the distance of nearly half an inch, leaving a sort of island between them, and then coalesce as before. Their termination is in the Lower Median Sinus* of the Dura Mater; into which they open at its anterior extremity. Sometimes, immediately before opening into the Sinus, they unite into one Vessel.

The small veins from the superior surface of the Cerebellum, form three or four Trunks of inconsiderable size, which inclining towards the Median Line and the Mons Cerebelli, open into the Lower Median Sinus also, penetrating through its lower side.

The capillary Venous Vessels on the inferior surface of the Cerebellum, unite, on each Hemisphere, into two or three Trunks, each scarcely more than a tenth of an inch in diameter. These incline backwards and outwards, and winding round the margin of the Cerebellum, ascend towards the Lateral Sinus of the Dura Mater, and penetrate into this Sinus, through its inferior parietes.

All these Venous Vessels just described, are in general easily distinguished in the recent Brain, in consequence of the quantity of Blood which is usually found collected in them, and the extreme delicacy of the Membranes with which they are embraced, and which they in part contribute to form. Their apparent size will vary according to the quantity of Blood with which they are distended; and this depends, partly, I believe, on accidental circumstances accompanying the cessation of the Circulation, but chiefly, as I am convinced from many observations, upon the position which the Head is permitted to assume after Death, or during dissection. A minute injection of the Veins of the Pia

* SYNONYMS. The Fourth Sinus. *Fr.* Le Sinus Droit. *Lat.* Torcular Herophili.

Mater, depending upon one or other of these causes, is every day erroneously set down, as an effect and indication of a previously inflamed state of that Membrane, or a morbid determination of Blood to the Vessels of the Brain in general. But the appearance of vascularity produced by inflammation is very different from this; and topical congestions such as are here supposed, are no longer perceptible after the circulation has ceased.

Along the whole of the upper and inner margin of each Hemisphere of the Brain Proper, there are usually found enveloped in the Pia Mater, clusters or patches of little soft bodies called *Granulations**. These are of a whitish or yellowish colour, about the size of the head of a pin, and seldom single, but joined together into groups, apparently, by the net-work of the Pia Mater. I have not been able to discover any thing relative to their intimate structure. They do not seem to be very vascular. They are disposed chiefly, around the extremities of the Veins, which have just been described, entering into the Longitudinal Sinus of the Dura Mater; and are easily distinguished, through the Arachnoid Membrane, by their peculiar colour, when the Dura Mater is raised from the upper surface of the Brain. I have never seen them in any other region of the Brain Proper or Cerebellum. The substances which BICHAT † has ranked along with them, in the Choroid Membrane and Choroid Plexus, and in the Pia Mater of the Spinal Fossa of the Cerebellum, seem to me to be of a different nature; they look like tender convolutions of Bloodvessels, and, therefore, I have spoken of them as Plexuses.

The *Arachnoid Membrane* differs very much from the Pia Mater both in structure and distribution. Placed on the outside of this coat, it embraces only the more superficial parts of the external surface of the Brain. It neither dips

* SYNONYM. Glands of PACCHIONI.

† Anatom. Descrip. III. p. 63.

down between the Convolutions of the Brain Proper or Laminæ of the Cerebellum, nor penetrates into the Central Fissures; and it passes across all the larger Fossæ between the Hemispheres and Lobes of the Brain, as soon as these Fossæ cease to be occupied by projections of the Dura Mater or of the Cranium. At various parts, too, particularly at the Basis of the Brain, it is perforated for the transmission of Bloodvessels and Nerves.

Bichat * has described the Arachnoid Membrane as continued from the outer surface of the Brain Proper into its Central Fissure. He says, it enters this Fissure, by a small opening just under the posterior extremities of the Corpus Callosum; and that it immediately embraces the Choroid Membrane and Plexuses; lines the whole surface of the Ventricles in the form of a shut sac; and is then prolonged, through the Aqueduct of Sylvius, into the Central Fissure of the Cerebellum. I have often sought, however, for this continuation, but in vain; and am rather inclined to suspect, that Bichat has fallen into an error in this instance, from his eagerness to establish an analogy between the Arachnoid Membrane and those Membranes, in other parts of the Body, which are called Serous. I am even doubtful, whether there be any Membrane lining the Ventricles at all; notwithstanding the minute description of a very delicate covering of this nature, which has lately been given, by the accurate and indefatigable Wenzels †. It does not appear to me clear, that the substance they have described as a Membrane, is not merely a thin, dense, stratum of Nervous Matter.

The Arachnoid Membrane, is, as its name imports, as thin as cobweb; dense, colourless, and almost perfectly transparent. Its outer surface is quite smooth; its inner more or less thready or flocculent, according to its connection with the Pia Mater.

* Anat. Descrip. III. p. 51.

† De Penit. Struct. &c. p. 80.

Nothing is known respecting its structure. I have never seen Bloodvessels in it, either in its healthy or diseased states, with or without injection; nor do I believe that they have yet been detected by any Anatomist. I have not attempted to inject its Absorbents, nor has any one, so far as I know, hitherto succeeded in demonstrating these, in a satisfactory manner. It is equally impracticable to demonstrate its Nerves. BICHAT* classes it with the Serous Membranes; and his reasons for this arrangement are certainly not without weight, in so far as they relate to its functions; but the analogy between them, in point of structure, is far from having been established; and as the classification of the Membranes and other Common Textures is, or ought to be, founded entirely on Anatomical characters, I prefer, in the meanwhile, to regard the Arachnoid Membrane, as of a peculiar structure.

The connection betwixt this Membrane and the Pia Mater is in most places very close, as we have already had occasion to remark when speaking of the latter; and yet it is impossible to discover any connecting medium between them, except Bloodvessels. Even where they are separated to a considerable distance from each other, the slender, white, filaments, which appear between them, may be only long and delicate ramifications of Arteries or Veins.

Its particular distribution is easily described. It passes accross from the top of one Convolution to another, adhering closely to the Pia Mater, over the whole outer and upper surface of each Hemisphere of the Brain Proper. Along the border of these Hemispheres, next the Longitudinal Fissure, it is perforated, at various points, by the Veins already described entering the Longitudinal Sinus of the Dura Mater. In the same manner it covers the Convolutions on the sides of this Fissure, as far down as the

* Anat. Descrip. III. p. 32.

Hemispheres remain separated by the Dura Mater, and unconnected by Pia Mater; and then it passes across from the one Hemisphere to the other, being perforated immediately below the posterior extremity of the Corpus Callosum by the Galenian Veins. It has a similar distribution on the Convolutions of the basis of the Brain Proper. It does not line the furrow in which the Olfactory Nerve lies, but passes over that Nerve, as will afterwards be more particularly mentioned. It stretches across the Fissure of SYLVIUS, where that Fissure ceases to have its sides united by Pia Mater. In the hollow formed by the Anterior Lobes before, just where the Olfactory Nerves arise, by the Middle Lobes on each side, and by the Peduncles of the Brain Proper and Annular Protuberance of the Cerebellum behind, it is separated to a considerable distance from the Pia Mater; and is perforated, on each side, by the Optic and Oculo-Motor Nerves, and the Internal Carotid Artery, and in the middle, by the extremity of the Infundibulum. It is continued down from the inner and posterior border of the Middle Lobes of the Brain Proper, and the posterior extremity of the Corpus Callosum, to the upper surface of the Cerebellum. It is spread over the Laminæ on this surface, just as it is over the Convolutions of the Brain Proper, and is equally closely connected to the Pia Mater. On the anterior surface of the Annular Protuberance, it is but loosely attached to the Pia Mater, so that here, it may be raised up from that Membrane, to a considerable extent, merely by inflation with the blow-pipe; or it may be dissected off almost entire, by cutting carefully across those filamentous productions which stretch between them. It is perforated, at the junction of the Peduncles of the Brain Proper with the Protuberance, by the Pathetic Nerves; at the lateral parts of the Protuberance, by the Trigeminal Nerves; and towards its lower and middle part, by the Oculo-Abductor Nerves. From the Protuberance, it is continued over the Peduncular Fossa laterally, across which it is laid rather loosely; and is perforated, towards the inside, by the Facial, Auditory, Glossopharyngeal, Gastropulmonary, and Accessory Nerves. It is still more loosely attached to the outer and lower part of the Spinal Lobule, than to any other part of the Brain. From these Lobules, it is continued across to the top of the Spinal Cord, where it is afterwards to be described; consequently, it does not line any part of the Spinal Fossa, nor the anterior part of the Median Fossa of the Cerebellum.

Such is the Anatomy of the Brain in the Adult Male; and so far as has yet been ascertained, it seems to be precisely the same in the Adult Female. Slight differences in the size, and shape, of this organ, have been asserted by some, to be perceptible in the two sexes; but these have not been satisfactorily established.

Almost all that is at present known respecting the Anatomy of the Brain, before and after Maturity, has been ascertained by the ingenuity and industry of the Wenzels. Anatomical writings, previously to the appearance of their work*, contained little relative to this subject, that could be relied on.

Their observations on the dimensions of the Brain at different periods of Life, are particulary interesting. They

* De Penitior. Struct. &c. This is the best and most original book on the Structure of the Brain, that has appeared for more than a century. The authors seem to have laboured unremittingly at the subject, for upwards of twelve years, and to have enjoyed the most ample opportunities for observation, during the whole of that period. On comparing many of their descriptions with nature, I have found them so exact, that I am disposed to place the utmost reliance on the accuracy of their remarks in general. I regret exceedingly, that many of the preceding pages were printed, before I had become aware of the valuable matter which their volume contains. I should gladly have availed myself of their observations on the Pineal Gland, the Pituitary Gland, the Sinus of the Septum Lucidum, and the Choroid Plexus.

are the result of an immense number of measurements of this organ, made apparently with the utmost accuracy, and with every attention to the usual sources of fallacy, in experiments of this nature.

According to them, the total length of the Brain Proper, three months after Conception, is an inch and three lines; at Birth, four inches and two lines; and at the seventh year, and from the seventh to the eightieth, between six and seven inches. The total breadth of the Brain Proper, three months after Conception, is an inch and one line; at Birth, from three inches and eight lines, to four inches and six lines; and at the seventh year, and from the seventh to the eightieth, from five inches, to six inches and five lines. It appears, therefore, that the Brain Proper, increases rather more in length and breadth during the six months immediately preceding Birth, than during the first seven years after Birth; that these dimensions arrive at their maximum at the age of seven; and that they suffer no change during the whole of after Life *.

The total length of the Cerebellum at the third month after Conception, they found to be four lines; at Birth, an inch and six or eight lines; at the seventh year, and during the whole of after Life, two inches and from two to eight lines †. Its total breadth at the third month after Conception, was seven lines; at Birth, from two inches, to two inches and six lines; and at the seventh year, and during the remainder of Life, from three inches and nine lines, to four inches and four lines. The absolute increase, therefore, of the Cerebellum, as well as of the Brain Proper, in both dimensions, is greater during the six months preceding Birth, than the seven years immediately succeeding it; at the seventh year the length and breadth have arrived at their

* De Penitior, &c. p. 295, 254.

† In this measurement, I presume, the Annular Protuberance is excluded.

maximum; and during the remainder of Life, these dimensions neither increase nor diminish*.

The WENZELS have given, also, a minute detail of the average dimensions of each particular part of the Brain, at various periods, from the third month after Conception, till the eightieth year †. The length of this description, however, will hardly permit me, on the present occasion, to do more than refer to it.

The Convolutions of the Brain Proper, begin to be formed, only about the third month after Conception. At this period, they are mere superficial depressions and prominences. They appear first on the Middle and Posterior Lobes, and extend to the Anterior. At the fifth month, they are still indistinct; but at the seventh, they are strong and well marked. After this, they become gradually larger, in proportion to the age of the Fœtus and of the Child ‡.

There is no Acervulus on the Pineal Gland, before Birth. A soft, glutinous, substance, which may perhaps be regarded as its rudiments, sometimes appears in its place before the seventh year; but a perfect Acervulus is never found until this period. From the seventh to the sixtieth year, the number of grains in the Acervulus seems to increase; and after this, rather to diminish §.

The Laminæ of the Cerebellum are developed a good deal earlier than the Convolutions of the Brain Proper. In an Embryo of five months, they are very distinct and regular, and separated by deep fissures ||.

The general result of their investigations is, that some parts of the Brain increase most in size before Birth, others between Birth and the seventh year; but that all parts of

* De Penitior. &c. p. 323, 253, 254.

† Same book, p. 249.

‡ Same book, p. 296.

§ Same book, p. 315.

|| Same book, p. 324.

this organ have acquired, at the seventh year, their full dimensions, and suffer no alteration in this respect afterwards *.

With regard to the weight of the Brain, they observe, that this is difficult to be ascertained in the Embryo prior to the fifth month, as the organ is so soft as not to be easily extracted entire.

The following, however, is part of a Table †, in which they have exhibited the weight of the whole Brain, of the Brain Proper, and of the Cerebellum, and the ratio of the two last to each other, as it was ascertained in nineteen different instances, at various periods, from the fifth month after Conception to the eighty-first year.

Age.	Weight of Whole Brain.	Weight of Brain Proper.	Weight of Cerebellum.	Ratio of Brain Proper to Cerebellum.
5 months after	*Grains.*	*Grains.*	*Grains.*	
Conception.	720	683	37	$18\frac{17}{37} : 1$
At Birth	6150	5700	450	$12\frac{2}{3} : 1$
3d year	15240	13380	1860	$7\frac{6}{31} : 1$
5th ——	20250	17760	2490	$7\frac{11}{83} : 1$
25th ——	22200	19500	2700	$7\frac{6}{27} : 1$
46th ——	20490	18060	2430	$7\frac{35}{81} : 1$
81st ——	23970	21210	2760	$7\frac{63}{92} : 1$

The general result of their experiments relative to this subject is, 1. That the weight of the whole Brain, most commonly arrives at its maximum, at the age of three years, and remains without diminution the whole of after Life; the maximum being in general from 20000 to 22000 grains, and seldom exceeding 24000; 2. That the weight of the Brain Proper, at the age of three years, does not in general exceed 21000, nor that of the Cerebellum 2000 grains, the weight of the former

* De Penitior, &c. p. 254. † Same book, Tab. Tert.

being usually from 18000 to 20000 grains; and that these two parts preserve the same weight for the remainder of Life; 3. That the younger the Fœtus, the greater the ratio of the weight of the Brain Proper to that of the Cerebellum; that the nearer the Fœtus approaches the Period of Birth, the more slowly is the ratio of the weight of the Brain Proper to the Cerebellum diminished; that this ratio, at the age of three years, is usually about 7 to 1; and that it remains the same ever after *.

Soemmerring †, Bichat ‡, and the Wenzels §, agree in stating, that the Nervous Matter of the Brain, in an Embryo of five or six months, is almost fluid; and that it gradually increases in consistence, with the age of the subject; so that it is always firmest in those who are most advanced in years.

The Wenzels have subjected the Nervous Matter of the Brain at Birth, to examination with the microscope, and have found it to be composed of Globules, differing from those in the Adult, only in size ||.

According to Bichat ¶, the Nervous Matter of the Brain, in the Fœtus, is dissolved with great facility by the Caustic Alkali. The first effect of this substance upon it, is to change it into a viscid, transparent, reddish matter, capable of being drawn out into threads like White of Egg; it then dissolves it entirely. Acids coagulate the Nervous Matter, he also found, as in the Adult, but they do not render it so hard.

In the Brain of an Embryo of three months, the Wenzels ** found the whole Substance of a pearly colour, without any appearance of Brown Nervous Matter. The Brown

* De Penitior, &c. p. 265. 296.

† De Corp. Hum. Fab. iv. p. 41.

‡ Anat. Descrip. III. p. 136.

§ De Penitior, &c. p. 293.

|| De Penitior, &c. p. 294.

¶ Anat. Gener. I. p. 200.

** Same book, p. 299.

Matter was equally imperceptible in an Embryo of five months. At these early periods, they found the White Nervous Matter very vascular. In a child at Birth they observed, that the White Nervous Matter was reddish from the number of its Vessels, and the Brown was very pale. In an infant of eight weeks, they perceived the two kinds of Matter, but the difference between them was very slight. Their observations on this Matter in old age, correspond with those of other Anatomists; both species of it become darker in colour, but the Brown in particular, in proportion as the individual advances in years.

They have entered into some very minute details, as to the state of the Nervous Matter, in different portions of the Brain, at different periods of Life; but for these, I must refer the reader to the work itself*.

On the subject of the Granulations of the Pia Mater, they observe, that there is not the slightest appearance of these bodies previous to Birth. They are generally found between birth and the seventh year, though there are always fewer of them at this period than in the Adult. When they happened to be wanting altogether, which, however, is very seldom, the deficiency generally occurs before the third year †.

OF THE SPINAL CORD‡.

From a few measurements which I have made of this prolongation, I am inclined to think, that its length, in a a person of the average stature, is generally about thirty inches. Its thickness is different at different parts; but it

* De Penitior, &c. p. 300. 326.

† Same book, &c. p. 290.

‡ Synonyms. Spinal Marrow. *Fr.* Le Prolongement Rachidien.

is scarcely an inch thick even where it is thickest, and its diameter at the slenderest part, is usually a little less than half an inch.

I have made no trials of its weight, but according to Chaussier *, it is from about a nineteenth to a twenty-fifth of the whole Brain,

Like the Brain, it consists of a peculiar *Substance* embraced by *Membranes*. Each of these I shall consider separately.

The Substance of the Cord does not occupy its whole length, but is shorter by about nine inches.

It may be divided into three portions. The first, may be called the *Top* of the Cord, or the *Cranial Portion*†, as it is contained entirely within the cavity of the Cranium. It extends, from the Annular Protuberance of the Cerebellum, downwards, for about an inch; and is thicker above than below. Its transverse diameter at the upper part, is usually about seven eighths of an inch, and its diameter from before backwards about three quarters of an inch; while both these diameters below, are only about four tenths of an inch. The surface of the section, by which it is separated from the Cerebellum, exhibits precisely the same appearances as the corresponding surface of the Annular Protuberance described p. 113.

The second part, I shall call the *Cervical Portion* of the Cord, because it is lodged in the Cervical region of the Spinal Canal. Its length is about five inches. Its transverse diameter above, is about four tenths of an inch, but it gradually enlarges to six tenths of an inch, as it extends down-

* Exposit. Sommaire, p. 119.

† Synonyms. *Lat.* Medulla Oblongata; Principium Medullæ Spinalis; Pars Cephalica Medullæ Spinalis. *Fr.* Le Bulbe Rachidien

wards. The diameter from before backwards is also about four tenths of an inch at the upper part, but rather diminishes than increases below.

