Outlines of lectures on human physiology / By John Gordon.

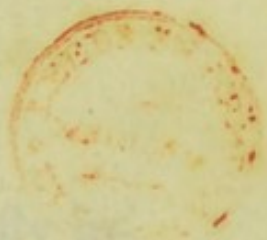
OUTLINES

OF

LECTURES

ON

HUMAN PHYSIOLOGY.



BY

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EDINBURGH;

PRINTED FOR WILLIAM BLACKWOOD, PRINCE'S STREET:

AND T. & G. UNDERWOOD, FLEET STREET,

LONDON.

1817.

EDINBURGH:
Printed by Balfour & Clarke.

PREFACE.

THE following "OUTLINES" are chiefly intended for the use of the Author's Pupils. As they present, however, a full Tabular View of Physiology, he is not without hope, that they may also afford some assistance to those, who are prosecuting the study of that Science in private. They exhibit the Arrangement which he has been accustomed to follow, for several years, in his Lectures on the Institutions of Medicine; and in a Systematic Work on Phy-

siology, which it is his wish to lay before the Public at some future time, a similar Order will be observed.

EDINBURGH, 1*st November* 1817.

INTRODUCTION.

PART I.—The province of Physiology defined. The present state of the Science. General remarks on the facts which it comprehends, and the opinions or theories which prevail in it. Causes which have contributed to retard its progress. Its interest, as a branch of general knowledge. Its importance to the Medical Practitioner.

PART II.—Knowledge necessary before entering on the study of Physiology. Indispensable necessity of a knowledge of the Anatomy or Structure of the whole Human Body. Importance of a general knowledge of Natural Philosophy and Chemistry.

Order in which the phenomena of Physiology ought to be studied. The Course proposed to be arranged into Four Divisions; the *first* treating of the Functions in General of the Common Systems and Common Textures of the Body; the *second*, of the Functions in General of the Skeleton, and of Attitude and Progression; the *third*, of Vision, Hearing, Respiration, the Alimentary Function, the Urinary Function, and the Generative Function; and the *fourth*, of the Signs of Life and Death, the Phenomena of Natural Decay, and the Rate of Mortality among Mankind. Objections to the Classifications of the Functions into Animal, Vital, and Natural; or Internal and External; or Digestive and Locomotive; or Animal and Organic, &c.

Of Elementary and Full Views of Physiology. The former, such as contemplate the Functions of the Body in that condition only, which is regarded as approaching nearest to the state of Health; the latter, such as consider, not only the functions as they are exhibited to us during the healthy condition, but

the causes in general which contribute to modify these functions, and to produce deviations from the healthy state. The terms INSTITUTIONS or THEORY OF MEDICINE, in the Edinburgh School, understood to designate a FULL VIEW of Physiology. Such View intended to be given in the following Course.

General Remarks on the more valuable Writings on subjects relating to Physiology.

ERRATUM.

Page 128. § I. 3. read *Follicles* and *Meibomian*.

FIRST DIVISION.

FIRST DIVISION.

THE FUNCTIONS IN GENERAL OF THE COMMON SYSTEMS AND COMMON TEXTURES OF THE BODY.

THIS DIVISION comprehends Twelve Parts. The First Part treats of the Functions of the Nervous System, and Muscular Texture; the Second, of the Functions of the Circulating System; the Third, of the Functions of the Absorbent System; and the remaining Nine, of the Functions of Cellular Substance, Adipose Substance, Skin, Hair, Cartilage, Bone, Tendon, Serous Membrane, and Synovial Membrane.

PART I.

THE FUNCTIONS IN GENERAL OF THE NERVOUS SYSTEM AND MUSCULAR TEXTURE.

Div. I. Part I. Sect. I.

PRELIMINARY Remarks. General Division of the Subject. 1. Sensibility and Sensations. 2. Ideas, or Thoughts. 3. Irritability, and Muscular Actions. 4. The Sensibility of Muscle. 5. The Nourishment of Muscle. 6. Properties Attributed to Muscle on Insufficient Grounds. 7. Emotions. 8. Sleep. 9. Functions of the Parts containing the Brain and Spinal Cord. 10. The Nourishment and Secretions of the Brain and Spinal Cord. 11. The Nourishment of the Nerves.

SECTION I.

OF SENSIBILITY AND SENSATIONS.