The remaining part of the Cord may be denominated the *Dorsal Portion*, as it is contained chiefly in the Dorsal Region of the Spinal Canal. It is generally about fifteen inches in length. The upper part of it gradually tapers and becomes cylindrical as it descends, its diameter below being only about four tenths of an inch. Its middle part remains cylindrical, but is even a little narrower than the former. Its lower part widens out a little, at first, in its transverse diameter, and then gradually tapers to a point. I have never seen this portion, however, so large as the Cervical Portion; nor have I ever observed that double swelling at its tapering extremity, which SOEMMERRING* and some other Anatomists have described.

The Spinal Cord is perfectly symmetrical in the longitudinal direction, from before backwards; consequently it is divisible into Right and Left Halves.

A fissure runs along each surface of it, from one extremity to the other, exactly on the Median Line. These are called the *Anterior* and *Posterior*, *Median Fissures* of the Cord. The Anterior Fissure begins above, at a little triangular pit, just under the middle of the lower margin of the Annular Protuberance of the Cerebellum; the Posterior, is continuous with the groove described p. 120, on the anterior side of the Central Fissure of the Cerebellum. Both Fissures are widest and deepest in the Top of the Cord; where, in truth, from the convexity of the parts on each side of them, they form rather Furrows than Fissures. Their depth here, however, even at the deepest part, does not exceed an eighth of an inch. In the other portions of the Cord, they are as narrow as a hair; and I am very

* De Corp. Hum. Fab. IV. p. 75.

doubtful, whether they are even the sixtieth part of an inch deep. I suspect, that in examining these Fissures in general, they have been made to appear deeper than they really are, from the laceration of part of the Substance of the Cord; this, however, is a point to be investigated.

Just where the Top of the Cord joins the Cervical Portion, the Anterior Median Fissure is interrupted or crossed, by two or three ridges, varying a little in their shape and size, but seldom exceeding a twelfth of an inch in diameter, which run, with a slight obliquity downwards, from one side of the Cord to the other. These ridges would hardly have been worthy of particular notice, were it not for the absurd theories, with which they have often been connected in physiological writings.

I have never observed the slightest appearance of a Lateral Furrow in the Spinal Cord, dividing each half of it into anterior and posterior portions, such as SOEMMERRING* and PORTAL†, and several Anatomists prior to them have described. I am confident, therefore, that if it ever exists, it is by no means a constant appearance.

The colour of the Cervical and Dorsal Portions of the Cord, is Orange-White throughout.

The upper portion of the Top of the Cord exhibits three Eminences on each side, exactly similar to each other.

The first is situated close to the Anterior Median Fissure, forming one side of it. It is about half an inch long, and a quarter of an inch broad; and as its breadth is uniform throughout, without the slightest appearance of tapering, I prefer to call it the *Oblong Eminence*, instead of the *Corpus Pyramidale*‡, which it is often denominated. It is continuous above, with the Annular Protuberance of the Cerebellum;

* De Corp. Hum. Fab. IV. p. 78.

† Cours d'Anatomie. IV. p. 62.

‡ SYNONYMS. *Fr.* Les Corps Pyramidaux Anterieures; Bandes Medullaires.

but the lower margin of the Protuberance, projects farther forwards than it does, and consequently there is a pretty deep groove between them. Its colour is Orange-White.

Exterior to the Oblong Eminences, on each side, is the *Oval Eminence**, of an Orange-White colour also. The long diameter of this, is about half an inch, and its short one, about a quarter; its elevation being nearly a tenth of an inch. It looks outwards and forwards; and the groove between it and the lower border of the Annular Protuberance, is still deeper than that between this Protuberance and the Oblong Eminence. I observe, however, that there is considerable variety in the depth of this Fossa, depending on varieties in the projection of the two prominences between which it lies.

Behind the Oval Eminences and exterior to them, and occupying the whole of the remaining part of the Cord, round to the Posterior Median Fissure, there is an Eminence, on each side, which I should be disposed to call the *Peduncle* of the Spinal Cord†. It is about half an inch long, three eighths of an inch broad, and between two and three eighths of an inch high at the upper part, but falling gradually lower, towards its inferior extremity. Its posterior surface is slightly concave for a short way from the Median Fissure outwards; and this concave part, from being about four tenths of an inch wide above, gradually tapers to a point below. Consequently, when these surfaces in both Peduncles are joined together, they form a *Triangular Fossa*‡ in the Top of the Cord, the basis of which is turned up-

* SYNONYMS. *Lat.* Corpus Olivare; Corpus Pyramidale Anticum Laterale.

† SYNONYMS. *Lat.* Processus Restiformis; Processus a Cerebello ad Medullam Spinalem; Corpus Pyramidale Posterius. *Fr.* Colonne ou Pédoncule de la Moëlle Alongée; Colonne Inférieure du Cervelet.

‡ SYNONYMS. *Lat.* Calamus Scriptorius. *Fr.* Sillon du Ventricule du Cervelet; La Fossette Anguleuse.

wards, and the apex downwards, with the Posterior Median Fissure running exactly through its middle.

On the surface of this Fossa, there are two things to be particularly attended to. 1. There is a narrow space, distinguished by its darker colour, which diverges from the apex of the Fossa on each side, and extending upwards, tapers to a point within a fifth of an inch of the base of the Fossa. The colour of this space is Yellowish-White with a mixture of Red, sometimes Greyish-White, while the colour of the surrounding parts is Yellowish-White. 2. Several small ridges, very gently elevated, and of an Orange-White colour, are generally seen extending, from the Posterior Median Fissure on each side, nearly parallel to the base of the Fossa, outwards to its lateral margin. Sometimes, however, these *White Ridges*, are wanting on one side of the Fossa, sometimes on both; and even when present, the observations of PROCHASKA* and the WENZELS† have abundantly established that there is the greatest variety in their number, breadth, and distribution. They vary in number from one to ten or even more; and in point of size, from the breadth of a hair, to the twentieth of an inch. Sometimes they keep quite distinct from each other, in their progress outwards from the Median Fissure; sometimes two or more run together. Sometimes one or two of them, sometimes the whole, terminate before they reach the outer border of the Fossa. Occasionally, some of those on one side, appear to be continuous, at the Median Fissure, with those on the other. Not unfrequently, too, one of them may be seen beginning at a little distance from the Fissure, and instead of running outwards to the margin of the same side, crossing the Fissure, and joining the Ridges of the opposite side. Some of them are much more inclined upwards

* Oper. Min. Pars. I. p. 388.

† De Penitior, &c. p. 169.

than others, in particular instances; and sometimes the inclination of the upper Ridges is so great, that they stretch into the Central Fissure of the Cerebellum. The Ridges on the opposite sides are seldom or never exactly alike.

The Peduncles of the Cord on each side, form, on the forepart, a deep Triangular Pit with the Oval Eminences, the lower border of the Annular Protuberance, and the inferior margin of the Peduncles of the Cerebellum; and from this Pit, a slightly convex space extends downwards and backwards, narrow at first and widening as it proceeds, which separates the remaining part of the Peduncles of the Cord from the Oval Eminences.

In describing the lower surface of the Peduncles of the Cerebellum, I had occasion to take notice of a white ridge upon it, running backwards and inwards, from the origin of the Auditory Nerve. From the inner extremity of this ridge, a *Ridge* of a Greyish-Brown colour, is almost always found running round the top of the Peduncle of the Spinal Cord, close to its connection with the Cerebellum, and terminating at the angle at the base of the Triangular Fossa*. I have found this Ridge once wanting on the right side in an Adult Male, and the WENZELS once found it wanting in an Adult Female on the left side; but it would appear from their observations, that the cases in which such deficiency occurs, are exceedingly few. It is about at welfth of an inch broad, but generally a little broader at its anterior than its posterior extremity. It varies a good deal in its height, being sometimes nearly a twelfth of an inch high,

* PROCHASKA seems entitled to the merit of having first taken notice of these ridges; although he has described and represented them but very imperfcetly. Oper. Min. Pars. I. p. 391.

The WENZELS have left nothing to investigate with respect to them; and they have accompanied their copious description with several good engravings, De Penitior. Struct. &c. p. 183. It is only to be regretted, that none of these engravings represent the ridges throughout the whole of their course.

at other times just perceptible and no more. The WENZELS examined the Brains of fifty persons, from the age of twenty to one hundred and seven, and they found the Brown Ridges well marked in thirty nine of these ; in the remaining eleven, they were smaller and of course less distinct. The Ridges are generally connected, by their posterior extremities, with the outer ends of some of the White Ridges in the Triangular Fossa. I have often seen them approaching to Yellowish-White or even Orange-White in their colour, but seldom or never of a darker shade than Greyish-Brown.

There are two slender *Membraniform Processes*, which project from the Peduncles of the Cord, which do not seem hitherto to have been described. In point of appearance and delicacy, they are precisely like the Wings of the Inferior Vermiform Process of the Cerebellum. The Posterior one projects from the edge of the Triangular Fossa inwards ; and lines, and is supported by, that prolongation of the Pia Mater, which is stretched across the Fossa behind and converts it into a shut cavity. It is attached to the edge of the Fossa a little above its apex, and is about a quarter of an inch broad at its base. It seldom extends more than an eighth of an inch inwards; but it is so apt to be torn even in the most careful dissections, that I am not yet satisfied as to its real dimensions, The Anterior one is attached to the forepart of the Peduncle, near its margin, and below the Brown Ridge. It projects outwards and forwards; connected behind to the lower part of that Plexus-looking portion of the Pia Mater, which covers the Subpeduncular Lobules of the Cerebellum; and covered before, by the roots of the Glossopharyngeal and Gastropulmonary Nerves. It is about a quarter of an inch in length, and a sixth in breadth, but varies in its thickness a good deal more than the Posterior Process. I have repeatedly seen it nearly a twelfth of an inch thick towards its outer margin; so that it had rather the appearance of a little tubercle than a Membrane.

The substance of the Spinal Cord is composed entirely of Nervous Matter; differing but very little, apparently, from the Nervous Matter of the Brain. Both species of this Matter occur in it.

The White Matter is chiefly of the Orange-White kind; and from a considerable number of observations, made upon the Cord soon after death, I am inclined to agree with CHAUSSIER *, that this Matter is firmer in its consistence, than the same substance, in any part of the Brain, except the Annular Protuberance. According to PROCHASKA †, the globules it exhibits under the microscope, are of the same size with those seen in the Brain; but the WENZELS ‡ rather think they are a little smaller; and this corresponds with the few observations I have myself made. It is coagulated, and rendered very firm, by Alcohol, Acids, &c.; and when it is torn in this state, it exhibits, in most parts, a very distinct *fibrous* appearance. According to VAUQUELIN, when treated chemically with Alcohol, in the manner already described p. 124, it yields much more Fatty Matter, but less Albumen and Ozmazome, than the Nervous Matter of the Brain.

The Brown Nervous Matter in the Cord, is chiefly of the Greyish kind.

The arrangement of these two kinds of Matter in the Spinal Cord, has not hitherto been either described, or represented, with sufficient accuracy. I shall endeavour, on some future occasion, to supply this deficiency, by means of engravings; verbal description in such cases not being sufficiently precise.

* Exposit. Sommaire, p. 116.

† Oper. Min. Pars. I. p. 345.

‡ De Penit. Struct. &c. p. 33.

In the mean time, I may observe, that the whole of the Cervical and Dorsal Portions, and the lower part of the Top, of the Cord, consist of a *Central Column* of Greyish-Brown Matter, surrounded by a Stratum of Orange-White. Some idea of the Central Column may be given, by describing it as four-sided and rectangular, the sides looking backwards and forwards, right and left; with a slender *Wing* projecting outwards from each angle, the anterior turning a little backwards, and the posterior a little forward, so that the sides of the Column present a semilunar surface, concave outwards. The middle part of the Column measures, in general, about a tenth of an inch in both directions. The posterior Wings are about a fifth of an inch in length; the anterior ones, a little shorter. In thickness, both of them are about a twentieth of an inch at their base, but taper to about a fiftieth of an inch as they proceed outwards.

The appearance, however, and situation of the Column at its commencement above, is peculiar. If we trace it from the Cervical Portion of the Cord upwards, we find, that as soon as it gains the Top of the Cord, it inclines backwards in its ascent; and having reached the apex of the Triangular Fossa, it splits into two parts, one of which runs up on each side of the Posterior Median Fissure. Here they are covered only by a very thin layer of Yellowish-White Nervous Matter; through which they may be distinctly traced to their termination. It is they which cause those *narrow spaces of a darker colour*, on each side of the Median Fissure, which were taken notice of p. 179, in the description of the Triangular Fossa. The Central Column, therefore, may be said to begin in the Triangular Fossa of the Top of the Cord.

The stratum of Orange-White Matter which surrounds this Column, is of course thinnest opposite the Median Fissures, and thickest, laterally, between the Wings of the Column.

The Top of the Cord contains, on each side, between the Median Plane, and the Oblong and Oval Eminences, a substance exactly similar to the Corpus Dentatum in the Cerebellum, and to which the same name may be applied *. It is oval-shaped and flattened. Its long diameter lies upwards and downwards; and its flattened surfaces are turned, one forwards and inwards, the other backwards and outwards. It is about five eighths of an inch long, a quarter of an inch broad, and a sixth of an inch in thickness. Its outer half occupies the whole length of the Oval Eminence; and its capsule is separated from the surface of this Eminence only by a Stratum of Orange-White Matter about a twentieth of an inch thick. Its inner border reaches to within a fifteenth part of an inch of the Median Plane. Its capsule consists of the same Brown Matter as that of the Corpus Dentatum in the Cerebellum; but its indentations are finer. This capsule is generally quite complete along the outer half of the body; but towards the inner border I have always found several small deficiencies in it. The nucleus consists of pure Orange-White Matter; through which numerous Bloodvessels, chiefly Venous, and larger than commonly occur in the White Matter, are distributed. This greater vascularity will account for its having been often mistaken for Brown Matter, as well as the nucleus of the Corpus Dentatum of the Cerebellum.

The Oblong Eminences consist entirely of Orange-White Matter in general. Sometimes, however, I have seen a small portion of Greyish-Brown Matter, occupying their surface, close to their junction with the Annular Protuberance.

The outer half of the Peduncles of the Cord is composed of Orange-White Matter, with the exception of the Brown

* Vicq d'Azyr calls it "Le Corps Festonne, Dentelé, ou Rhomboïdal des Eminences Olivaires." Traité d'Anatomie, p. 98.

Ridge; the inner half, consists of Yellowish-White Matter with a tinge of Red, except the Ridges on the Triangular Fossa, which are Orange-White.

In the upper half of the Top of the Cord, there is a stratum of White Matter about a fiftieth of an inch thick, which occupies the whole of the Median Plane, running from the bottom of one Median Fissure to the other. This stratum, when divided horizontally, appears rather whiter than the White Matter it passes through, but when cut vertically, rather darker. Numerous small Bloodvessels may be seen in it, placed horizontally, and penetrating from the anterior to the posterior surface of the Cord. This stratum is continuous with a similar one, already described in the Annular Protuberance of the Cerebellum.

From the above description, it will be seen, that the upper half of the Top of the Cord, contains a much larger proportion of White Nervous Matter, than any other part of this prolongation.

I say nothing at present with respect to the effects of coagulation on the different portions of the Substance of the Cord; because I have not yet completed my experiments on this subject. I find however, that considerable portions of it, are rendered fibrous in the longitudinal direction, by this operation.

THE *Membranes* of the Spinal Cord are three: the *Pia Mater*, the *Serrated Membrane* *, and the *Arachnoid Membrane*.

The *Pia Mater* embraces immediately the whole surface of the substance of the Cord, except the Triangular Fossa. It is nowhere thicker than a sixtieth of an inch, but is denser and of a closer texture, than any part of the corresponding Membrane of the Brain.

* SYNONYM. *Lat.* Ligamentum Dentatum.

Its outer surface is pretty smooth, except along the attachment of the Serrated Membrane; the Arachnoid Membrane being connected to it only here and there by long slender filaments. Its inner surface, when stripped from the Substance of the Cord, and plunged into a fluid, is flocculent or villous.

It is so much more difficult to inject it minutely, than the Pia Mater of the Brain, that there is much reason to believe, that its Vessels are interwoven with fine threads of a peculiar texture.

The minute Bloodvessels, which enter so largely into its composition, have the same relation to the Substance of the Cord, that the Vessels of the Pia Mater of the Brain have to the Substance which it covers.

The Pia Mater of the Top of the Cord is continuous on the forepart with the Pia Mater of the Annular Protuberance; laterally, with the Pia Mater of the Peduncles of the Cerebellum, the Subpeduncular and Spinal Lobules; and behind, with that fringe of Plexus-looking substance formerly described (p. 158.), as being attached to the Head of the Inferior Vermiform Process and its Wings. It does not line the surface of the Triangular Fossa, but passes directly across it, closely applied to the two Posterior Membraniform Processes; and this portion of it always exhibits, on the surface turned towards the Fossa, a small mass of the same Plexus-looking substance just alluded to*, and with which, indeed, it is connected above. In this manner, the Triangular Fossa is shut out from all communication with the external surface of the Cord or Cerebellum; and is made to form a part of a close cavity, along with the Central Fissure of the Cerebellum, into which it opens by the slit described p. 113, behind the lower surface of the Annular Protuberance. This is the Cavity which has usually been deno-

* This has been called *the Choroid Plexus of the Fourth Ventricle.*

minated the *Fourth Ventricle*, or *Ventricle* of the *Cerebellum*. As it is obviously not formed, however, by the Cerebellum alone, but partly by the Spinal Cord, a better name for it, perhaps, would be, the *Spino-Cerebellar Ventricle*. It communicates with the Middle Ventricle of the Brain Proper through the Aqueduct of Sylvius. The Central Mass, therefore, of the Nervous System, contains four cavities called Ventricles, the Middle, and two Lateral Ventricles of the Brain Proper, and the Spino-Cerebellar Ventricle; all communicating with each other, but having no external opening.

The parts forming the Spinal Fossa, in which the Top of the Cord is placed, are covered with their proper Pia Mater also; and this is loosely attached to the Pia Mater of the Cord, by means of delicate Bloodvessels.

The Pia Mater of the other parts of the Cord, exhibits nothing peculiar. Where it terminates, however, at the pointed extremity of the Dorsal Portion, a slender, round cord sets off from it, which is continued straight downwards, amidst the roots of various Nerves afterwards to be described, to the very extremity of the Spinal Canal, where it is inserted into the Dura Mater. Its length is consequently about nine inches; and its thickness is usually about the fifteenth part of an inch, except just at its commencement above, where it is a little thicker. It is of a whitish colour, pretty strong, and capable of being separated into fine longitudinal threads: but what proportion of these apparent filaments may be Bloodvessels, I do not know.

The Arteries of the Pia Mater of the Cord are derived from the *Vertebral*, *Inferior Thyroid*, *Intercostal* and *Lumbar Arteries*.

Those derived from the *Vertebral Arteries*, of which there are two, one Right and the other Left, may be divided into two sets.

The first set are given off by these Vessels after they have penetrated the Arachnoid Membrane, and have come into contact directly with the Pia Mater of the Top of the Cord. This they do, at the lower extremity of the Top, close to its side, but upon its anterior surface. They ascend, upon this surface, and at same time incline towards the Median Line, and of course towards each other; at last they run together, opposite the Annular Protuberance, forming, by their union, the Basilar Artery already described. The diameter of the Vessels, during this course, is generally about an eighth of an inch; but they vary in their dimensions, and are frequently of unequal size on the opposite sides. Besides a number of Capillary Branches, throughout the whole of their progress, each of them gives off the two following. 1. The *Large Inferior Cerebellar Artery.* This Vessel usually arises opposite the middle of the Oblong and Oval Eminences, but often higher up on the one side than on the other. It is generally about a fifteenth of an inch in diameter. Extending outwards in a serpentine direction, it winds round to the posterior surface of the Top of the Cord, insinuating itself between the Cord and the Spinal Lobules of the Cerebellum; there it sends certain branches to the Cord, and is then distributed on the Cerebellum, in the manner already described. The branch chiefly worthy of notice which it supplies to the Cord, is the Vessel usually denominated the *Posterior Spinal Artery.* This Vessel is only about a fiftieth of an inch in diameter. It runs down, close to the Posterior Median Fissure, to the very extremity of the Cord; giving off Capillary branches in every direction. 2. The *Anterior Spinal Artery.* This Vessel commonly arises from the inside of the Vertebral Artery, within an eighth of an inch of its termination in the Basilar; often a little lower down on the one side than the other. It is generally larger, though sometimes less, than the Posterior Spinal Artery. It runs down, close to the Anterior Median

Fissure, until it reaches the Cervical Portion of the Cord; and then it usually unites with the corresponding Artery of the opposite side. The single Artery thus formed, which is a little larger than either of the branches forming it, runs down along the line of the Median Fissure to the end of the Cord, giving off little twigs in every direction in its way.

The second set of branches supplied by the Vertebral Arteries, are very small Twigs, which these Arteries send off in their ascent through the Cervical Vertebræ; a part of their course which falls to be described in another division of the work. Five or six of these Twigs penetrate the Arachnoid Membrane on each side, along with the Cervical Nerves; and reaching the Pia Mater of the Cervical Portion of the Cord, they are there expended, anastomosing freely with Twigs of the Spinal Arteries.

The Branches derived from the *Inferior Thyroid*, *Intercostal*, and *Lumbar Arteries*, are exactly similar to the set last described of the Vertebrals. They are distributed on the lower part of the Cervical Portion, and the Dorsal Portion of the Cord; passing from their respective trunks to this distribution, along the Spinal Nerves, through holes in the Spine afterwards to be described.

The Veins of the Pia Mater of the Cord, do not seem to form trunks so large even as its Arteries. Most of those belonging to the Top of the Cord unite at last with Veins of the Cerebellum; those from the other Portions, pass off in general by the same route by which the lateral Arteries enter.

The *Serrated Membrane* is a narrow, thin, Membrane, placed between the Pia Mater and Arachnoid Membrane on each side of the Cord; running along, exactly in the middle of each half of it, almost from one end to the other.

It is whitish and semitransparent in its appearance; and thinner than the Pia Mater, yet fully stronger. Its inner border, which is straight, is intimately connected with the Pia Mater; while its outer one, presents a series of angular projections or Teeth, each of which is attached firmly to the Dura Mater of the Spinal Canal, the spaces between the Teeth being free. When extended, the distance betwixt its inner margin and the extremity of one of the Teeth, nowhere exceeds a quarter of an inch; but its breadth is different at different parts. Its anterior and posterior surfaces are smooth and unconnected with any other part.

In its internal structure, it most resembles the substance called Tendon. The Teeth, in particular, have a good deal of that shining appearance which distinguishes the Tendinous Texture. Towards its inner border too, fine, white, filaments are very apparent in it, placed parallel to each other. This border is attached to the Pia Mater by a fine texture, which when extended, resembles delicate Cellular Substance.

This Membrane begins at the top of the Cervical Portion of the Cord, and ends, in general, just where the swelling commences in the lower part of the Dorsal Portion. The number of Teeth is generally twenty; sometimes only eighteen or nineteen, at other times twenty-two or twenty-three. It rather increases in breadth as it proceeds downwards, and the distance also between the Teeth, becomes greater. The distance, for example, between the second and third Teeth is only about half an inch; between the nineteenth and twentieth, fully more than an inch. After the Membrane has terminated, a very slight ridge may be seen running down the surface of the Pia Mater, exactly in its direction, for about an inch and a half. I have never seen this ridge however, reach the extremity of the Cord.

The *Arachnoid Membrane* of the Spinal Cord is precisely similar in its appearance to the Arachnoid Membrane of the Brain.

Continued down from the Annular Protuberance, and inwards from the Spinal Lobules, of the Cerebellum, it covers the anterior surface of the Top of the Cord; but is so loosely connected to the Pia Mater, that it may be raised from it, to the distance of a quarter of inch, with the utmost ease. A few, long and slender, whitish, filaments, only, unite them together. The Posterior surface of the Top of the Cord, is without any Arachnoid Membrane; being closely applied to the anterior surface of the Spinal Lobules.

From the anterior surface of the Top of the Cord, and from the lower surface of the Posterior Lobes of the Cerebellum, the Arachnoid Membrane is continued down to the Cervical Portion of the Cord; from this to the Dorsal Portion; and from this, instead of tapering to a point like the Pia Mater, it is prolonged, in the form of a wide sheath, inclosing a large bundle of Nerves afterwards to be described, to the very extremity of the Spinal Canal. Throughout the whole of this course, its attachment to the Pia Mater underneath, is as loose as it has already been described to be, at the upper part of the Cord. It may not only be pinched up with the Forceps or the Fingers, with great facility, but it may be inflated by a blow-pipe, from one end of the Cord to the other. We may regard it as perforated not only by the Vertebral Arteries above, but by all the Spinal Nerves, and all the Teeth of the Serrated Membrane on each side. At same time it is to be observed, that at each of these points, it is firmly tacked to the inner surface of the Dura Mater of the Spinal Canal.

I AM not acquainted with any material circumstances in which the Spinal Cord of the Female differs from that of the Male.

CHAUSSIER* says he thinks the substance of the Cord in the Female is softer; but I doubt the accuracy of this.

VERY little is known respecting the state of the Spinal Cord before Maturity, or in the Decline of Life.

* Exposit. Somm. p. 117.

It has been said*, that in Children, its Substance reaches only as far down as the last Dorsal Vertebra; whereas in the Adult, it extends to the second Lumbar; but it does not follow from this, that the Substance is proportionally longer in young than in old persons; the difference observed, may be owing to differences in the length of the Spine.

According to CHAUSSIER†, its weight at Birth, is only the fortieth part of the weight of the Brain.

The same Anatomist‡ concludes, from a great number of observations, that the Substance of the Cord is firmer at Birth than at any other period of Life, and that it gradually becomes softer as the individual advances in years. If this be really so, the Cord will form a very singular contrast to the Brain in this respect; but with all deference to CHAUSSIER, I cannot but suspect, that there has been some fallacy in his observations.

It appears very clearly, from the dissections of the WENZELS§, that the White Ridges on the Triangular Fossa of the Top of the Cord do not exist before Birth. In an infant of seven months, they found them just beginning to appear, but their developement is very slow; in point of breadth, they seem to observe no ratio to the age of the person. In a boy of five years, they found them very large and distinct.

According to their observations¶, the Brown Ridge on each Peduncle of the Cord, appears at a much earlier period. They saw a sort of eminence in their place, which seemed to be their rudiments, in an Embryo of three months. In an Embryo of five months, they were large and distinct. As the individual approaches to Maturity, they seem to become

* SOEMMERRING. De Corp. Hum. Fab. iv. p. 75.

† Expos. Sommaire, p. 119.

‡ Same Book, p. 117, 119.

§ De Penitior Struct. p. 320.

¶ Same Book, p. 321.

broader and more prominent; but in old Age, again begin to fade. A boy of four years, and another of eight, were the only two cases, in which the WENZELS found them wanting, out of ninety-seven dissections.

How soon the distinction between the White and Brown Nervous Matter is perceptible in the Substance of the Cord, does not seem to have been ascertained. The Brown Central Column, however, is very distinct at Birth; and I am almost inclined to think, that it is larger proportionally, and darker in its colour at this, than at any after Period of Life. I have repeatedly observed, that in old people it had entirely disappeared; its place being occupied by White Matter; and I find that CHAUSSIER * states this to be a change, which the Cord constantly undergoes in the Decline of Life.

The WENZELS † examined the Nervous Matter of the Cord, at the Period of Birth, with the Microscope; and they say, that its globules appeared to them smaller than those of the Nervous Matter of the Brain, at the same Period.

SECTION II.

OF NERVES IN GENERAL.

NERVES may be defined to be, Cords, consisting of one or more threads or filaments of Nervous Matter, connected either directly or indirectly with the Central Mass.

These Cords are of various shapes; some are flat, others round; some taper slightly, others exhibit irregular enlargements. They vary, also, in their size; some are too small to be perceptible to the naked eye, while others are half an inch or an inch broad.

* Expos. Som. p. 146.

† De Penitior. Struct. &c. p. 294.

There are slight varieties, too, in their colour ; some are a little darker than others ; but few of them are so dark in their hue, as the Greyish-Brown Matter of the Central Mass. Their most common colour is Yellowish-White. Their external surface is sometimes quite smooth, sometimes flocculent or downy.

Their strength varies with the thickness and texture of their Coats. They have scarcely any elasticity.

There is the utmost variety in the mode of their distribution. Many of them may be seen spreading themselves out by regular ramification ; the branches taken together, in this case, always exceeding the trunk in size. Others divide into branches, which, soon after, unite into trunks again. Others may be traced into a net-work or *Plexus*, formed of various Nerves interwoven in every direction, but in which each individual Nerve is in a manner lost ; and which sends off new branches to be expended by new ramification, or to unite with new Plexuses. There is but one Nerve in the Body, viz. the Optic Nerve, which neither exhibits ramification, nor is connected with any other Nerve by Plexus, throughout the whole of its course.

At the union of two or more Nervous branches with each other, certain knots or tumors frequently present themselves, which have been called *Ganglia ;* and the same name has been extended to similar swellings, which very often occur on single Nerves. These Ganglia are of various shapes and sizes ; but none of them exceed three quarters of an inch, or an inch, in any direction. They vary, also, in their colour and consistence ; some being both darker and firmer, than the Nerves to which they are attached ; others not.

One end of a Nerve is always denominated its *Origin,* and the other its *Termination.*

Many Nerves are attached directly to the Central Mass ; and in such cases, the extremity of the Nerve which happens to be connected to the Brain or Spinal Cord, is invariably considered as its *Origin*. I wish it to be remembered, however, that I do not understand by the term *Origin* applied to such Nerves, any eminences, or streaks, of any sort, which may chance to be connected with the particular part of the Central Mass, to which the Nerves are attached; for that would imply a species of hypothesis, for which I am satisfied there is at present no good foundation. I mean by the Origin of such Nerves, that precise point merely, where, supposing them to spring from the Central Mass, as the trunk of a tree does from its root, they first completely leave this Mass. Thus I say, that the Origin of the Optic Nerves is in the Commissure of the Tractus Optici, and not in any of those parts with which the Tractus Optici are connected behind. This language, seems to me preferable to that which has long been very prevalent in the Continental Schools, because it is not founded on uncertain speculation. All those Nerves which have their Origin in the Central Mass, I propose to call *Primary Nerves*.

The other Nerves of the Body take their Origin, either from Plexuses or Ganglia, or from larger Nerves, of which they constitute branches. All these, for the sake of brevity, may be denominated *Secondary Nerves*.

The *Termination* of a Nerve, is, of course, always the opposite extremity to its Origin; but the Terminations are various. A Nerve may terminate, by dividing into two or more branches; or by uniting with another Nerve; or by running into a Plexus or Ganglion; or it may cease at once, or gradually disappear, in some of the other Textures or Organs of the Body. With respect, however, to this last species of Termination, all we can affirm is, that the Nerve *appears* to end abruptly or gradually in such parts; whether it really does so or not, is, in every instance, uncertain. It may be prolonged a considerable way, after this apparent Termination, though imperceptible, even with the microscope, from its minuteness or delicacy of texture, or from the opacity of the parts through which it passes; and after all, it may not, strictly speaking, cease, in the part, but be continued into some other Nerve equally delicate with itself.

From these remarks, it will be seen, that the application of the terms *Origin* and *Termination* to Nerves, is in some cases fixed, in others optional. The Origin of all the Primary Nerves is fixed, and of course their Termination also. The Origin of a Nerve which is joined to another Nerve, is sometimes fixed, sometimes optional. The Origin of a Nerve connected by both extremities to a Plexus or a Ganglion, or by one extremity to a Ganglion and by the other to a Plexus, is always optional; either end may be regarded as the Commencement or the Termination. A Nerve, of which one extremity does not seem connected with any other part of the Nervous System, has its Origin determined by this circumstance; for this unconnected extremity is always denominated the Termination*.

The Primary Nerves, we have seen, arise immediately from the Brain or Spinal Cord; and they communicate by means of ramification, reunion, Plexus, or Ganglion, more or less intimately, with all the other Nerves of the Body. All the Nerves, therefore, are connected, either directly or indirectly, with the Central Mass.

Nerves are composed of Filaments of Nervous Matter, inclosed in sheaths of a peculiar substance, hence called *Neurilema.* The structure and arrangement of these, have been admirably described by REIL†. I have repeated most of

* REIL was, I believe, the first who proposed to apply the terms *Central* and *Peripheral* to the extremities of Nerves, instead of Origin and Termination. (Exercit. Anat. Fascic. Prim. 12.) But it has not yet been found practicable, in many instances, to ascertain which is the *Central Extremity* of a Nerve; and, on the other hand, there are many Nerves, which can hardly be said to have any *Peripheral Extremity* at all.

† Exercit. Anatom. Fascic. Prim.

his experiments, and obtained precisely the same results. Nothing seems to me to have been added to our knowledge on this subject since his treatise.

There is but one Nerve in the Body, the Olfactory Nerve, in which the Brown Species of Nervous Matter occurs; in all the rest, it is of the Yellowish-White kind.

This Matter does not seem to differ much from the Nervous Matter of the Central Mass. Its globules have always appeared to me of the same size*. According to VAUQUELIN, however, when treated chemically, as described p. 124, it yields much less Fatty Matter, and much more Albumen than the Nervous Matter of the Brain. But as the Neurilema does not seem to have been detached from the Nervous Matter in VAUQUELIN's analysis, some doubts may be entertained of its accuracy.

The Filaments† of this substance, are of different sizes in different Nerves, and sometimes even in the same Nerve. They seldom exceed the thickness of a hair; and in most cases, are smaller than the finest fibre of silk or cotton, so that it requires a microscope to see them distinctly.

They are placed side by side; and, in their course, divide and subdivide, and reunite, and run into each other, forming the most intimate connection.

The greater number of the Nerves in the Body, consist of several separate *Bundles* or *Fasciculi* ‡ of these Filaments; some of only one Fasciculus.

The Fasciculi, like the Filaments, are of various sizes. Some are more than an eighth of an inch thick, others scarcely more than a hundredth part of an inch. Some-

* PROCHASKA (Oper. Min. I. 345.) and the WENZELS (De Penitior. Struct. &c. p. 37.) leave this doubtful; but the former rather thinks, that they are of the same magnitude.

† By *Filaments*, I here mean, what REIL has distinguished by the term *Fila* or *Fibrillæ*.

‡ I mean by these terms, the *Funes* or *Chordæ* of REIL.

times they are all nearly of one size in the same Nerve, sometimes of different sizes.

When a Nerve consists of more than one Fasciculus, all the Fasciculi communicate as freely with each other, as the Filaments of a single Fasciculus do.

It is impossible to display the Filaments of Nervous Matter in a satisfactory manner by dissection. This can only be done, by the artifice so happily employed by REIL, for unfolding the structure of Nerves; which is, macerating the Nerve for a short time in Muriatic Acid. The Acid dissolves the Neurilema, and at same time hardens considerably the Filaments of Nervous Matter. The Filaments then admit of being separated gently from each other, and their form, and size, and connexions, are readily examined.

When this operation is carefully performed, the Filaments always present themselves of the same size in the same Nerve. Whether these Filaments, however, may not be separable, by other means, into Filaments still smaller, we cannot pretend to say.

Some of the Primary Nerves, such as the Olfactory Nerves, close to their Origin, do not exhibit the Filamentous structure, but consist of a thick, undivided, Chord of Nervous Matter.

The Neurilema or substance which surrounds each Filament, ties the Filaments into Fasciculi, unites several Fasciculi together, and finally forms a general sheath for the whole Nerve, is, in most instances, so like Cellular Substance, that we may regard it as a species of that Texture. It is denser where it immediately embraces a Fasciculus, and of a looser texture between the Fasciculi. In some Nerves, a small quantity of Adipose Substance is distinctly intermingled with it. REIL found, that by macerating a portion of a Nerve in a diluted Alkali, the Nervous Matter was dissolved, while the Neurilema remained entire; so that the latter, after this operation, might be injected with Quicksilver, shewing all the little canals in which the Filaments of Nervous Matter were contained, and all the bundles of these, which were united into Fasciculi.

The small Arterial Vessels which supply the larger Nerves, seem to observe a pretty uniform mode of distribution. Penetrating the outer sheath of the Nerve at various points, they subdivide into two sets of branches, one of which runs upwards and the other downwards, parallel to the Fasciculi, and between them; these subdivide in the same manner, and are distributed between the smaller Fasciculi; and these again subdividing, are ramified upon the fine canaliculi which inclose the Filaments, and thence penetrate into the substance of the Filaments themselves. REIL has represented this distribution very beautifully. It may be presumed that the Arteries are distributed in all Nerves, pretty much in the same manner. Veins are often seen in great abundance on the surface of Nerves, filled with Blood which had collected in them at the period of Death; but they are not so easily injected as the Arteries. Their Absorbents are hardly perceptible, except occasionally on the surface of the largest Nerves.