ARTICLE I.

§ I. The phenomenon called a Sensation illustrated. Terms synonimous with Sensation.

§ II. The property called Sensibility illustrated. Terms synonimous with Sensibility.

§ III. All Sensations referable to two great classes, viz. Simple Sensations, and Sensations of Emotion. Each of these illustrated. Their subdivision into Genera and Species.

§ IV. Some genera of Sensation experienced in one part of the body only; others in more than one.

§ V. Question whether we can be conscious of two or more Sensations of different genera, at one and the same moment.

§ VI. Qualities of Sensation.

1. Qualities common to all Sensations.—Intensity, Strength, or Degree.
2. Qualities common to many genera of Sensation.
   a. Position.
   b. Magnitude, Size, Extension, Dimension, or Space.
   c. Form, Figure, or Shape.
3. Qualities peculiar to some genera.—Colour, Tone, &c.

§ VII. The Causes of Sensation. Divisible into Proximate and Remote.

Div. I. Part I. Sect. I.

1. The Proximate Cause. Is, in every instance, a change in the Immaterial Mind. The nature of this change not known.

2. The Remote Causes. Are the whole series of phenomena which precede the affection of the Mind, and are necessary to it. Are not entirely known in any instance. Are partially known in some instances. In other instances are not known at all. Hypotheses on the subject. Opinion, that all Sensations are preceded by a change in the Nervous System, examined.

The Causes of the differences in some of the Qualities of Sensation partially ascertained. Ex. Intensity, Position, &c.

ARTICLE II.

DIFFERENCES IN SENSIBILITY DEPENDENT ON SEX AND AGE.

§ I. Sensibility of the Female compared with that of the Male.

§ II. State of the Sensibility before and after Maturity.

ARTICLE III.

ORIGINAL DIFFERENCES IN SENSIBILITY IN DIFFERENT INDIVIDUALS.

ARTICLE IV.

DIFFERENCES IN SENSIBILITY IN THE SAME INDIVIDUAL AT DIFFERENT TIMES.

Preliminary Observations. 1. On the use of the terms Stimulant and Sedative, as applied to Sensibility. 2. On the distinction between Total Insensibility, and the state of Stupor, Coma, or Deep Sleep.

§ I. The Sensibility of some parts diminished by Their having been previously the Seat of Sensation. Experiments illustrating this fact.

§ II. Sensibility modified in some parts by Change of Temperature.

§ III. Sensibility nodified by the diseased state called Inflammation. Some parts Sensible in this state, that are Insensible in health.

§ IV. Sensibility modified by the Application of Certain Substances directly to a Part.

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§ V. Sensibility modified by Causes operating primarily on the Nerves leading to a Part.

1. Effects of Compression of a Nerve in any part of its course

2. Effects of Division or Destruction of a Nerve in any part of its course.

§ VI. Sensibility modified by Causes operating primarily on the Central Mass of the Nervous System.

1. Causes operating primarily on the Brain.
   A. Effects of Destruction of portions of the Brain on Sensibility. Variety, and apparent inconstancy, of these effects. Greater tendency to Insensibility in the side of the body opposite to that of the Brain which seems most injured. SAUCEROTTE's experiments on quadrupeds.
   B. Effects of Unusual Compression of the Brain.
      a. Effects of Fractures of the Skull with Depression of Bone.
      b. Effects of Effusion of Blood, Serum, or Pus, upon the surface of the Brain, or into its Ventricles.
      c. Effects of Morbid Tumors growing from the Surface of the Brain itself, or of the Cavity containing it.
      d. Question whether the Brain be ever subjected to such Increased Compression, from mere Con-

gestion of Blood in its vessels, as to affect Sensibility.

C. Question whether the Sensibility be not sometimes affected by the Brain's being exposed to *Less* Compression than usual.

a. Cause of the Insensibility accompanying Fainting.

b. Cause of the Insensibility sometimes induced by suddenly raising the Head after Stooping.

D. Question whether Sensibility be not sometimes affected simply by Concussion of the Cerebral Mass.

E. Effects of the Circulation of Morbid Blood through the Arteries of the Brain, on Sensibility.

a. Effects of the Circulation of Venous Blood through these vessels instead of Arterial. Insensibility in Asphyxia.

b. Experiments on the lower animals, in which, when Certain Substances were mingled directly with the Circulating Blood, Insensibility was induced. Question as to the cause of this Insensibility.