The Neurilema of the Primary Nerves, as long as these remain within the cavities of the Cranium or Spine, obviously consists of Pia Mater. The Optic Nerves are peculiar, in having their general, external, sheath, composed of a substance, possessing the structure of Tendon.

A good deal still remains to be investigated respecting the structure of the Ganglia. Meantime it seems to me, that SCARPA's description and representations of them, are by far the most accurate which we possess *.

They are bodies, in which the Fasciculi of Nervous Filaments attached to them, suffer a temporary subdivision and separation from each other, and are then combined anew. A

* Anatom. Annotat. Lib. Prim.

Nervous Fasciculus, as soon as it enters a Ganglion, divides into smaller Fasciculi, and these into Fasciculi still smaller, and all of these spread out, and intersect each other, in every direction. Then the Fasciculi begin to unite again with each other, or with the branches of some other Fasciculus, which has subdivided within the Ganglion in a similar manner; and forming, by their union in this way, bundles successively larger and larger, they at last emerge from the Ganglion, either all in one and the same Fasciculus, or in different Fasciculi. The intermixture of Fasciculi which thus takes place within a Ganglion, is, in general, so intimate, that it looks, as if every Fasciculus of every Nerve which emerges from the Ganglion, contained more or fewer Filaments, from every Fasciculus of every Nerve which entered it. Even if the Filaments of any Fasciculus, happen to be combined into the same Fasciculus again on emerging, there is every reason to believe that their relative position has been completely changed. There is no appearance of any Fasciculus or Filament terminating in a Ganglion, or arising in it; all seem to pass through.

Each Fasciculus, in its progress through the Ganglion, seems to be provided with its proper Neurilema. But besides this, the spaces left between the intersections of the Fasciculi, are filled up with a peculiar, soft substance, of a greyish, sometimes a yellowish, colour. This substance has been very confidently pronounced, by some Anatomists, to be of the same nature with the Brown Nervous Matter of the Brain and Spinal Cord. There does not seem to me, however, to be the slightest resemblance between them. SCARPA * is inclined to regard it, as a soft cellular substance, filled with a greyish, and mucilaginous matter, in emaciated subjects, and with a yellowish, oily, matter, in those that are fat.

* Annat. Annotat. Lib. I. p. 13.

I have examined, with considerable attention, some of the largest and most intimate *Plexuses* of Nerves, that occur in the Body; and yet I cannot say, that I have ever perceived the slightest appearance of any substance in them, similar to that which has just been described, filling up the interstices of the Ganglia. The subdivision of the Fasciculi which meet in a Plexus is sometimes pretty minute; but never so minute, it seems to me, as that which occurs in Ganglia.

The structure of the Nerves, is, so far as I know, the same in the Female as in the Male.

The state of the Nerves, with respect to general structure, before and after Maturity, has not yet been properly investigated. There are some remarks on this subject by Bichat*, but they are very vague and unsatisfactory.

Having thus considered the structure of the Nerves in general, it now only remains for me, in this Section, to enumerate and classify the Primary Nerves; to describe the parts of the Central Mass from which they arise; and to follow them from their Origins, until they penetrate the Arachnoid Membrane. Their distribution beyond this, falls to be treated of, in other departments of the Work.

The Central Mass of the Nervous System, we have seen, may be divided into two halves, Right and Left. From corresponding points in each half, forty-two Nerves arise; all differing more or less from each other, on the same side, but exactly similar, each to each, on the opposite sides. There are, therefore, eighty-four Primary Nerves in all, forming forty-two corresponding Pairs.

Some of these arise from the Brain, others from the Spinal Cord; they may therefore, be divided into two classes, *Cerebral* and *Spinal*.

* Anat. Gener. I. p. 197.

The *Cerebral Nerves* are sixteen in number, forming eight corresponding Pairs. These are the following *.

1 *The Olfactory Nerves.*
2 *The Optic Nerves.*
3 *The Common Oculo-Muscular Nerves* †.
4 *The Internal Oculo-Muscular Nerves* ‡.
5 *The External Oculo-Muscular Nerves* §.
6 *The Trigeminal Nerves* ||.
7 *The Facial Nerves* ¶.
8 *The Auditory Nerves* **.

The three first of these arise from the Brain Proper, and the remaining five from the Cerebellum; so that if the subdivision were of any utility, they might be arranged into *Cerebral-Proper* and *Cerebellar* Nerves.

* I have purposely forborn to apply any *numerical appellations* to these Nerves, or to those which arise from the top of the Spinal Cord. It is now more than thirty years, since the old Nomenclature, founded on this principle, was admitted by all sound Anatomists to be entirely inaccurate, and was rejected by Vicq d'Azyr. (Traité d'Anatomie, p. 48.) The new enumeration, too, which has been proposed in its place, although correct in other respects, seems to me objectionable, on account of the general classification to which it is subservient. It is better, therefore, I apprehend, to drop both enumerations entirely; and to confine ourselves to appellations implying something relative to the distribution of the Nerves. This, fortunately, can be done, in the present instance, without any inconvenience; as all of these Nerves have long had names of this kind applied to them, which are familiar to Anatomists, and almost all of which may be retained.

† Synonym. *Lat.* Motores Communes Oculorum.

‡ Synonyms. The Fourth Pair, in the old enumeration. *Lat.* Nervi Pathetici.

§ Synonyms. *Lat.* Abductores Oculorum. *Fr.* Les Moteurs Externes.

|| Synonyms. The Fifth Pair, in the old enumeration. *Fr.* Les Nerfs Trifaciaux.

¶ Synonym. The Portio Dura of the Seventh Pair, in the old enumeration.

** Synonym. The Portio Mollis of the Seventh Pair, in the old enumeration.

Of the *Spinal Nerves* there are sixty-eight, forming thirty-four corresponding Pairs. These are the following.

9 *The Glosso-Pharyngeal Nerves.*
10 *The Pneumo-Gastric Nerves* *.
11 *The Hypo-Glossal Nerves* †.
The Accessory Nerves ‡.
The Sub-Occipital Nerves ‖.
The Cervical Nerves.—Seven Pairs.
The Dorsal Nerves.—Twelve Pairs.
The Lumbar Nerves.—Five Pairs.
The Sacral Nerves.—Five Pairs.

Let us now attend to the Origins of each of these Primary Nerves separately.

Origins of the Cerebral Nerves.

Origins of the Olfactory Nerves.

The Olfactory Nerve, on each side, arises from that pyramidal Eminence on the lower surface of the Anterior Lobe of the Brain Proper, already minutely described, (p. 87.)

* SYNONYMS. The Eighth Pair of the old enumeration. *Lat.* Par Vagum; Nervi Vagi. *Fr.* Les Nerfs Vocaux.

The name *Pneumo-Gastric*, which I have chosen for these Nerves, is adopted from CHAUSSIER. It seems to me preferable to a translation of *Nervi Vagi*, viz. the *Wandering Nerves;* and also to the appellation of *Vocal Nerves*, which would imply a greatly more limited distribution than they really have. I have sometimes called them the *Gastro-pulmonary Nerves.*

† SYNONYM. *Fr.* Les Nerfs Linguaux.

‡ These Nerves have derived their name, from having been described by the older Anatomists as *Accessory Nerves* to the Eighth Pair. Different French writers have called them, Les Nerfs Spinaux; Les Nerfs Spino-cranio-trapeziens; Les Nerfs Trachelo-dorsaux.

‖ These Nerves have been arranged by many Anatomists among the Cervical Nerves; of which they then form the First Pair. There is no advantage, however, in this arrangement; and by adopting that in the text, the number of the Cervical Nerves is made to correspond exactly with the number of the Cervical Vertebræ, which is very convenient.

It runs forwards and a little inwards, lodged in a Fossa also formerly described, (p. 85.) between two Convolutions of this Lobe; closely connected to these Convolutions by the Pia Mater which forms its Neurilema, and having the Arachnoid Membrane passing across its inferior surface. After a course of about an inch and a half, it divides into a number of minute branches, which immediately perforate the Arachnoid Membrane.

For about an inch from its Origin forwards, the Olfactory Nerve is of a triangular shape, and nearly an eighth of an inch thick; with one side looking downwards, and the opposite angle lodged in the Fossa between the Convolutions already mentioned. Beyond this, however, it gradually swells out into an oval or pyriform *Bulb*, from the lower surface of which those branches come off, which perforate the Arachnoid Membrane. This Bulb is wider at its anterior than its posterior extremity; its greatest transverse diameter seldom exceeds a fifth of an inch; and its length is usually about half an inch. It varies, however, a little both in its shape and dimensions.

The whole of the Olfactory Nerve, from its Origin to the extremity of its Bulb, consists of one undivided cord of Nervous Matter, embraced by Pia Mater for a Neurilema. Both kinds of Nervous Matter exist in it, pretty nearly in equal quantity, and mingled together, from one end of it to the other. They alternate with each other longitudinally, so that the White Matter appears like threads, running through the Brown, from the Origin of the Nerve to its Bulb. The threads of White Matter, however, are most numerous towards the lower surface; the upper half of the Nerve consisting chiefly of a ridge of Brown Matter. In the Bulb, the filaments of White Matter expand, and the intervening spaces are filled up, and the whole surrounded with Brown Matter, of which the quantity appears to be greater here, proportionally, than in the preceding parts.

I have often lacerated the part of the Olfactory Nerve just described, after it had been coagulated by Acids, Alcohol, &c.; and find that it tears very readily in the longitudinal direction; at same time I cannot say that I have yet seen any distinct fibrous appearance on the lacerated surfaces.

The Olfactory Nerves not unfrequently differ a little from each other in shape, dimensions, and structure, in the same subject.

SOEMMERRING * states, that the portion of the Olfactory Nerve we are now considering, is rounder, shorter, and thicker, in the Fœtus, than in the Adult, proportionally. According to SCARPA†, it seems to contain no White Nervous Matter at all in the Fœtus, but to consist entirely of Brown; the White Matter only appearing as the individual advances towards Maturity. In the Decline of Life, on the other hand, he has observed, that the Brown Matter seems to disappear, leaving nothing but White.

Origins of the Optic Nerves.

THE Optic Nerve, on each side, arises from the anterior corner of the Commissure of the Tractus Optici.

It inclines forwards, outwards, and a little downwards, for about three eighths of an inch, closely applied to the lower surface of the Anterior Lobe, within the Origin of the Olfactory Nerve, and then perforates the Arachnoid Membrane.

Throughout this short course, it is cylindrical in its shape, and about a sixth of an inch in diameter, in general.

For about an eighth of an inch from its Origin, it consists of one, undivided, cylinder of White Nervous Matter, sur-

* De Corp. Hum. Fabric. IV. p. 197.

† Anat. Annotat. Lib. II. p. 27. This is the best treatise that has yet been written on the Anatomy of the Olfactory Nerves.

rounded by Pia Mater, and capable of being rendered fibrous in the longitudinal direction by coagulation *. For an eighth of an inch beyond this, it consists, in the centre, of a conical portion of undivided White Matter with its apex turned forwards; and externally, of Nervous Filaments, each contained in its little canal of Neurilema formed of Pia Mater. The remaining part of the Nerve, before it perforates the Arachnoid Membrane, is composed entirely of such Filaments †.

Origins of the Common Oculo-Muscular Nerves.

The External Oculo-Muscular Nerve arises, on each side, from a point on the inner and anterior surface of the Peduncles of the Brain Proper, described p. 90.

It runs forwards, a little outwards, and a very little downwards; passes between the Posterior Artery of the Brain Proper, and the upper border of the Annular Protuberrance; is then applied to the inner and anterior surface of the Inner Lobule of the Middle Lobe; and at the forepart of this Lobule, after a course of about five or six eighths of an inch, it perforates the Arachnoid Membrane.

The thickness of the whole of this portion is about a tenth of an inch. It is round; and is composed of Filaments or fine Fasciculi of Filaments, embraced by Neurilema. These,

* Those who regard the Tractus Optici as portions of the Optic Nerves, have long agitated the question, whether the Optic Nerves actually decussate each other in the Commissure. This point never can be determined by pathological observations, such as some have thought sufficient to decide it; (see SOEMMERRING De Corp. Hum. Fab. IV. p. 200.) but by a minute examination of all the parts in their most healthy state. The WENZELS seem rather inclined to think that there is a *partial* decussation; (De Penit. Struct. &c. p. 109.) but this does not accord with my observations hitherto.

† REIL's description and representation of the Structure of this part of the Optic Nerve, are the only correct ones I have met with. (See Exercit. Anatom. Fasc. Prim. p. 2.)

for about a quarter of an inch from their Origin, are less closely bound together than farther forwards, where they are compacted into a close cord.

Origins of the Internal Oculo-Muscular Nerves.

The Internal Oculo-muscular Nerve arises, on each side, in general, from a point already described, p. 111, on the upper and inner part of the Pillar of the Vieussenian Valve. Sometimes, however, it takes its Origin a little farther inwards; at other times nearer the Lower Corpus Bigeminum; and at other times farther downwards.

From its Origin it passes outwards and forwards, round the Pillar of the Vieussenian Valve; then forwards round the outer surface of the Peduncle of the Brain Proper, lying immediately above the Superior Cerebellar Artery; and then about half way between the Annular Protuberance and the Inner Lobule of the Middle Lobe, it perforates the Arachnoid Membrane.

The length of this course is about an inch and a half; and the Nerve, throughout, is round, and scarcely more than a fortieth of an inch thick.

The Pia Mater peels off from it so easily, that I rather imagine it is not composed of Filaments or Fasciculi. After coagulation, however, I find, that it splits up, from end to end, very readily. Sometimes, just at its Origin, it consists of two or three smaller threads.

Origins of the External Oculo-Muscular Nerves.

The External Oculo-Muscular Nerve arises, on each side, from the lower margin of the Annular Protuberance of the Cerebellum, at the point described p. 113 *.

* I have seen examples of most of those appearances which have been described by VICQ D'AZYR (Traité d'Anatomie, p. 52.) as varieties in the Origin

From this, it runs upwards, forwards, and a little outwards, closely applied to the Anterior surface of the Protuberance, and covered by the larger branches of the Basilar Artery. After a course of about five eighths of an inch, it perforates the Arachnoid Membrane.

It is flat at its Origin, and becomes rounder as it ascends; its breadth nowhere exceeding the fifteenth part of an inch.

It is obviously composed of Filaments, or fine Fasciculi of Filaments, with a Neurilema of Pia Mater. At their Origin, these generally form two or three little bundles; between which, very often, pretty large branches of the Basilar Artery may be seen running.

Origins of the Trigeminal Nerves.

The Trigeminal Nerve arises, on each side,* from two points which were described p. 116, 117, one on the upper, and another on the anterior surface, of the Peduncle of the Cerebellum.

It projects, from its Origin, forwards and a little inwards, for about three quarters of an inch, and then perforates the Arachnoid Membrane.

It is always of a flattened shape, but less so in some subjects than others. The flat surfaces look, the one upwards and outwards, the other in an opposite direction. Its greatest breadth varies from a sixth to a fifth of an inch.

This portion of the Trigeminal Nerve is composed, throughout, of Fasciculi of Nervous Filaments, which are surrounded, individually and generally, with a Neurilema of Pia Ma-

of this Nerve. But in all of these, the little white Cords which seemed to run into the Nerve from the Pyramidal Eminences, remained attached also to the Annular Protuberance, until they reached the point described in the text. It is on that account, in conformity with the signification in which I have hitherto employed the term Origin, that I still continue to consider this Nerve as arising from the Annular Protuberance.

ter. Fifty or sixty of these, may be easily counted with the naked eye. At their very Origin they always form two distinct sets or bundles. The upper bundle, which, in general, is not more than a fifth of the size of the lower one, consists commonly of from two to six Fasciculi, which arise from the superior surface of the Peduncle of the Cerebellum. The lower bundle, comprehending all the remaining Fasciculi of the Nerve, arises from the anterior surface of the Peduncle, immediately under the Origin of the former. The two bundles, directly after this Origin, run together into one, the upper one occupying the upper and inner margin of the Nerve; and their union is so close, that the little ridge usually intervening between their Origins, (see p. 117.) is completely concealed. Not unfrequently, however, this ridge also gives off a few Fasciculi, thus connecting the two bundles together.

Origins of the Facial Nerves.

The Facial Nerve arises, on each side, from the lowermost point of the anterior surface of the Peduncle of the Cerebellum, close to its junction with the Annular Protuberance. (See p. 117.)

It extends outwards, forwards, and a little upwards, for about half an inch, and perforates the Arachnoid Membrane, opposite the inner extremity of the Peduncular Fossa.

It is of a round shape, and nearly a twelfth of an inch thick; and consists, from its very Origin, of fine Fasciculi of Filaments, with a Neurilema of Pia Mater. Very often too, it is joined by four or five very delicate Fasciculi, which arise from the Peduncle, about a thirtieth of an inch above and behind it.

Origins of the Auditory Nerves.

The Auditory Nerve arises, on each side, from the anterior surface of the Peduncle of the Cerebellum, immediately behind the Origin of the Facial Nerve. (See p. 117.)

From its Origin, it extends outwards, forwards, and a little upwards, for about a third of an inch, in the same direction as the Facial Nerve. It is closely applied to the posterior surface of this Nerve, and perforates the Arachnoid Membrane along with it. Below and behind it rests on the Sub-peduncular Lobule; and at the lower and forepart, it is partially covered, by the Plexus-looking substance attached to that Lobule.

This portion of the Auditory Nerve is always of a flattened shape, one surface looking inwards and the other outwards; and its greatest diameter is about an eighth of an inch. It does not acquire the Filamentous structure of Nerve in general, until it is just about to perforate the Arachnoid Membrane. Before this, it consists of a cord of undivided, White, Nervous Matter; sometimes of two or three such cords, bound together by Pia Mater. This portion, I find, is distinctly fibrous in the longitudinal direction, after coagulation.

Origins of the Spinal Nerves.

Origins of the Glosso-Pharyngeal Nerves.

The Glosso-pharyngeal Nerve arises, on each side, from the anterior margin of the Peduncle of the Spinal Cord, close to the Annular Protuberance of the Cerebellum.

It extends, forwards, at first, and a very little outwards, closely applied to the Plexus-looking substance which covers the inner surface of the Sub-peduncular Lobule of the Cerebellum; then it turns outwards, over the continuation of the same substance which lies on the lower and anterior surface of that Lobule; and after a course of about half an inch, altogether, from its Origin, it perforates the Arachnoid Membrane.

It is of a round shape, is about a twentieth of an inch thick, and consists of fine Fasciculi of Nervous Filaments, with a Neurilema of Pia Mater.

Origins of the Pneumo-Gastric Nerves.

The Pneumo-gastric Nerve arises, on each side, from the anterior margin of the Peduncle of the Spinal Cord, immediately below the Origin of the Glosso-pharyngeal.