2. Causes operating primarily on the Spinal Cord.

A. Effects of Unusual Compression of the Spinal Cord on Sensibility. Apparent difference in the effects when the Compression is gradually applied. Doubts with respect to this.

B. Effects of Division, or Destruction, of Portions of the Spinal Cord on Sensibility.

Div. I. Part I. Sect. I.

§ VII. Substances applied to various Natural Surfaces of the body, often modify the Sensibility of parts distant from them.

1. Substances introduced into the Stomach, or injected into the Rectum. Examples. Question as to the manner in which they operate. Whether they be conveyed into the Circulation or not. Experiments on the lower animals by WHYTT, MONRO, FOWLER, ALEXANDER, WILSON, &c. Whether they affect the Nervous System or not. If they do, in what manner.

2. Substances inhaled into the Lungs. Examples. Similar questions respecting their mode of operation.

3. Substances applied to the Skin. Examples. Similar questions respecting their mode of operation.

§ VIII. Substances applied to the Surfaces of Wounds often modify the Sensibility of parts distant from them. Examples. Question as to the mode of their operation.

§ IX. The Sensibility of parts sometimes modified by Trains of Ideas, or of Sensations and Ideas, during Emotion. Experiments of the French Commissioners on Animal Magnetism. HAYGARTH'S interesting Experiments with the Fictitious Tractors.

§ X. Causes modifying Sensibility not referable to any of the foregoing classes.

SECTION II.

OF IDEAS OR THOUGHTS.

ARTICLE I.

§ I. The phenomenon called an Idea or Thought illustrated. Terms synonimous with Idea or Thought.

§ II. Question whether or not we are capable of experiencing a Sensation and an Idea at one and the same moment.

§ III. Question whether or not we are capable of experiencing more than one Idea at a time.

§ IV. Causes of Ideas. Divisible into Proximate and Remote.

Div. I. Part I. Sect. II.

1. The Proximate Cause. Is in every instance an affection of the Immaterial Mind. Nature of this affection unknown.

2. The Remote Causes. Are all those phenomena which precede the affection of the Mind, and are necessary to it.

A. Every Idea excited by the Idea or Sensation immediately preceding it.

Reasons why one Idea is excited by a previous Sensation or Idea, in preference to any other.

a. Principle of Previous Association. Memory.

b. Principle of Resemblance or Analogy.

c. Question whether there be any other Exciting Principles but these.

B. No direct Voluntary Power over Thought.

C. Reasons for believing that every Idea is preceded by, and dependent upon, some corporeal change. Questions as to the seat of this change. Supposed in general to take place in the Nervous System.

a. By DARWIN, to take place in the extremities of the Nerves. His reasons. Objections to them.

b. By most other physiologists, in the Brain. Examination of this hypothesis.

ARTICLE II.

DIFFERENCES IN IDEAS DEPENDENT ON SEX AND AGE.

§ I. The Intellectual Character of the Female compared with that of the Male.

§ II. State of the Intellect before Maturity. State in the Decline of Life.

ARTICLE III.

ORIGINAL DIFFERENCES WITH RESPECT TO IDEAS, AMONG DIFFERENT INDIVIDUALS.

§ I. These are referable to two classes; first, Differences in the influence of the principle of Previous Association on the Train of Thought; and, secondly, Differences in the influence of the principle of Resemblance or Analogy.

1. Differences in the influence of the principle of Previous Association.
   - A. Differences in the Retentiveness of the Memory. Strong Memory. Weak Memory. Examples.
   - B. Differences in the Susceptibility of the Memory. Quick Memory. Slow Memory. Examples.

2. Differences in the influence of the principle of Resemblance or Analogy.

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§ III. Causes of these Original Differences.

1. Question, whether they depend on the Mind or the Body.

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A. Hypotheses ascribing them to original differences in the Nervous System.

a. To differences in the Dimensions of certain parts of this system. Objections to all these.

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DIFFERENCES WITH RESPECT TO IDEAS IN THE SAME INDIVIDUAL AT DIFFERENT TIMES.

Previous inquiry relative to what constitutes Mental Derangement.

§ I. The Train of Thought often modified by Causes operating primarily on the Brain.

1. Effects of Unusual Compression of the Brain on the train of Thought.
   - A. Effects of Fracture of the Skull, with Depression of Bone.
   - B. Effects of Effusion of Fluids on the Surface, or into the Ventricles of the Brain.
   - C. Effects of Morbid Tumors growing from the Surface of the Brain, or of the Parts containing it.
   - D. Question whether the Brain be ever subjected to such Increased Compression, from mere Congestion of Blood in its vessels, as to affect the train of Ideas.

2. Question whether the train of Thought be ever influenced by the Brain's being subjected to *Less* Compression than usual.
   - A. Cause of the loss of Ideas accompanying Fainting.
   - B. Cause of the loss of Ideas sometimes occurring when the Head is suddenly raised after Stooping.

3. Question whether the train of Thought be ever influenced by mere Concussion of the Brain.

4. Effects of Destruction of Portions of the Brain on the train of Ideas. Remarkable variety of these; and their apparent inconstancy.

5. Effects of the Circulation of Morbid Blood through the Arteries of the Brain on the train of Thought.
   - A. Effects of the Circulation of Venous Blood through these vessels instead of Arterial. Loss of Thought in Asphyxia.

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§ III. The Train of Ideas modified by Substances applied to various Natural Surfaces of the body.

1. Substances introduced into the Stomach, or injected into the Rectum. Question as to the mode of their operation. Whether they be conveyed into the Circulation or not. Influence of the process of Digestion on the train of Thought.

2. Substances inhaled into the Lungs. Similar question relative to the mode of their operation.

3. Substances applied to the Skin. Similar question relative to their mode of operation.

§ IV. The Train of Thought modified by Substances applied to the Surfaces of Wounds.

Examples. Question as to the mode of their operation.

§ V. Causes modifying the Train of Thought, not referable to any of the preceding classes.

Modifications occurring in a variety of Diseases, &c.

SECT. III.

OF IRRITABILITY, AND MUSCULAR ACTIONS.

ARTICLE I.

§ I. The property called Irritability illustrated. Possessed by Muscle everywhere; but whether or not by Muscle alone, is uncertain. Terms synonimous with Irritability.

§ II. Term Stimulus explained. Terms synonimous with it.

§ III. Terms Action and Relaxation, as applied to Muscle, explained. A Muscle, in Action, may be shorter, of the same length, or longer than before; and so, also, a Muscle in Relaxation. Contraction not necessary to Action.

§ IV. State of a Muscle during Action.

1. During Action accompanied with Contraction, there are no Rugæ, or Plaits, in the Muscular Fibres. Observations and experiments on the Human

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Body, as well as on the Lower Animals, made by myself, proving this.

2. Thickness of the Fibre during Action and Contraction. Not increased. Experiments and observations on the Human Body, and on the Lower Animals, by myself, shewing this. Whether or not diminished, doubtful. What is commonly called the Swelling of a Muscle explained.

3. Hardness of a Muscle during Action.

4. Bulk of the Muscular Fibre during Action and Contraction.

A. By some thought to be Less than before. Ingenious experiments by SWAMMERDAM. Objections to these, and contrary experiments, by myself. Experiments by GODDART, and by GLISSON. Objections to these.

B. By others, thought to be Unchanged. Neat experiments by BLANE. Objections to these.

C. By others, thought to be Increased. Curious experiment by Mr. CARLISLE. Objections to it; and shewn, by another experiment, to be subject to a fallacy, not suspected by the ingenious Author himself.

5. Force with which a Muscle is capable of acting.

6. Extent to which a Muscle is capable of shortening when in Action.

7 State of the Circulation of the Blood in an Acting Muscle.

§ V. Causes of Muscular Action. Divisible into Proximate and Remote.

1. The Proximate Cause. Seems to be a Temporary Increased Attraction between the Particles of the Fibre. Grounds of this theory.

2. The Remote Causes; otherwise called Muscular Stimuli. The principal of these may be arranged under the following Heads:

   A. Things operating primarily on the Nerves leading to a Muscle.

      a. Sudden Pressure, or Sudden Impulse, communicated to a Nerve in any part of its Course. Experiments on Members of the Human Body after Amputation, and on the Lower Animals. Particular description of the Actions excited by this Stimulus. Inquiry into the mode of its operation.

      b. Acrid Substances. The Actions they excite. Mode of operation.

      c. Electricity. The Actions it excites. Mode of operation.