It follows precisely the same course as the Glosso-pharyngeal Nerve, running underneath it throughout, at scarcely more than the distance of a hair-breadth. Just after its Origin, it rests on the Anterior Membraniform Process of the Top of the Spinal Cord; and farther outwards, lies on the Plexus-looking substance covering the Sub-peduncular Lobule.

It consists of from ten to twenty fine Fasciculi of Filaments, embraced as usual with Pia Mater, which form a band about an eighth of an inch broad, and perhaps a sixtieth of an inch thick; but always a little thicker above than below, because the upper part of the band contains the strongest Fasciculi.

Origins of the Hypo-Glossal Nerves.

The Hypo-glossal Nerve arises, on each side, from the Fossa in the Top of the Spinal Cord, between the Oblong and the Oval Eminence.

It consists at its Origin of from ten to twenty Filaments, or delicate Fasciculi of Filaments, which spring from the Cord in three or four sets or bundles, placed one above the other in a row. These extend outwards and a little forwards, behind the Basilar Artery, and gradually converge so as to form one Fasciculus, about half an inch from the Cord, which immediately perforates the Arachnoid Membrane.

Each of the rootlets or first bundles of Fasciculi is embraced by Pia Mater; and the Nerve which they form by their union, is about a twelfth of an inch thick and a little flattened.

Origins of the Accessory Nerves.

The Accessory Nerve arises, on each side, by a series of Filaments, or delicate Fasciculi of Filaments, from the lateral surface of the Top and Cervical Portion of the Spinal Cord.

There is considerable variety in the point at which the first of these Filaments arises below; but, in general, it is within half an inch of the termination of the Cervical Portion. From this, they continue to arise, one above the other, in a row, as far up as the Origin of the Pneumo-gastric Nerve; and uniting successively with each other, they at last form a round Nerve, about a twentieth of an inch in thickness. The line from which they spring, however, does not correspond exactly to the middle of the lateral surface of the Cord, but is a little posterior to it.

The number of the Fasciculi or Filaments is various; sometimes they are more numerous on one side than on the other. They seem to me, to be most numerous, in general, opposite the Top of the Cord. I have counted fourteen or fifteen, arising within the space, between the Pneumo-gastric and Sub-occipital Nerves.

The lower Filaments lie close almost to the Cord; those farther up incline successively more and more outwards; and the uppermost of all extend directly outwards. All those arising from the Cervical Portion of the Cord are placed behind the Serrated Membrane; or between this Membrane, and the Posterior Fasciculi of the Cervical Nerves.

Each Fasciculus or Filament is embraced by Pia Mater, as well as the trunk which they form, which is of a very compact texture. This trunk ascending gradually, and at same time inclining outwards, passes along the anterior surface of the Spinal Lobules of the Cerebellum; and coming into contact with the Pneumo-gastric Nerve, just where that Nerve is perforating the Arachnoid Membrane, it pierces this Membrane along with it.

There are connexions, occasionally, between the Accessory Nerve and the Sub-occipital, as to the nature of which, I am not yet quite satisfied.

Origins of the Sub-Occipital Nerves.

The Sub-occipital Nerve arises, on each side, by two sets of Fasciculi, one from the anterior and the other from the posterior surface of the Spinal Cord, just where its Top passes into its Cervical Portion.

The Anterior set, usually consists of from four to seven Fasciculi, arranged into two bundles. These arise at the distance of about a fifth of an inch from the Anterior Median Fissure, one above the other in a straight line, and extend outwards for about a third of an inch. The posterior set arises in a similar manner, within the same distance of the Posterior Median Fissure; but it consists usually of only three or four Fasciculi.

Both sets obviously consist of Fasciculi of Filaments, surrounded individually and generally with a Neurilema of Pia Mater, continuous with that of the Cord. They extend outwards at right angles from the Cord, but at same time converge towards each other; and they perforate the Arachnoid Membrane close together.

The posterior set of Fasciculi is very often entirely wanting.

Origins of the Cervical, Dorsal, Lumbar, and Sacral Nerves.

These Nerves take their Origin, in regular succession, one below the other, and in the order in which they have now been named, from the top of the Cervical Portion of the Cord, to the very extremity of its Dorsal Portion.

Each Nerve arises by two Roots or Sets of Fasciculi, one from the anterior, and the other from the posterior surface of the Cord, external to the Median Fissures.

The Fasciculi of each Set arise, one above the other in a straight line, and immediately converge into one bundle; and the Anterior and Posterior Set of the same Nerve, always arise from points on the opposite surfaces, corresponding in point of height.

The two Roots of each Nerve incline outwards from their Origin, and more or less downwards; at same time they mutually approach each other; and at last perforate the Arachnoid Coat, very nearly, but not exactly, at the same point. The Serrated Membrane of the Cord runs up, in the angle between them; and the Teeth of this Membrane project outwards to their insertion in the Dura Mater, in the interspaces between the Nerves.

All the Fasciculi now described are obviously composed of Nervous Filaments, inclosed in a Neurilema of Pia Mater, which is continuous with that of the Cord.

Of the Cervical Nerves in Particular.—These arise from the Cervical Portion of the Cord, beginning at the top, and extending to the bottom of it.

Their Anterior Roots, take their Origin about a sixth of an inch from the Median Fissures; their Posterior, between a sixth and an eighth of an inch.

The Fasciculi composing the Anterior Roots, at the time they perforate the Arachnoid Membrane, vary in number from two to five; those of the Posterior Roots, from three to seven. The Roots of the First, Second, and Third Cervical Nerves contain fewest; those of the remaining four, most. Varieties, however, sometimes occur in this respect, in the opposite Nerves of the same Pair.

The Fasciculi composing the Anterior Roots, are very slender at their immediate Origin; and unite successively with each other to form larger Fasciculi. Those of the Posterior Roots are of the same dimensions when they arise as afterwards, and are larger than the Fasciculi of the Anterior Roots. The lower Cervical Nerves have the largest Fasciculi.

There is hardly a fiftieth of an inch between one Anterior Root and another; but between one Posterior Root and another there is in general, from a sixth to an eighth of an inch. Among the Posterior Roots, it is by no means uncommon to find a Fasciculus of one Root sending off a branch to the Root immediately above or below.

The Roots of the First Cervical Nerve incline a very little downwards, and the inclination increases regularly from the First to the Seventh. Their length too, increases with this obliquity; the Roots of the First being about a third of an inch long, and those of the Seventh, rather more than a half.

Of the Dorsal Nerves in Particular.—These take their Origin from the three upper fourths of the Dorsal Portion of the Cord.

The Origins of their Anterior Roots gradually approach the Median Fissure as they descend; those of the First being at the distance of a sixth of an inch, and those of the Twelfth only a tenth. The Origins of the Posterior Roots, on the other hand, are, from the First to the Twelfth, all at the distance of an eighth of an inch from the Median Fissure.

The Anterior Roots of all the Dorsal Nerves, except the First, consist of one Fasciculus only, at the time they perforate the Arachnoid Membrane; the First consists of three or four. All the Posterior Roots, except the First and Second, are composed, in general, of two Fasciculi; the First consisting commonly of four, and the Second of three.

The Anterior Roots, like those of the Cervical Nerves, consist at their immediate Origin of very delicate Fasciculi, which unite successively with each other, until they form one. The Fasciculi of the Posterior Roots arise directly from the Cord, of the same dimensions which they preserve throughout. Each of the Fasciculi of the Posterior Roots is nearly as large as the single Fasciculus composing the Anterior Roots. The Fasciculi of both Roots, increase a little in size, successively, from the First to the Twelfth Dorsal Nerve.

As to the distance between each of the Anterior and Posterior Roots, the same remark will apply to these Nerves as to the Cervical; with this exception, that the distance between the Posterior Roots rather diminishes from the Eighth to the Twelfth Nerve.

The inclination downwards of the first Dorsal Nerve, is a little greater than that of the Seventh Cervical, and the inclination increases regularly in all the remaining Dorsal Nerves in succession.

The length of the Roots of the First, is about two thirds of an inch, that of the Twelfth about two inches.

Of the Lumbar Nerves in Particular.—The Lumbar Nerves arise from the upper half of the lowest fourth of the Dorsal Portion of the Cord.

The Origins of both their Roots approach nearer and nearer to the Median Fissures, from the First to the Fifth. The Anterior Root of the First Lumbar Nerve, arises about a tenth of an inch from the Anterior Median Fissure; that of the Fifth about a twelfth. The Posterior Root of the First Lumbar Nerve takes its Origin within an eighth of an inch of the Posterior Median Fissure; that of the Fifth within a tenth.

The Anterior Roots, consist, at their immediate Origin, of three or four small Fasciculi; but these, before they have run half an inch, unite into one Fasciculus, of which the Root is composed, until it perforates the Arachnoid Membrane. The Posterior Roots of all the Lumbar Nerves, except the Fifth, consist of two Fasciculi, when they perforate the Arachnoid Membrane; the Fifth in general consists of three. Each of these Fasciculi is formed by the union of several smaller ones, which may be easily traced, quite distinct from each other, until the Root is just about to pass through the Arachnoid Membrane.

Each of the Fasciculi of the Posterior Roots is as large as the single Fasciculus of the Anterior Roots; except in the Fifth Lumbar Nerve, where they are always smaller.

The Fasciculi composing the Roots of the First Lumbar Nerve are larger than those of the Last Dorsal; and those of Second, Third, and Fourth Dorsal, are a little larger in succession. The Fasciculi of the Posterior Roots, however, of the Fifth Lumbar, are smaller than any of the Fourth; while the Fasciculus forming its Anterior Root, is the largest of all the Lumbar Fasciculi.

The Anterior Roots arise about a sixteenth of an inch from each other; the Posterior Roots about an eighth.

The First Lumbar inclines more downwards than the Twelfth Dorsal Nerve, and the inclination increases from the First to the Fifth.

The First Lumbar Nerve measures, from its Origin to its perforation of the Arachnoid Membrane, nearly three inches; and the rest are longer in succession; the Fifth being more than five inches.

Of the Sacral Nerves in Particular.—The Origins of these Nerves occupy the remaining part of the Spinal Cord.

Both their Roots arise a very little nearer to the Median Fissures than those of the Lumbar Nerves.

In point of number of Fasciculi, both at their immediate Origin, and at their perforation of the Arachnoid Membrane, their Roots are the same as those of the Lumbar Nerves.

In point of size, the Fasciculi of the Anterior and of the Posterior Roots, are pretty much the same in all of them. The Fasciculi of the First and Second Sacral Nerves, are as large as the Anterior Root of the Fifth Lumbar Nerve; but those of the Third, are only half the size of the Second; those of the Fourth, half the size of the Third; and those of the Fifth, half the size of the Fourth. Those of the Fifth, in consequence, are only about a fortieth part of an inch in diameter.

All the Roots, Anterior and Posterior, arise close to each other.

They have all a greater inclination downwards than the Lumbar Nerves, and they incline the more, the lower they are; so that the Last Sacral Nerve, is almost parallel to that thread-like prolongation from the Pia Mater covering the extremity of the Cord, which was described p. 187.

The length of the First Sacral Nerve, from its Origin to its perforation of the Arachnoid Membrane, is about five inches and a half; that of the Fifth, about eight inches.

The whole of the Sacral Nerves, together with the three lower Lumbar Nerves, extend beyond the lower extremity of the Cord, before they perforate the Arachnoid Membrane; and the farther beyond it, the higher their Origins. All these are accumulated together into a large Bundle, which fills the whole remaining part of the Spinal Canal. They are slightly tied together by delicate Bloodvessels; and partly, also, by fine, dense, threads, such as those that are found between the Arachnoid Membrane and Pia Mater in particular parts, only a great deal longer. The whole Bundle is surrounded, loosely, by the Arachnoid Membrane, prolonged from the Spinal Cord above.

In speaking of the inclination of each of the Nerves individually, which compose this Bundle, I have supposed them to be stretched out, in a straight line, from their Origin to the point at which they perforate the Arachnoid Membrane. But this is not their actual position in the Body. In consequence of their exceeding in length, considerably, a straight line drawn from their Origins to the points at which they pass out of the Spinal Canal, they have a bent, or convoluted, or serpentine course; and appear, even when viewed through the transparent Arachnoid Membrane, as if they were twisted a little round each other.

BOOK II.

OF THE ANATOMY IN GENERAL, OF THE COMMON TEXTURES.

CHAPTER I.

THE ANATOMY IN GENERAL OF CELLULAR SUBSTANCE *.

The Texture to which this name has been applied, is the most extensive in its distribution of any in the machine. It is found in almost every region of the Body, and forms a part of almost every Organ.

It has a peculiar appearance, which it is not possible to convey any idea of, by words, to those who have not seen it. A mass of it, is usually of a greyish colour, and appears, when examined by the magnifying glass, to be composed entirely of delicate fibres.

When such a mass is laid hold of with the fingers or forceps, and its parts are gently pulled asunder, it immediately separates itself into innumerable transparent laminæ, finer than the finest cob-web, which intersect each other in every direction, and leave spaces or *cells* between them of various shapes. This separation into cells may also be effected, by simply inserting the point of a blow-pipe into a mass of the

* Synonyms. Cellular Membrane; Reticular Membrane: *Lat.* Corpus Cellulosum.

substance and blowing in air, or by injecting into it, a fluid such as water. Either of these experiments shows very clearly, that all the cells communicate freely with each other; for, in this manner, the whole mass may be injected or inflated from one point.

In proportion as we continue to pull asunder a piece of Cellular Substance, the smaller laminæ successively give way, and several cells are thus united into one; until at last the whole are torn. The instant the distention is discontinued, the parts collapse, and the cellular appearance vanishes.

Without mechanical distention of some sort, there is no appearance of cells in this Texture, either in the Living or the Dead Body. It is merely a substance, of which the parts are so constructed, as to assume this arrangement when they are gently separated from each other. Whether it consists, in its natural, undistended state, of numberless fine laminæ, of a definite size and form, closely applied to each other; or whether the cells are not formed by the mere accidental separation of layers of the Substance, always accompanied by greater or less laceration of parts, and of course varying with the direction and degree of the distending force, it is not easy to determine.

The ease with which it may be separated into cells, and the extent to which the separation may be carried, without destroying the cellular appearance, is very different, in different parts of the Body. Hence the distinction of this Texture into *loose* and *dense*.

From the very extensive distribution of the Cellular Substance, and the free communication of its cells when it is distended, air or thin fluids may be made to pass through it, from any one region of the Body almost to any other. This is exemplified even in the Living Body, in the diseases called *Emphysema* and *Anasarca*.

On the closest examination of the fine laminæ which appear, on the distention of this Substance, nothing can be seen composing them, but transparent, and colourless, fibres, of the utmost delicacy. Small Bloodvessels may almost always be perceived, after injection, running in great abundance between the laminæ and through the cells ; and there is no Texture in the Body, in which Absorbent Vessels are so often perceptible; though their minute beginnings may not be easily demonstrable. Delicate ramifications of Nerves may be traced through it, in most parts where it is accumulated in considerable quantity.

When macerated for some time in cold water, it acquires a white colour, and a flocculent or downy appearance ; and it becomes a little more elastic than before.

By long boiling in water, it may be entirely dissolved ; and the solution contains Albumen and Gelatine.

In young persons, this Texture is more delicate than in the Adult, and exists in much smaller proportion. In old persons, there is not only less of it, in general, diffused throughout the body, but its laminæ seem less extensible, and somewhat more opaque*.

* Bordeu has written a little volume upon this Texture, which he has called ' Le Tissu Muqueux.' (Recherches sur le Tissu Muqueux, &c.) A single page, however, would have comprehended all his remarks upon it, that are accurate.

Bichat's Chapter on the same Texture, in his ' Anatomie Generale,' (Tom. I. p. 11.) is filled with matter which is not only quite foreign to the subject, but often vague, and often incorrect.

By far the best, as well as the most original essay on the Anatomy of the Cellular Substance, is that by Dr. William Hunter, in the Medical Observations and Inquiries, Vol II. It is quite worthy of his great talents.

CHAPTER II.

THE ANATOMY IN GENERAL OF ADIPOSE SUBSTANCE.

Every one may be presumed to be familiar with the appearance of the Substance called *Fat*, in the bodies of Quadrupeds. The *Adipose Substance* or *Fat* of the Human Body, is pretty much the same.

Next, perhaps, to the Cellular Substance, this Texture is the most extensively distributed throughout the Body; but it varies very much in its quantity, in different individuals, It seems, almost every where, to be accompanied with Cellular Substance; whether, indeed, it ever occurs without this Texture, is very doubtful.

Its colour and consistence vary a little, in different regions of the Body. In some, it is of a pretty deep yellow colour, in others, straw-coloured; in some parts it is pretty firm and elastic, in others, rather soft and easily torn. In making this comparison, however, it is necessary, that the different specimens submitted to examination, should be at the same temperature; for example, betwixt 95^0 and 100^0 Fah^t., which is nearly the standard temperature of the Living Body.

It is obviously composed of two distinct substances; an Oily Matter, and a Vascular Cellular Texture, in which this Matter is contained.

The Oily Matter possesses all the characters physical and chemical, of the class of Oils called Fixed. Its more peculiar or specific properties, do not seem to have been investigated. It is deeper in its colour in some parts than in others; and the colour of the whole Texture obviously depends upon it. It seems to me most probable, that it exists every where in the Living Body in a perfectly fluid state.

I judge so, at least, from an examination of different portions of Adipose Texture, taken from the Dead Body, and raised to the temperature of the Living; for the fact cannot be easily ascertained on the Living Body itself. In all Surgical Operations, however, I observe, that when a thick portion of Adipose Substance happens to be divided, minute globules of Oil may be seen swimming, in great abundance, in the stream of Blood that flows from the wound.

As to the Vascular Cellular Texture which contains the Oily Matter, it appears to consist of little spherical cells, placed closely together, side by side. These cannot be distinctly seen without a magnifying glass. They vary a little in their size, but are all exceedingly minute. I have made no measurement of them; but according to Dr. Monro*, none of them exceed the eight-hundreth part of an inch, nor are less than the six-hundredth.

One cannot be certain whether they communicate with each other; though I perfectly agree with Dr. Hunter†, that the incompressibility of Adipose Substance, and the impossibility of moving its Oily Matter from one portion of it to another, by means of moderate pressure, renders such communication extremely improbable.

Of the nature of the Texture which forms the cells, I know nothing, but that it seems to be fully as delicate as Cellular Substance, equally transparent, and, like it, to exhibit an appearance of slender filaments, when raised with the point of a needle, and inspected with the microscope. Abundance of little Bloodvessels may be seen running through it, though it is not perhaps upon the whole so Vascular as Cellular Substance; and both Absorbents and Nerves, by proper management, may sometimes be traced into it, to a considerable degree of minuteness. Many Anatomists have

* Description of the Bursæ Mucosæ, &c. p. 37.