   B. Things operating primarily on the Spinal Cord. Sudden Pressure, or Sudden Impulse, on any part of it. Acrid Substances. Electricity. Actions excited by each described; and inquiry into their mode of operation.

   C. Things operating primarily on the Brain.

      a. Sudden Impulse, or Pressure, on a part of it. Experiments on the Lower Animals. Particu-

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lar description of the Actions excited by this Stimulus. Inquiry into the mode of its operation.

b. Destruction of Portions of the Brain. Observations on the Human Body, and experiments on the Lower Animals. Actions excited by this Stimulus described. Inquiry into the mode of their operation. Case by Dr. Howell.

c. Acrid Substances applied to Parts of the Brain. Experiments on the Lower Animals.

d. Electricity applied to this Organ. Experiments on the Lower Animals.

D. Volition, or the Will.

a. This Stimulus illustrated.

b. Kind of Action it excites. Opinion of Rogerus, that the Action is not Continued but Interrupted, revived by Dr. Wollaston, and supported by ingenious Experiments. Objections to this hypothesis.

c. Number of Muscles on which Volition may be exerted at the same time.

d. Whether Volition may co-exist with Sensations or Ideas.

e. Causes of Volition. Divisible into Proximate and Remote.

α. The Proximate Cause. Is an Affection of the Immaterial Mind. Its Nature not known.

β. The Remote Causes. 1. A previous Train of Thought, constituting what is called the Object in View. 2. A certain Corporeal Change, as it is supposed. Reasons for this

hypothesis. The Seat of the change supposed to be in the Brain.

f. Mode in which Volition operates on the Muscular Fibre. Opinion, that it is through the medium of the Nervous System. Examination of this hypothesis.

g. Volition capable of acting as a Stimulus on certain Muscles only. Hence the division of all the Muscles of the Body into Voluntary and Involuntary. Reason of this limitation in the influence of Volition not known. Supposed by some to be dependent on the Nervous Ganglia, but very erroneously.

E. Sympathetic Stimuli. This term applied to certain Impressions produced on Parts, which are followed by Action in Muscles distant from them. For example, Irritations in the Nose and Windpipe excite Actions in the Muscles of Respiration called Sneezing and Coughing. Such Actions denominated Sympathetic.

a. The Actions particularly described.

b. Occur chiefly, if not solely, in Voluntary Muscles.

c. Question as to the Manner in which the Stimulus operates. Whether it operate through the medium of the Nervous System.

d. Question whether the Stimulus must be accompanied with Sensation.

e. Inquiry how far Volition can assist or counteract a Sympathetic Stimulus.

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F. Stimuli of Emotion. These are certain Trains of Ideas, or of Sensations and Ideas, which occur during the state called Emotion, and excite Actions in certain Muscles. For example, in the Emotion of Grief, a certain Train of Thought, or of Sensations and Ideas, excites an Action in the Muscles of Respiration and those of the Face, called Sobbing.

a. The Actions described.

b. Whether they occur in any other than Voluntary Muscles.

c. How the Stimulus operates.

d. Whether the Stimulus may be assisted or Counteracted by Volition.

G. Things applied directly to a Muscle itself.

a. Sudden Pressure or Impulse. Experiments on Amputated Members of the Human Body, and on the Lower Animals. Actions particularly described.

How the Stimulus operates.

α. Whether through the Nerves of the Fibres, or on the Fibres themselves. Difficulty of determining this.

β. HALLER's hypothesis of a Vis Insita and Vis Nervea. Objections to this hypothesis by WHYTT. Additional objections.

b. Acids, Alkalis, Oxyds, Salts, &c. Experiments. Actions they excite. Similar questions relative to their mode of operation.

c. Electricity. Variety of experiments on Man

and Lower Animals. Actions excited. Mode of operation.

d. Laying bare a Muscle. Actions, which often occur when a Muscle is exposed, described. Inquiry into the Nature of the Stimulus in this case. Whether Air, or Temperature, &c.

H. Things applied to a Thin Membrane covering a Muscle. For example, to the Serous Membrane of the Heart; the Serous or Inner Membrane of the Alimentary Canal; or the Inner Membrane of the Bladder.

a. Acids, Alkalis, &c. Actions they excite. How they operate.

b. Water. Experiments by Dr. ALEXANDER.

c. Simple Exposure. Actions sometimes thus excited. Nature of the Stimulus. Whether Air, or Temperature, &c.