† Med. Obser. and Inquiries. II. p. 34.

pronounced it to be nothing else but Cellular Substance, into the cells of which an Oily Matter has been exhaled But there is obviously no resemblance between its cells and those of that Texture. Clusters of cells of Adipose Substance seem always to be tied together by Cellular Substance ; and yet the cells of the two Textures, do not appear to have the slightest communication with each other. Altogether, I can have no doubt that they are of a different nature. Dr. Hunter * pointed out this distinction long ago, and yet it is singular how much it has been overlooked.

The quantity of Adipose Substance diffused over the whole Body, is in general smaller, the younger the subject. It is also more tender, and paler in its colour. In most cases too, the quantity begins to be diminished in the Decline of Life ; though by no means in all, as must be consistent with the knowledge of every one. Its colour at same time becomes yellower, and I think, upon the whole, that it acquires a firmer and tougher consistence.

CHAPTER III.

THE ANATOMY IN GENERAL OF MUSCLE.

The Texture which Anatomists have distinguished by the term *Muscle*, is that which is commonly known by the name of *Flesh.* Those, therefore, who have not seen this Texture in the Human Body, may form a very good idea of it, by an examination of the Flesh of Quadrupeds.

Its colour varies a good deal. In most parts, it is of that peculiar tint, which is generally known by the term Flesh-Colour ; but in some organs, it is considerably browner

* Medical Obs. and Inquiries. II. p. 33.

than this; and in others, greyer. Very thin slices of it are semitransparent.

Its consistence, in the Dead Body, is subject to the utmost variety; not only from causes operating after, but previously to, Death. The property of *Irritability* or *Contractility*, also, which it possesses during Life, and which it is the business of Physiology to treat of, causes its consistence to vary, even in the Living Body.

It seems to be composed of delicate Fibres of a peculiar nature; of a substance like Cellular Substance enclosing these Fibres, and uniting them together; and of Bloodvessels, Absorbents, and Nerves.

Much has been written respecting the Fibres; and a good deal still remains to be investigated. In the meanwhile, PROCHASKA's description of them*, appears to me by far the most accurate.

Were we to judge of them, merely from an examination, with the naked eye, of various specimens of Muscle taken in the most recent state from the Dead Body, we should say, that they were soft, straight, reddish-coloured, solid, Fibres; more or less flattened or angular; varying in diameter from the twentieth to the hundredth part of an inch; placed parallel and close to each other; and thus collected into Fasciculi of various sizes, which generally unite with other Fasciculi to form larger ones, and these again with others, and so on.

But there is no Fibre, however small to the naked eye, which may not be seen, by the aid of the microscope, to be composed of Fibres still smaller; and Fibres which, when examined in the recent state, even under the microscope, appear to be simple, in general resolve themselves into Filaments still more delicate, after having been for some time exposed to the action of boiling water. This operation,

Oper. Min. Pars I. p. 160.

while it strengthens the Fibres, and renders them more opaque, seems to soften or dissolve the connecting medium between them.

We should form then but a very imperfect idea, it is obvious, of the structure of the Muscular Fibres, were we to content ourselves with such an analysis as can be made of them in their unprepared state, and without the assistance of magnifying glasses. PROCHASKA has employed these means with great industry; and the following are the results of his investigations.

In the first place, the Fibrous part of every species of Muscle, may ultimately be resolved, into Fibres of the same form, dimensions, and general appearance. The tenuity of these is very great; their diameter not much exceeding, the forty-thousandth part of an inch, perhaps *. There is not the least appearance of their being divisible into smaller Fibres; PROCHASKA seems to have no doubt that these are the smallest Fibres of Muscle. He calls them *Fila Carnea;* but I am rather inclined to denominate them, the *Primary Muscular Fibres*†. They are very variable in their length. It may be collected from some of PROCHASKA's observations, that he conceives they extend, in some parts, to nearly three feet. However long they are, they preserve the same diameter throughout. As far as one can judge from a transverse section of them, none of them are perfectly circular in their shape; they are all more or less flattened or angular. They have no appearance of hollowness; but seem to be solid diaphanous filaments.

In the second place, these Primary Fibres, placed parallel and close to each other, are in the first instance united into

* PROCHASKA says, that he found their diameter to be, seven or eight times the greatest diameter of a red globule of the Blood.

† The term *Primary* is here employed in the same manner as the word *Simple* is by chemists, as denoting *something not yet demonstrated to be Compound.*

Fasciculi, which in all sorts of Muscle, appear to be pretty nearly of the same form and thickness. I propose to call these, therefore, the *Primary Fasciculi**. In a transverse section, these Fasciculi always appear polyedrous; triangular, or quadrangular, or pentagonal; but never circular. As to their thickness, I observe, that, in the representation which PROCHASKA has given of their appearance, as seen through a microscope magnifying the diameter two hundred times, the largest of them does not exceed an eighth of an inch, and the smallest is not below a sixteenth. In point of length, they are various; but PROCHASKA affirms, that he has traced them extending, unbroken, and unconnected with any other Fasciculi, from one end to the other of the longest piece of Muscle in the Body, (viz. the Sartorius Muscle) which is fully two feet in length.

In the third place, two or more of these *Primary Fasciculi*, are generally found placed parallel and close to each other, so as to form larger or *Secondary Fasciculi*; these again, are often, though not always, united into Fasciculi still larger, which might be called *Ternary*; and so on.

Such are the more important of PROCHASKA's observations respecting the Muscular Fibres. In one microscopical inspection, apparently of the Primary Fibres, made by the WENZELS †, each Fibre appeared to them to be composed of exceedingly minute, roundish, corpuscules. The piece of Muscle, however, had been previously steeped in a mixture of Muriatic Acid and Alcohol for eight days.

The substance which unites the larger Fasciculi of Muscle together, corresponds, in every particular, with the Texture already described under the name of Cellular Substance. But the connecting medium between the lesser Fasciculi and between the Primary Fibres, is so delicate as

* PROCHASKA has rather inaptly denominated these, *Fibræ Musculares.*

† De Penitior. Struct. p. 33.

not to admit of accurate examination. I imagine, however, that it is of the same nature as the rest; very delicate filaments, at least, like those seen in Cellular Substance, are always perceived between the finer Fasciculi of Muscle, when they are gently separated from each other.

The Bloodvessels of Muscular Texture admit of easy injection in all parts of the Body. In Muscle which is composed of large Fasciculi, their ramifications may be traced to a considerable degree of minuteness between these, always accompanying the different sheaths of Cellular Substance. In what manner, however, the extremities of the Arteries and commencements of the Veins, are disposed with respect to the Primary Fibres, is not known.

Absorbent Vessels have occasionally been injected, on the surfaces of certain portions of Muscle in the Body; but they have not hitherto been traced far between the Fasciculi.

Nerves may often be followed, by dissection, to a great degree of minuteness between the Fasciculi. They ramify in the Cellular Substance like the Arteries; and after a number of subdivisions corresponding to the different orders of Fasciculi, terminate at last, in all probability, in the substance of the Primary Fibre. This, however, is merely conjecture.

When thin slices of Muscle are exposed to a stream of dry air, they become brownish, semi-transparent, and very tough. When plunged into cold water, on the other hand, if the water be regularly renewed, Muscle loses its rednes, entirely, the Fibrous part remaining of a straw colour. The whole Texture, too, swells out in consequence of the maceration, and gradually becomes softer.

Alcohol, diluted Acids, Corrosive Sublimate, Alumn, Common Salt, Nitrate of Potass, increase the consistence of Muscle, contract it slightly, promote its separation into Primary Fibres, and affect its colour variously. The first three render it paler; Alumn gives it a greater degree of toughness than any of the rest, and usually changes its colour to brown; Nitrate of Potass and Common Salt make it more florid in its hue; and although they render it somewhat firmer at first, this effect seems gradually to go off, and it becomes softer or more tender; its decomposition, however, being at same time retarded.

I do not find that the Chemical Properties of Muscle in the Human Body, have hitherto been particularly investigated. Numerous and very minute analyses, however, have been made of this Texture in Quadrupeds; a full account of which will be found, in all the Elementary Works on Chemistry*. From the close resemblance which subsists between this substance in Man and in these Animals, there can be no doubt, that when Human Muscle is submitted to the same operations, similar results will be obtained. In all probability, it will be found, 1. That after it has been long exposed to the action of boiling water, it yields to the water a quantity of Albumen, Gelatin, the Extractive Matter described by THOUVENEL, and a little Phosphat of Soda and of Ammonia; and that the fibrous substance which remains undissolved, possesses all the properties of Fibrin; 2. That when a portion of Muscle is calcined, it leaves about 5 *per cent.* its weight of Saline Matter, composed chiefly of Phosphates of Soda, Ammonia, and Lime, and Carbonat of Lime.

THERE are various portions of Muscle in the Body, which are smaller, in general, in the Female than in the Male; but whether this depends, in any degree, on an actual difference in the diameter of the Primary Fibres, has not been ascertained. In other respects, this Texture seems to be the same in both Sexes

* See in particular, MURRAY's System of Chemistry, IV. p. 615; THOMSON's System of Chemistry, V. p. 522; HENRY's Elements of Chemistry, II. p. 304.

Muscle is uniformly observed to be paler, and softer, in young persons than in the Adult; and more so in proportion to their youth. I confess, too, I can have little doubt, that the Primary Fibres are actually more slender in the earlier periods of Life than afterwards. It will also be found, I presume, that in Man, as well as in Quadrupeds, the Muscle of young subjects, yields a much greater quantity of Gelatine, proportionally, to boiling water, and less Fibrine, than of Full Grown persons.

In the Decline of Life, Muscle becomes paler again, and distinctly more delicate in its Primary Fasciculi, than in the Adult. In all probability, too, its Primary Fibres diminish.

CHAPTER IV.

THE ANATOMY IN GENERAL OF SKIN.

This general integument of the Body, varies in its thickness, from about a fifth to a twentieth of an inch.

It is exceedingly tough, and is by far the most elastic of all the softer Textures.

The appearance of its external surface I suppose to be familiar to every one. *Furrows* of different sizes are perceptible on it. The largest of these, are such as are seen in the Palm of the Hand, forming an appearance somewhat like the letter *M;* or opposite the joints of the Fingers. Specimens of almost all the lesser kinds, may be perceived, on the back of the Hand. These intersect each other in every direction; leaving spaces of various forms between them. All these Furrows are made shallower by distending the Skin; the lesser ones disappearing altogether, when the distention is considerable.

The Skin in certain parts, as around the Alæ and Tip of the Nose, on the Chin and Cheeks, and in the Axillæ and Groins, exhibits a number of greyish or yellowish coloured, circular, spots, from a hundredth, to a fortieth or fiftieth part of an inch in diameter. These are the mouths of little cylindrical cells called *Sebaceous Follicles*, which dip straight down into the Skin; and are generally filled with a sebaceous matter, which becomes a little coloured on its surface, and so enables us to discover the position of the cysts containing it.

My present belief is, that there are no distinct *Pores* visible, either with the microscope or with the naked eye, on the outer surface of the Skin, in its natural state; but this is a point to be further investigated. I cannot perceive any appearance of them, at the points from which the Hairs spring; these little prolongations seem to fill up completely the canals by which they penetrate to the surface. The little depressions which have been described as Pores, on the tops of the Ridges observable on the Skin covering the points of the Fingers and Toes, I shall have occasion to consider afterwards, when treating of the Integuments of the Extremities; but they do not appear to me deserving of the name of Pores.

The appearance of the inner surface of the Skin, is very different from the outer. One cannot give an idea of it by words. I may observe, however, that except in a very few parts, it exhibits a number of depressions, placed close to each other, and varying in size from a twelfth to an eighth of an inch or more, which give an areolar appearance to the whole surface. BICHAT *, who first took notice of these depressions, affirms, that besides the passages for the Hairs, there are little pores or canals in the bottom of each of them; which penetrate to the outer surface of the Skin, and serve,

* Anat. Gener. IV. p. 651.

as he conceives, for the transmission of Bloodvessels, and Exhalents, and Absorbents, and Nerves, to that surface. I believe, however, it will be found, that these pores are not perceptible in the recent skin; but that they are the effects of maceration.

The Skin consists of two parts, placed one above the other, in the form of layers or laminæ. The inner lamina is called *True Skin* *; the outer, *Cuticle*, *Epidermis*, or *Scarf-Skin*.

These two adhere to each other so closely, not only during Life, but in the recent Dead Body, that it is in vain to attempt separating them, without destroying either the one or the other. The method by which I have always found, that they may be detached from each other with most ease, and with the least injury to either, is, to preserve a piece of Skin, either on the recent subject or detached from it, carefully from moisture; and at the end of a week or ten days, or of a longer or shorter period, according to the state of the atmosphere, such a degree of decomposition generally takes place, as enables one, by the gentlest pressure, with the point of the finger, in an oblique direction on the Cuticle, to separate it completely from the True Skin. Maceration in cold water, or plunging into boiling water, I do not find by any means well adapted for producing this separation; the former process is always exceedingly tedious, and both injure the texture very much, of the parts which they separate.

The *True Skin*, is that part of the Skin upon which its strength entirely depends.

Its outer surface corresponds almost exactly in appearance, with the outer surface of the Skin, before the Cuticle has been removed. It presents precisely the same Furrows; and is only the slightest shade lighter in its colour.

* SYNONYMS. *Lat.* Corium. *Fr.* Le Chorion.

In peeling off the Cuticle, however, the Hairs are in general extracted along with it, from their canals in the True Skin. Consequently, when the outer surface of the True Skin is examined with a microscope, a number of little holes are seen in it, which were not perceptible on the whole Skin.

The intimate structure of the True Skin is quite peculiar. It seems chiefly made up of a species of very small, but dense, whitish fibres, which are interwoven with each other closely, and in every direction; but which are more firmly compacted together, the nearer they are to the outer surface. These fibres appear to me to resemble those which compose the External Coat of an Artery, more than any other Texture. By maceration in cold water, they are rendered easily separable from each other.

Bloodvessels enter largely into the composition of the True Skin. They admit of being injected with the utmost facility, and to the greatest degree of minuteness. The outer surface is always much more vascular than the inner; and it is to the Blood circulating in these Vessels, that this surface entirely owes its red colour in the Living Body. After having injected the True Skin with Size and Vermilion, so minutely, that its outer surface had acquired a bright red colour, and many fine ramifications could be traced upon it, with a magnifying glass, I have repeatedly endeavoured to remove the redness and vascularity, by scraping the surface, firmly, with the edge of a fine scalpel; but always without success. The Vessels seem to be completely incorporated with the substance of the Texture.

The Absorbent Vessels of the True Skin are so large and so numerous, that after a successful injection of them with Mercury, the whole outer surface looks, at a little distance, like a sheet of silver. They are very easily injected. Their distribution, resembles network more than regular ramification. There is no appearance of distinct origin any where among them; and I have never seen the smallest particle of the Quicksilver escape from the outer surface, in the most successful injections.

There are few Regions of the Body, in which distinct branches of Nerves may not be traced, entering the internal surface of the True Skin, from the parts beneath. Many of their ramifications, on this surface, may often be displayed by dissection; but it is difficult if not impossible to follow them into the outer surface. Their actual mode of termination is nowhere known.

With respect to the Sebaceous Follicles, all that I can discover is, that they are little, smooth, cylindrical cells in the True-skin, which penetrate almost completely through to its inner surface.

The Canals in the True Skin for the transmission of the Hairs, are all more or less oblique to its surfaces.

The True Skin, when dried, becomes hard, elastic, yellowish or greenish like horn, and semitransparent. A portion of it, in this state, plunged into Oil of Turpentine, becomes perfectly transparent. Maceration of the True Skin in Cold Water, after a considerable length of time, renders it softer, looser in its texture, and at last reduces it to a kind of pulp. When plunged into Boiling Water, it instantly shrinks up to a great degree, becomes thicker, and greatly more elastic. In proportion, however, as the boiling is continued, the elasticity is destroyed.

With respect to the Chemical Properties of this substance, all I have to remark at present is, that I have found it may be completely dissolved by long boiling in Water, and that the solution contains a large quantity of Gelatine. I have no doubt, however, that if submitted to the operation of the same agents, as have been employed in the analysis of the True Skins of Quadrupeds*, it would be acted upon in a similar manner.

* See the Systems of Chemistry which were referred to at p. 230.

The True Skin is invariably united to the parts which it covers, by means of Cellular Substance, which is intimately interwoven with its inner surface.

When a blister happens to be formed, by any accident, on the surface of the Body, the pellicle which is raised by the fluid of the blister, and which, when divided, allows this fluid to escape, is that part of the Skin, which is called the *Cuticle*. Every person, therefore, I presume, has a pretty good general idea of this substance.

To enable one to examine it minutely, it must be separated from the True Skin, in the manner already described.

It is seldom more than a fifth or a sixth part the thickness of the portion of True Skin which it covers.

It is inferior in elasticity to the True Skin, very flexible, and easily torn.

It is transparent, and of a slightly yellowish-grey colour. The colour of the outer surface of the True Skin is, therefore, seen through it; and upon the colour of this surface, blended with the slight tinge of grey from the Cuticle, I have no doubt whatever, that the natural colour of the Skin, in all Europeans, depends.

Its inner surface presents an appearance precisely the reverse of its outer, and of the outer surface of the True Skin to which it is applied; every Furrow or Depression in these, has a ridge or Eminence corresponding to it in the other, and *vicê versâ*. In general, however, as was formerly remarked, when the Cuticle is peeled off from the True Skin, the Hairs are extracted along with it; consequently, the portions of the Hairs which were lodged in the canals of the True Skin, are now seen projecting from the inner surface of the Epidermis. I once thought, that each of these canals in the True Skin, was lined with a little sheath of Cuticle, which came away with the portion of the Hair contained in the canal; but on more attentive examination, I suspect, that this is not the case; but that there is simply a perforation in the Cuticle, corresponding exactly to the mouth of the canal in the True Skin. I believe that this is its arrangement also, with respect to the Sebaceous Follicles.

When the Cuticle is examined in the closest manner, either with the naked eye or with the microscope, not the slightest appearance can be discovered in it, either of laminæ or fibres; nor has maceration, nor any other process with which I am acquainted, the least effect in unfolding any structure of this sort in it. In almost all persons in health, there are certain parts of the Soles of the Feet, on which the Epidermis is divisible into layers; but this seems to be purely the effect of compression, which accumulates into a thick stratum, those portions of the Cuticle which are constantly separated from its surface, and which in other parts of the Body, are immediately removed. This laminated appearance of the Epidermis, is never seen, in the Soles of persons who have been long confined to bed, or in those, who, from accident or disease, have not been able to put the foot to the ground. In the Palms of the Hands, too, the Scarf-Skin may sometimes be peeled off in layers; but only in persons, in whom this part of the Body has been exposed to constant and considerable pressure.