Observations on the Length of Time which Muscles continue excitable by the various Stimuli above enumerated, after the Circulation has ceased in them. Interesting experiments with Galvanism on Decapitated Persons by NYSTEN. Experiments on Amputated Members by myself, shewing the Influence of Temperature on the Continuance of Irritability in such circumstances. Distinction between Total Loss of Irritability, and such Diminution of it as only renders the Muscle incapable of being excited by some particular Stimulus.

Inquiry, whether there be any circumstance in the operation of the Stimuli above enumerated common to

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them all. WHYTT's opinion, that they all excite an Uneasy Feeling, and are dependent on Sensibility. Objections to this doctrine.

§ VI. Muscular Actions naturally going on in the Body. Divisible into Two Classes, Voluntary and Involuntary.

FIRST CLASS. VOLUNTARY ACTIONS.

1. Voluntary Actions enumerated.
2. General Observations on the Motives of Human Action.

SECOND CLASS. INVOLUNTARY ACTIONS.

These are divisible into Three Orders, viz. Sympathetic Actions; Actions of Emotion; and Actions produced by Stimuli Operating through a Thin Membrane.

I. Order. Sympathetic Actions.

Enumeration of these. Breathing, Sneezing, Coughing, Yawning, Hiccup, Nisus, &c.

II. Order. Actions of Emotion.

Enumeration of these. Laughing, Crying, Sighing, &c.

III. Order. Actions produced by Stimuli Operating through a Thin Membrane.

Enumeration of these. Actions of the Heart, Alimentary Canal, &c.

§ VII. Uses of Muscular Actions in the Living Body. To produce or to prevent Motion of the Solid and Fluid Parts according to circumstances.

1. Modes in which they are exerted for these purposes. May be reduced to Two.
   A. Both Extremities of the Acting Fibre remain equally Fixed, or are equally Moved.
      a. Equally Fixed. Ex. Action of Diaphragm; of Muscles compressing the Abdomen; of Buccinator, &c.
      b. Equally Moved. Ex. Stomach, Intestines, Sphincters, &c.
   B. One Extremity of the Acting Fibre is more Fixed than the Other; so that the more Moveable End is drawn towards the Less. Ex. Muscles moving the Os Hyoides; the Biceps Flexor and Triceps Extensor of the Fore Arm, &c.

2. Extent to which the Acting Fibre must shorten to produce a given effect, when it forms an angle with the line of direction of the part to be moved.
   A. When the Part is moveable in a Straight Line.
   B. When the Part is moveable in a Circle, round a Centre or Fulcrum.

3. Force which an Acting Fibre must exert to produce a given effect, when it forms an angle with the line of direction of the part to be moved.
   A. When the Part is moveable in a Straight Line.

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B. When the Part is moveable in a Circle, round a Centre or Fulcrum.

ARTICLE II.

DIFFERENCES IN IRRITABILITY AND MUSCULAR ACTIONS DEPENDENT ON SEX AND AGE.

§ I. Differences dependent on Sex.

1. Irritability in general in the Female, compared with that in the Male.
2. Natural Muscular Actions in the Female, compared with those in the Male.

§ II. Differences dependent on Age.

1. Irritability in general, and Natural Muscular Actions, before Maturity.
2. Irritability in general, and Natural Muscular Actions, after Maturity.

ARTICLE III.

ORIGINAL DIFFERENCES IN MUSCULAR ACTIONS AMONG DIFFERENT INDIVIDUALS.

§ I. Differences in Voluntary Actions.

§ II. Differences in Involuntary Actions.

ARTICLE IV.

DIFFERENCES IN MUSCULAR ACTIONS IN THE SAME INDIVIDUAL AT DIFFERENT TIMES.

Preliminary Observations on the Meaning of the Terms Stimulant and Sedative, as applied to the Irritable Fibre.

I. DIFFERENCES IN VOLUNTARY ACTIONS.

Preliminary Observations on the Meaning of the Terms Palsy or Paralysis, Convulsion, and Tremor.

§ I. Fatigue induced by long continued Voluntary Action; and, finally, Total Loss of Power.