One would have expected to have found the Cuticle full of *Pores*; and yet it is curious, that, even with the most powerful microscopes, not a single pore can be seen in it. Cruikshank's observations on this subject accord so completely with my own, that I cannot do better than transcribe them.

" When a piece of Cuticle," says he, " falls off from the " Cutis*, some of the Hairs go with it, and some remain " with the Cutis. Those Hairs certainly perforated the " Cuticle, yet in the microscope not the least vestige of these " perforations can be traced. In places where the Hairs

* By *Cutis*, he means True Skin.

" either do not exist, or where they are invisible, where, " however, the pores are very numerous, as on the Nose " and some parts of the External Ear, no perforations can " be traced in the separated Cuticle; though the sebaceous " matter could formerly be pressed from the cavities of these " pores on the Nose, in the form of a small worm, of some " considerable length."—" I perforated pieces of Cuticle " with a fine needle, but these perforations were invisible " in the microscope, as they would have been had I perfo- " rated the elastic gum. The pores of filtrating paper, " when dry, are very manifest in the microscope; but on " wetting this paper, they become invisible*."

Their can be little doubt, that the Cuticle is entirely destitute of Bloodvessels, Absorbents, and Nerves. Nothing resembling these, has ever been seen in this substance; and it exhibits no phenomena, either healthy or diseased, in the Living Body, which would lead us to infer that it possesses them. It is the first substance, therefore, which we have had occasion to consider, which is truly inorganized or *non-vascular.*

In separating it from the True Skin, in the manner formerly recommended, particularly in a piece of Skin from the Soles of the Feet or Palms of the Hands, a number of very delicate, transparent, colourless filaments, may in general be seen, stretched out in the angle between it and the True Skin; which sometimes admit of being extended to the length of nearly an inch, before they give way. Dr. HUNTER†, who has described and represented these filaments exceedingly well, regarded them as the Vessels of the Sweat, passing from the True Skin to the Cuticle. Twenty years before, (although Dr. HUNTER does not seem to have been aware of this,) the same filaments had been taken notice

* Experiments on the Insensible Perspiration, p. 12.

† Medic. Obser. and Inquir. II. p. 52.

of, and the same opinion entertained with respect to them by KAAU*. CRUIKSHANK† conceived, that, if they were not Vessels, they were exceedingly fine processes of the Cuticle, which lined the smallest pores of the True Skin. But I can have no doubt, after repeated examination of them, that these filaments are neither Vessels nor processes of Epidermis; but that they are merely threads of that mucous matter, which always forms between the Cuticle and True Skin after Death, in consequence of decomposition. Similar filaments may be produced, at pleasure, by placing a small quantity of any viscid substance between two plates of glass, and then gently separating the plates from each other.

When Cuticle is dried, it diminishes in bulk, but becomes firmer, more elastic, and somewhat yellower.

Precisely the opposite effects are produced by maceration in Cold Water. It swells out a little, is rendered softer and less elastic, and acquires a considerable degree of whiteness and opacity. It is a substance, however, which imbibes water very slowly. It is not until after long continued immersion of the Hands or Feet in water, that the Cuticle of the Palms or Soles, takes up enough of this fluid, to render it white and opaque; and yet I suspect, that the Epidermis of these Regions imbibes moisture more readily, than that of any other part of the Body. This is the reason, obviously, that the fluids of Blisters or Vesications in the Living Body, are so long of escaping; and that the Skin of the Dead Body is so long of drying, even in the driest atmosphere, provided the Cuticle has not been removed from it. This property of the Epidermis, was first pointed out by Dr. HUNTER ‡.

When plunged into Boiling Water, Cuticle scarcely suffers any apparent change at first; but after a little while,

* Perspiratio Dicta Hippocrati, p. 42.

† Experiments, &c. p. 25.

‡ Med. Observ. and Inquiries, II. p. 46.

it becomes whiter and more opaque; and if removed, will be found to have lost a great deal more of its elasticity, than it would have done, in the same time, in Cold Water.

With respect to its Chemical Properties, it may be observed, 1, That when thrown into the Fire, it burns exactly like a piece of Horn or Feather, and emits a similar smell. 2. After long boiling in Water, it yields to the Water, only a small quantity of Gelatine. The undissolved substance, scarcely differs from the original Cuticle, either in bulk or appearance. 3. The Pure Fixed Alkalies dissolve it completely; forming with it a substance of a soapy consistence. Perhaps, it is, in some degree, owing to a partial solution of this kind, as Dr. MURRAY* has remarked, as well as to the small quantity of Oily Matter which generally besmears the Skin, that when we rub a little of an Alkaline Ley between the Fingers, we experience so strong a soapy feel. 4. When plunged into Pure Nitric Acid, it instantly acquires a yellow colour †; in the course of twenty minutes, it becomes thicker, softer, and more opaque; and in twenty-four hours it is reduced to a yellowish pulp. Pure Muriatic Acid acts upon it much less powerfully, and more slowly; only rendering it softer, and a little thicker at the end of twenty-four hours. Pure Sulphuric Acid immediately gives it a deep-brown colour; and in twenty-four hours renders it thicker and more elastic; so that it is not unlike a thin slice of Glue, both in colour and consistence. 5. A Saturated Solution of Corrosive Sublimate in Alcohol produces no change upon it whatever.

* System of Chemistry. IV. p. 626.

† CRUIKSHANK mentions it as a remarkable result of his experiments with Nitrous Acid and the Cuticle, that although this Acid gives the Epidermis a yellow colour as soon as it touches it in the Living Body, yet it has no immemediate effect of this kind upon it, in its separated state. I am pretty sure, however, that this must have been owing, to his having employed pieces of Cuticle in his Experiments, much more moist than this substance generally is.

I have already had occasion to remark, the firmness of the connexion subsisting between the Cuticle and the True Skin. It may further be observed, that when a piece of recent Skin is divided, not the slightest perceptible space seems to intervene between these two. They adhere as closely to each other, as the particles of either of them do separately. The separation which is so easily effected between them, sometime after Death, is, obviously, the consequence of a decomposition of part of the outer surface of the True Skin, or of the inner surface of the Epidermis, or, partly of both. The product of the decomposition, is a highly fœtid, viscid, transparent, matter.

About a hundred and sixty years ago, a layer of a substance, somewhat like another Cuticle, was described by MALPIGHI*, as intervening between the Cuticle and the True Skin, to which he gave the name of *Corpus Mucosum et Reticulare.* This substance, he affirmed, was black in the Negro, and of various lighter colours, in the other varieties of the Human Species; and to it, therefore, he ascribed the colour of the Skin in general. Since his time, most Anatomists have continued to describe a similar substance, under the same, or a similar, name, such as *Reticulum*, or *Reticulum Malpighianum*, or *Rete Mucosum*; some regarding it as a layer of the Epidermis, others as a distinct texture; some considering it as *non-vascular*, others as nothing but a network of Vessels†; all, however, agreeing, in ascribing to it the colour of the Skin in general. In the Negro it is black, and in the other varieties of the Human

* Oper. Omn. II. De Extern. Tact. Org.

† This last is BICHAT's opiuion. Anat. Gen. IV. p. 655. I find it quite impossible to conceive, what extraordinary fallacy it could have been, which could have led this ingenious Anatomist to believe, that there was such a substance, between the Cuticle and True Skin, as he has described so minutely, under the name of *Corps Reticulaire.* There is not only no such Membrane in this situation, but nothing at all resembling it.

Species, it was said to correspond, exactly, with their particular hue.

In the Negro, Caffre, and Malay, I have satisfied myself by many dissections, that there is a *Black Membrane* interposed between the Epidermis and the True Skin, upon which the dark colour of these people entirely depends; and hence I have no doubt, that the colour of Black Men in general, is owing to a similar substance. This Membrane sometimes peels off with the Cuticle, and sometimes adheres to the True Skin. It is more tender than the Cuticle, and thinner; but like it, perfectly inorganized, and without any appearance of holes, or plates, or fibres*. But, after the strictest examination, I have not been able to find any light-coloured Rete Mucosum, corresponding to this black one, in the inhabitants of Great Britain, nor in those of other nations, resembling them in colour. I have tried all the means usually said to be necessary for discovering it, and many others besides, but always without success: I am, therefore, disposed to deny the existence of any such Membrane in White Persons. The greater number of Anatomical writers seem to have copied the description of it, one from another; and I have little doubt, that those who conceived they had actually seen it, had seen only the Cuticle, from which they had previously peeled off some superficial layers. The colour of the Skin in White People depends, partly on the Cuticle, but chiefly on the True Skin, as already remarked. (p. 236.) Whether this be the case, also, in the Tawny Varieties of the Human Species, or whether they

* MECKEL's description of this Membrane is the most minute, and the most accurate, I have met with. (Hist. de l'Acad Roy. de Berlin 1753.)

This author takes notice of a fact, which I have had many opportunities of observing; viz. that the Cicatrices of wounds, and the marks of the small Pox, or of Ulcers of any kind in Black People, so far from remaining white, as many have asserted, uniformly become blacker than the other parts of the Skin.

have not a Tawny Membrane, like the Black Membrane of the Negro, I have had no opportunity of ascertaining.

The Skin of the Female is thinner than that of the Male, and the Furrows on its surface are narrower and less deep. I know of no other difference between them.

In the Fœtus and young subject, the Skin is not thinner, in proportion to the other parts of the Body, than in the Adult. There is an obvious diminution, however, in its thickness in Old Age.

The same Furrows may be seen in the youngest Fœtus, on the outer surface of the Skin, as in the Adult; and of the same size proportionally. These Furrows, therefore, are not the consequence of frequent folding of the Skin by the action of Muscles, or the bending of Joints. The *Wrinkles* in old persons, are of a different nature altogether; they are produced by the wasting of the soft parts which the Skin covers.

The Skin is less elastic in the young subject than in the Adult; and less elastic still, in old persons than in young.

The True Skin is as thick, proportionally, in the Fœtus as at Maturity; and its structure is the same. The Blood-vessels, however, on its outer surface, are always more easily injected, the younger the subject. The True Skin in old persons is almost always, thinner, proportionally, than in the Adult; and its Vessels are less easily injected.

Except the difference of thickness, and a slight diminution in its elasticity in Old Age, the Cuticle is the same throughout the whole of Life*.

* The Nails will be considered along with the Integuments of the Extremities, in a different part of the Work.

CHAPTER V.

THE ANATOMY IN GENERAL OF HAIR.

It is unnecessary to say any thing respecting the general appearance of the Hairs of the Human Body; at least of that portion of them which projects beyond the surface of the Skin. I shall confine myself, therefore, to circumstances which are less familiar.

In every Hair, three parts may be distinguished; the *Root*, *Middle Part*, and *Point*. In the *Root*, I comprehend, not only that portion of the Hair which is contained in the *Bulb*, but the Portion which is lodged in the Skin; in other words, all that part which is not seen externally. The *Middle Part* and *Point*, are the parts which project beyond the surface of the Skin.

By laying hold of a Hair with a pair of round-pointed forceps, and pulling gently, but steadily, its Root is gradually detached from the Bulb and the Canal in the Skin, and it is extracted entire. This operation may be practised on the Living Body, with very little pain. On the Dead Body, it is the more easily accomplished, the farther decomposition has advanced between the Cuticle and True Skin. I have already remarked, that the Hairs are almost always extracted in this manner, along with the Epidermis, when it is peeled off from the True Skin.

All the Hairs in the Body are cylindrical, and taper regularly from the Root to the Point. In affirming that they are conical, I do not trust to my own microscopical observations alone; my friend Dr. Brewster assures me, that he has always found them to be so. This circumstance, therefore, affords the true explanation of the fact, said to have been first remarked by FOURCROY*; viz. that when a Hair is placed, lengthways, between the points of the Finger and Thumb, and the Finger and Thumb are then moved backwards and fowards on each other, the Hair is gradually forced from between them, and invariably in the direction of its Root. This motion had been supposed to be owing to minute serræ on the sides of the Hair, all inclining towards its Point; although no such projections could be perceived, by the most powerful microscopes. The larger Hairs are often split into two, towards the point; this, however, as well as the general tapering along the whole of the Middle Part, I believe to be entirely owing to attrition.

Whatever the colour of the Hair may be, the Root is always whitish, and semitransparent; particularly that part of it which is lodged in the Bulb. It is always much softer, too, at this part, than at any other; the very lowest portion being almost fluid.

After many observations with the microscope, I should be inclined to pronounce the Hair to be a solid cylinder throughout; without cells or canals of any kind. There is in the whiskers of the Seal, a small conical cavity in that part of the Root of the Hair, which is contained in the Bulb; but whether there be a similar arrangement in Human Hair, I do not know.

Nor have Hairs ever appeared to me, to be composed of fibres or laminæ placed closely together, as one would be led to imagine, from the representations which have sometimes been given of them. DR. BREWSTER very justly compares them to threads of spun glass; and it is one of the many curious facts, recently ascertained by this most ingenious and successful inquirer, that Hairs depolarize Light, and possess the most perfect neutral axes; the axes being parallel and perpendicular to the axis of the Hair†.

* See BICHAT, Anat. Gener. IV. p. 812.

† Phil. Trans. 1815.

Like the Epidermis, the Hairs seem to be quite destitute of Bloodvessels, Absorbents, and Nerves. In the disease called *Plica Polonica*, it was at one time supposed, that they acquired such a degree of Vascularity, as to bleed when divided. But this is now ascertained to be a mistake*.

The Chemical Properties of Human Hair, as far as they have yet been ascertained, are the following. 1. Mr. Hatchett found†, that when Hair was long boiled, under the ordinary pressure of the Atmosphere, in Distilled Water, it imparted to the Water, only a small quantity of Gelatine. The substance which remained, possessed all the properties of Coagulated Albumen. When dried in the air, it was found to have lost much of the original flexibility and elasticity of Hair; so that it was very easily broken. He was induced to believe, also, from a variety of experiments, that the Hair which loses its curl in moist weather, and which is the softest and most flexible, is that which most readily yields Gelatin on boiling; while that which is very strong and elsatic, affords it with greatest difficulty and in the smallest proportion. This opinion was corroborated by the experience of a considerable Hair merchant in London.

2. Vauquelin‡ found, that Hair might be completely dissolved in Water, boiled in Papin's Digester. In this operation, when the Heat was carried beyond a certain point, the Hair was wholly or partly decomposed; as was shewn by the Ammonia, Carbonic Acid, and Empyreumatic Oil which were found in the solution. During the solution, also, under whatever degree of Heat, a large quantity of Sulphur-

* I am quite aware of the minute description of the Structure of Hair which has been given by Bichat. Anat. Gener. IV. p. 807. But in this instance, as well as in several others, it appears to me that Bichat has written more from fancy than observation.

† Phil. Transac. 1800.

‡ Annales de Chimie. tom. 58. p. 41. There is an excellent abstract of Vauquelin's Memoir, in Nicholson's Journal, Vol. XV. p. 141.

ated Hydrogen Gas was evolved, which acted strongly on the sides of the Copper vessel, turning them black ; but the quantity of the Gas was greater, the higher the temperature. When the Hair employed was black, or the Heat was not sufficiently great to decompose it, a Black Matter remained, which fell down very slowly, in consequence of its minute division and the consistence of the solution. This Matter was found to be composed chiefly of a Black Oil, as thick as Bitumen, soluble in a slight degree, either in Alcohol or Alkalis, and of Iron and Sulphur, perhaps united together. A Yellowish-Red Matter was left by Red Hair, in which was found a great deal of Oil, Sulphur, and a little Iron. The Watery solution of Hair, when filtered, has scarcely any colour. Concentrated Acids render it turbid ; but an excess of these agents restores its transparency ; and weak Acids produce no change on it. The Infusion of Galls, and Oxygenated Muriatic Acid, form in it copious precipitates. Silver is blackened in it ; and the Acetate of Lead is precipitated brown. The Solution, carefully evaporated, did not assume the consistence of Jelly on cooling, but remained glutinous

3. VAUQUELIN also found, that Hair, might be dissolved in Water containing merely 4 *per cent.* of Caustic Potash. During this solution, Hydrosulphuret of Ammonia was evolved. Black Hair left a black residuum, composed of a thick Oil, with Iron and Sulphur ; and Red Hair, a Yellow Oil, with very small quantities of the same ingredients. In this Alkaline Solution of Hair, Acids form white precipitates, soluble in an excess of the Acids ; and when these precipitates are thus redissolved, at the expiration of a certain time, an Oil appears on the surface, in the form of a pellicle with prismatic colours. The same Solution precipitates Lead of a Black hue.

4. The same Chemist ascertained, that each of the Acids, acted in a particular manner on Hair. The Sulphuric and

Muriatic Acids first assumed a fine rose colour, and afterwards dissolved the Hair. Nitric Acid turned the Hair yellow, and when assisted by gentle Heat, dissolved it. In this case, the Solution of Black Hair exhibited a Black Oil on its surface, and the Solution of Red Hair, a red Oil; and both of these Oils ultimately grew white, and became concrete on cooling. The same Solution, when properly evaporated, afforded much Oxalic Acid; and the unchrystallizible mother-water contained Bitter Substance, a great deal of Iron, and Sulphuric Acid. Red Hair, in this operation, gave more Sulphuric Acid, and less Iron, than Black. Oxygenated Muriatic Acid Gas first whitened the Hair, soon after softened it, and then reduced it to the form of a viscous and transparent paste like Turpentine, of a bitter taste, and partly soluble in water, partly in Alcohol.

5. VAUQUELIN found, that Alcohol extracted from Black Hair two kinds of Oil; the one White, which, on cooling, subsides in the form of little shining scales; the other of a Greyish-Green hue, which separates as the Alcohol evaporates, and ultimately becomes concrete also. Red Hair, likewise, afforded a White Concrete Oil, like Spermaceti, and another Oil, as Red as Blood, when the Alcohol was evaporated. The Oil from White Hair, was nearly colourless.

6. From Hair subjected to the action of Fire in close vessels, VAUQUELIN obtained the same products as from other Animal Substances; with this difference, that it afforded more Sulphur, and gave out very little Gas. It left in the retort 0.28 or 0.30 of Coal.

7. The same Chemist found, that Hair yielded, by incineration, Iron and Manganese, imparting a brownish-yellow colour to the ashes; Phosphat, Sulphat, and Carbonat of Lime; a little Muriat of Soda; and a considerable portion of Silex. The ashes of Red Hair, were less coloured, because they contained less Iron and Manganese; and the

ashes of White Hair yielded still less. These last, however, contained a great deal of Magnesia; at least a great deal with respect to the other ingredients; for the Hair scarcely yielded above .015 of ashes.

The *Bulbs* of the Human Hair are so minute, that it is not easy to ascertain any thing respecting them, except their form. This varies a good deal in different regions of the Body. In some they are spherical, in others pyriform; but for the most part they are cylindrical. They have a slightly greyish colour, which enables us to distinguish them the more easily, among the Cellular and Adipose Substance, in which they are imbedded.

Judging by analogy, from the structure of the Bulbs of those large Hairs, which form the whiskers of such Animals as the Seal, I should imagine, that the Bulbs of the Human Hair consisted of two Coats or Tunics; an inner one, of a tender consistence, and very Vascular, embracing immediately the Root of the Hair; and an outer one, closely surrounding this, firmer, and less Vascular.

The Bulbs of the Hairs, are always situated under the True Skin; but so close to its inner surface, that no part of the Hair is perceptible, between it and the Bulb. Immediately after leaving the Bulb, the Hair is received into a Canal in the True Skin, which is constantly observed to be more or less oblique. A small hole in the Cuticle corresponds to this Canal; and the Hair passing through it also, reaches the outer surface of the Skin. In its passage through the True Skin, I believe, that it adheres to the sides of the canal just as Epidermis would do; and in piercing the Cuticle, it seems to me most probable, that the sides of the hole by which it penetrates, are intimately united with it.

THE differences in the Human Hair corresponding to Sex and to Age, are so familiar to every one, that they do not require pointing out.

CHAPTER VI.

THE ANATOMY IN GENERAL OF CARTILAGE.

CARTILAGE is the substance commonly known by the name of *Gristle*. It is distinguished from all the other Textures of the Body, by its firmness, great elasticity, and pearly appearance.

The forms in which it occurs are very various; sometimes it is found in layers or crusts, at other times in masses, more or less cylindrical.

Thick slices of it are exactly like Opal; thin slices are transparent and almost colourless.

On careful examination with the microscope, it appears to me, to be a uniform, homogeneous, substance, like Jelly, without either fibres, or laminæ, or cells.

There is no doubt of its being Vascular; but I do not know of any method by which its Bloodvessels can be injected after Death. These Vessels, therefore, must be exceedingly minute. I speak here only of pure Cartilage in the Adult; for in those pieces of Cartilage which form the Epiphyses of Bones before Maturity, Arterial Vessels, as large as a bristle, may often be seen, running towards some particular point, where Osseous Substance is beginning to form.

Neither Absorbents nor Nerves have ever been traced into this Texture.

When thin slices of it are dried, they become quite transparent, and of a yellowish colour, and are almost as brittle as glass.

Plunged into Boiling Water, it immediately shrinks up, and becomes yellower and more opaque than before.

Its Chemical Properties do not yet seem to have been particularly investigated. In its purest form, however, I believe, that it is entirely soluble in Boiling Water. Thin dried slices of it, I find, are acted upon by the Acids somewhat in the same manner that Cuticle is *.

CARTILAGE has the same structure in the Female as in the Male.

IN the Fœtus and young subject, Cartilage has much less of the opal appearance, which we observe in it in the Adult. It is, also, more transparent, softer, and less elastic. In the Decline of Life, it becomes whiter, more opaque, harder, and less elastic; and in many parts of the Body, is to a greater or less extent, converted into Bone. This last change occurs very early after Middle Age, in some individuals; but, in general, the tendency does not manifest itself, until the later Periods of Life.

CHAPTER VII.

THE ANATOMY IN GENERAL OF BONE.

BONE, or *Osseous Substance*, in the Human Body, resembles, in its recent state, the corresponding Texture in the Bodies of Quadrupeds.

* In MR. HATCHETT's admirable Papers on Shell and Bone, and on Membranous Parts, (Phil. Trans. 1799, 1800.) there are several remarks on the composition of Cartilage. But the author does not state whether he analysed any of the Cartilage of the Human Body, or whether he does not in general mean by this term, the soft part of Bone, which is left after steeping it in diluted Acids. He found it to resemble Coagulated Albumen in most of its Chemical Properties.

It cannot be sufficiently regretted, that this able philosopher has withdrawn himself so much, of late years, from those departments of experimental science, in which his talents seem so eminently calculated to lead to interesting discoveries.

I need say nothing respecting its colour, hardness, or elasticity.

The fabric of the *Skeleton* alone, of which every person has a general notion, is sufficient to show the great variety of forms under which it exists. In some parts, innumerable fibres and plates of it may be found, nearly as fine as a hair; in others, it occurs in solid pieces, fully half an inch thick.

Its structure is exceedingly simple. Divide it, and examine its surfaces, with a common magnifying glass, or cut off slender films of it, and inspect them in a powerful microscope, and it will appear to be a uniform substance, without fibres, plates, or cells, penetrated everywhere by delicate Bloodvessels.

The Bloodvessels admit of being injected with Size or Turpentine and Vermilion, pretty freely; but from the opacity and hardness of the Texture in its natural state, it is impossible to trace them, with the eye or by dissection, into its more interior parts. There is a very simple method, however, by which a piece of Bone, after it has been minutely injected, may be rendered almost perfectly transparent; and then its Bloodvessels are displayed in the most beautiful manner. For this purpose, it is only necessary to steep the piece of Bone in Diluted Muriatic Acid, for a few hours, or days, or weeks, according to the thickness of the specimen, until it has become quite soft and pliable. It is then to be well washed, and after it has been gradually but completely dried, it is to be plunged into Spirit of Turpentine. The instant it is immersed in this fluid, it becomes transparent; but the substance injected into the Arteries retaining its colour and opacity, the most minute ramifications of these Vessels are distinctly seen.

There can be no doubt that Bone is also possessed of Absorbents and Nerves; but these have not yet been traced into it.

The Sulphuric, Nitric, Muriatic, and Acetic Acids, when properly diluted, all soften Bone and render it pliable, without its being possible to discover, by the most minute inspection, that a single particle of its substance has been removed. I have repeated this experiment many times; and on some of the most delicate portions of Osseous Substance in the Body. The form and size of the slenderest fibre remains unaltered by the process. I find Muriatic Acid to be the menstruum best adapted for the purpose. In proportion as the piece of Bone becomes soft by this operation, it loses its yellowish colour, and becomes bluish or grey; approaching somewhat in appearance to Cartilage.

The very opposite effects are produced on Osseous Substance by exposing it to a strong Heat. If a bit of Bone be burnt in a charcoal fire, of which the heat has been gradually raised to whiteness, and it be then carefully removed and cooled very slowly, it will be found to have become exceedingly brittle, and of a pure white colour. Still, not a particle of the Substance will appear to have been destroyed. If the process have been carefully conducted, it will have precisely the same shape and dimensions as before.

There is no Texture in the Body, of which the Chemical Properties have been more frequently or more minutely investigated than Bone. The following are the more important facts relative to this subject,

1. If a piece of recent Bone, be taken from a part of the Skeleton, where it is least exposed to any foreign admixture of Oily or Gelatinous matters, and after being well washed, be rasped down, and boiled in Water for some time, it will yield to the Water a considerable quantity of Gelatine *.

* It is an extremely common opinion, that a considerable quantity of *Fat* also is extracted from Osseous Substance by this process. I am convinced, however, from many experiments, that this is a mistake. There is no Oily

2. When a piece of Bone is immersed in Diluted Muriatic Acid, an immediate, though inconsiderable, effervescence takes place. Minute Globules of a Gas, are seen rising from every point of the Bone. HATCHETT ascertained that this Gas was Carbonic Acid *.

If the Bone be kept a sufficient length of time in the Diluted Acid, it is rendered soft and flexible, as I have already remarked; the Acid, notwithstanding, remaining clear and colourless.

a. If to this Acid in which the Bone has been steeped, a little Infusion of Galls be added, a pretty copious precipitate takes place.

If to the same Acid, Pure Ammonia be added, a very copious precipitation is produced, of a pure white, flocculent, matter, which is Phosphat of Lime. The quantity of Phosphat, on an average, which may be obtained in this manner, will, I believe, be found to be about 50 *per cent.* of the whole Bone analysed.

If, after all the Phosphat of Lime has been separated by the Pure Ammonia, a little Carbonat of Ammonia be dropt into the remaining liquor, a small quantity of Carbonat of Lime is thrown down. The proportion of this, on an average, seems to me, to be about 10 *per cent.* of the whole Bone analysed.

b. The soft, flexible, substance which remains, retaining the form of the Bone, after the ingredients just mentioned have been extracted by the Acid, was found by HATCHETT †, to resemble Coagulated Albumen in most of its Chemical Properties. It has usually been called *Cartilage;* though it is perhaps better, to denominate it the *Albuminous Part* of

Matter of any kind in pure Bone. When it seems to exist in it, it has been derived, by transudation, either from Adipose Substance without, or from Marrow within.

* Phil. Trans. 1799. p. 328.

† Phil. Trans. 1799.

Bone. Its quantity on an average, is from 35 to 40 *per cent.* of the whole Bone analysed.

3. When a piece of Calcined Bone is plunged into Diluted Muriatic Acid, Carbonic Acid is disengaged, and it is entirely dissolved; and if to the solution Pure Ammonia, and afterwards Carbonat of Ammonia, as in the last experiment, be added, Phosphat and Carbonat of Lime are precipitated, and in the same proportions *. It is the Albuminous Part alone of Osseous Substance, therefore, which seems to be destroyed by Calcination; and upon this Part, it would appear, from the brittleness of Calcined Bone, the elasticity of the Texture entirely depends. On the other hand, it is the Calcareous Matter alone or chiefly, which is removed by the Diluted Acids; and to this, as the flexibility of the steeped Bone clearly shews, the firmness of Osseous Substance is owing.

4. By a very delicate and difficult analysis, FOURCROY and VAUQUELIN say, that they obtained from Human Bone, Phosphats of Magnesia, Iron, Manganese, Silex, and Alumina. They do not mention the quantities of these ingredients yielded; but there is no doubt, that they were exceedingly minute. The account of the processes they employed is tedious; and, therefore, I shall content myself with merely referring to the Memoir in which they are described †.

5. BERZELIUS informs us, that by a minute analysis of recent, dry, Human Bone, the particulars of which, however, he has not detailed, he obtained from it 2 *per cent.* of Fluat of Lime ‡.

* I have repeatedly endeavoured to discover Sulphat of Lime in the Acid Solution both of Calcined, and Uncalcined, Bone; but always without success.

† Journal de Physique. Tom. LXX. p. 135. Translated in NICHOLSON'S Journal, vol. 30.

‡ Annales de Chimie, LXI.

I have not been able to perceive any difference, between the Osseous Substance of the Female and that of the Male.

In the Fœtus and Infant, the colour of Bone is much redder than in the Adult. It becomes gradually paler as the individual approaches to Maturity. In the Decline of Life, it generally acquires a deeper tint of yellow.

In point of consistence, it will be found to be softer and more elastic, the younger the subject; and harder and more brittle, the older.

Its specific Gravity almost invariably increases with the Age of the individual.

Its Vascularity is much greater in early Life than at Maturity, and much less in Old Age. To this, no doubt, in part, the difference in its colour is owing.

With respect to Chemical Properties, it is sufficient to remark, that the quantity of Calcareous Matter contained in Bone, proportionally to the Albuminous Part, is always greater, the older the subject. This will account for the difference in its Specific Gravity, hardness, and strength at different periods of Life; and in part, also, for the difference in its colour.

CHAPTER VIII.

THE ANATOMY IN GENERAL OF TENDON *.

Tendon or *Tendinous Substance*, is the Texture commonly known by the name of *Sinew*.

* This is precisely the same Substance, as that described by Bichat (Anat. Gener. III. 145.) under the name of "*Système Fibreux*." I have not hesitated, however, to reject this appellation, because it is equally applicable to Nerve, Muscle, or even Cellular Substance, as to Tendon.

Its shining, silvery, appearance, distinguishes it from every other Texture in the Body.

Its distribution is very various, and very extensive. It forms not only those appendages to Muscular Fasciculi called *Tendons*, from which it has received its name, but also *Ligaments;* coverings to Bone and Cartilage, denominated *Periosteum* and *Perichondrium; Aponeuroses, Fasciæ, Membranes*, &c.

It possesses very little elasticity, but it is very flexible, and by far the toughest texture in the Body.

It appears to be chiefly composed of very delicate, white, silvery looking fibres, which are first collected into Fasciculi of different sizes, and then these are united together in various ways. Sometimes a piece of Tendon is formed of a number of such Fasciculi, of considerable size, tied together longitudinally, by Fasciculi so much smaller, that they are not seen unless the larger ones be pulled a little from each other. At other times, the Fasciculi are interwoven with each other, almost with the same regularity as the threads of a piece of cloth. At other times, again, they cross and intersect each other in every direction, forming a close, compact texture, which it is impossible to separate either into laminæ or threads. I have never tried to discover, how minutely the Tendinous Fibres might be subdivided; but it is no difficult matter to obtain them, by careful maceration in water, more delicate than the filaments of silk.

A few Bloodvessels may often be seen on the surface of a piece of Tendon after Death, even where no injection has been employed. After successful injection with Size and Vermilion, a good many more are generally brought into view; and if the piece of Tendon be dried and plunged into Spirit of Turpentine, the transparency which it immediately acquires, enables us to trace several of them into its Substance. In its natural state, however, Tendon is among the least vascular of the Textures.

No one, I believe, has yet succeeded in demonstrating its Absorbents or Nerves.

When Tendon is exposed to a stream of air, it very soon dries, becomes yellowish, transparent, hard, and very elastic.

By maceration in Water, it is rendered softer, and flocculent on its surface, its fibres unfolding themselves very delicately. But this is a very tedious process.

When plunged into Boiling Water, it immediately shrinks, loses its shining appearance, becomes yellowish, semitransparent, harder, and very elastic.

Its Chemical Properties require to be more carefully investigated, than they have yet been. In the meantime, I may observe, 1. That when small portions of it are boiled for a considerable length of time in Water, they are completely dissolved, and the Water jellies on cooling. 2. Sulphuric, Nitric, and Muriatic Acid act upon it very nearly in the same manner as they do upon Cuticle. The instant it is plunged into either of them, it shrinks up, becomes semitransparent, and elastic, just as it does in Boiling Water, but in a much greater degree. 3. The effects of the Pure Fixed Alkalies upon it are singular. At first they operate upon it somewhat like the Acids just mentioned; but instead of dissolving it after a while, as these do, they seem to produce very little further change upon it; at least for a considerable length of time. If in this state, we remove it from the Alkali, and pull its parts gently asunder, the delicate fibres will unfold themselves very readily, exhibiting at same time very bright prismatic colours.

Tendon in the Female, differs in no respect, from the same Texture in the Male.

In the young subject, this Texture is of a bluer colour, softer, less tough, more vascular, and more easily soluble in Boiling Water than in the Adult. In the Old subject, on the contrary, it is of a Yellower colour, much less shining, harder, tougher, less Vascular and soluble with much more difficulty in Boiling Water, than at Maturity.

CHAPTER IX.

THE ANATOMY IN GENERAL OF SEROUS MEMBRANE.

Serous Membrane is a substance scarcely so thick as a wafer, having one surface perfectly smooth and free, turned towards certain cavities of the Body, and another more or less flocculent, connected by fine Cellular Substance, to the sides of these cavities, or to the surfaces of their contents.

It is quite soft and flexible, yet possesses considerable strength; and except when its Bloodvessels are filled with Blood or with coloured Injection, it is almost perfectly transparent.

A successful injection of Size or Turpentine, coloured with Vermilion, brings into view, in general, such an amazing number of fine Bloodvessels in this Membrane, that one would be almost inclined to suppose that it was entirely composed of Arteries and Veins. By proper management, however, Absorbents may be injected in it, even with Quicksilver, to an equal degree of minuteness. There can be no doubt, therefore, that it is chiefly composed of these two systems of Vessels. Whether it contain any thing else but Vessels, remains to be ascertained. Nerves have not yet been traced into it; although they may be seen, everywhere, ramifying on the parts with which its external surface is connected.

When dried, it becomes transparent, firm, and elastic.

By Maceration in Cold Water, it is rendered opaque, becomes gradually softer, and is at last reduced to a pulp.

All I have ascertained respecting its Chemical Properties is, that it is soluble in Water after very long boiling, and speedily soluble in Concentrated Acids.

It is in every respect the same in the Female as in the Male.

I know of no differences in its Anatomy corresponding to Age.

CHAPTER X.

THE ANATOMY IN GENERAL OF SYNOVIAL MEMBRANE.

Synovial Membrane resembles Serous Membrane, in so far as it is a thin substance, having one smooth, free, surface, turned towards certain cavities of the Body, and another, connected by delicate Cellular Substance to the sides of these cavities, or to the parts contained in them. It resembles this substance also in being transparent.

But it differs from Serous Membrane in the following circumstances. In the first place, it is a substance possessing very little Vascularity in its healthy state. None of its Bloodvessels are almost ever seen filled with Blood after Death, nor can they be made to receive the finest injection. In the second place, its Absorbents are quite incapable of demonstration. Thirdly, very delicate fibres, like those of Cellular Substance, or like the finest filaments of Tendon, are distinctly perceptible in it after slight maceration. Fourthly, it is not so strong as Serous Membrane*.

I have not investigated its Chemical Properties.

* I am very doubtful, whether all the circumstances in which these two Textures are said to differ from each other by BICHAT (Anat. Gener. IV. p. 537), be well founded. At all events, it seems to me, that none of them can, with any propriety, be adopted as the grounds of an Anatomical distinction.

Its distribution throughout the Body is very extensive; but it is only to be found where parts of such hardness as Tendon, or Cartilage, or Bone, are intended to rub upon each other*.

I AM not aware of any material difference in the Anatomy of Synovial Membrane, corresponding either to Sex or Age.

* The continuation of the Synovial Membrane over the surface of Articulating Cartilages, (a distribution more than hinted at by DR. NESBIT and DR. HUNTER, and, confidently maintained by BICHAT,) is, I am convinced from a number of experiments, afterwards to be detailed, when treating of the Skeleton, altogether an Anatomical *refinement*. The continuation of the *Tunica Conjunctiva*, over the *Cornea* of the Eye, is, I fear, a *fiction* of the same kind.

ERRATA.

Page 47, *Line* 29, *for* Artificial *read* Arterial.

Page 107, *Line* 17, *for* Cerebellum *read* Cerebrum.

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END OF VOL. I.

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