§ II. Effect of Practice, or Repetition, on Voluntary Actions.

1. On the Quickness and Precision of the Actions. Advantages resulting from the Appropriation of Labour in the Manual Arts.
2. Question whether Practice increases the Force of Voluntary Action or not.

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§ III. Voluntary Action modified by Causes Operating directly on the Muscle.

1. Effect of Impeding, or Stopping, the Circulation of the Blood in the Muscle.
2. Effect of Imperfect Nourishment of the Muscle. Debility after Wasting Diseases. Tremor of Old Age, &c.
3. Effect of Reducing the Temperature of the Muscle. Experiments.
4. Question how far Voluntary Action is affected by the Circulation of Venous, instead of Arterial Blood through the Arteries of the Muscle.

§ IV. Voluntary Action modified by Causes Operating primarily on the Nerve leading to a Muscle.

1. Effect of Unusual Compression of the Nerve in any part of its Course. Inquiry how it operates.
2. Effect of Destruction of the Nerve in any Part of its Course. Inquiry how it operates.

§ V. Voluntary Action modified by Causes Operating primarily on the Central Mass of the Nervous System.

1. Causes operating primarily on the Brain.

   A. Effects of Destruction of Portions of the Brain on Voluntary Action. Variety, and apparent Incon-

stancy, of these Effects. Greater tendency to Palsy or Convulsion, in the side of the Body opposite to that of the Brain which seems most injured. Observations relative to Hemiplegia by CALDANI, MONTEGGIO, LEYDIG, and the WENZELS. Some Muscles more liable to be affected than others. SAUCEROTTE's experiments on Quadrupeds.

B. Effects of Unusual Compression of the Brain on Voluntary Actions.

a. Effects of Fractures of the Cranium, with Depression of Bone.

b. Effects of Effusion of Fluids on the Surface, or into the Ventricles, of the Brain.

c. Effect of Morbid Tumors growing from the Surface of the Brain itself, or of the Cavity containing it.

d. Effects attributed to mere Congestion of Blood in the Vessels of the Brain.

C. Question whether Voluntary Actions be not sometimes affected by the Brain's being subjected to Less Compression than usual.

a. Cause of the Convulsions sometimes accompanying Fainting.

b. Cause of the Convulsions preceding Death from Hæmorrhagy.

c. Action of the Muscles of the Face after Decapitation by the Guillotine. Curious discussion on this subject by ŒLSNER, LE SUE, SOEMMERRING, CABANIS, and LEVEILLE.

D. Question whether Voluntary Actions be not

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sometimes affected simply by Concussion of the Cerebral Mass.

E. Effects of the Circulation of Morbid Blood through the Arteries of the Brain, on Voluntary Actions.

a. Effects of the Circulation of Venous Blood through these Vessels instead of Arterial. Convulsions in Asphyxia.

b. Experiments on the Lower Animals; in which, when certain Substances were introduced directly into the Circulation, Palsy or Convulsions took place. Inquiry how these substances operated.

2. Causes operating primarily on the Spinal Cord.

A. Effects of Destruction of Portions of the Cord on Voluntary Actions. Cases. Experiments instituted by Dr. YELLOLY on the Quadruped. Experiments by ZINN, LE GALLOIS, &c.

B. Effects of Unusual Compression of the Cord.

§ VI. Voluntary Actions modified by Substances applied to various Natural Surfaces of the Body.

1. Effects of Certain Substances applied to the Tongue. Mr. BRODIE's interesting Experiments on Quadrupeds. Experiments by myself.

2. Effects of Various Substances introduced into the Stomach, or injected into the Rectum. Observations on the Human Body. Experiments by a va-

riety of physiologists on the Lower Animals. Question as to the Manner in which the Substances operate. Whether they be conveyed into the Circulation or not. Experiments. Whether they operate through the medium of the Nervous System or not.

3. Effects of Substances inhaled into the Lungs. Examples. Inquiry into the mode of their operation.

4. Effects of Substances applied to the Skin. Examples. Inquiry into the mode of their operation.

5. Experiments on the Lower Animals, made formerly by WHYTT and others, and more recently by Dr. ASHBURNER; in which, Various Substances were applied to the Arachnoid Membrane, the Pleura, the Pericardium, and the Peritoneum.

§ VII. Voluntary Actions sometimes modified by Substances applied to the Surfaces of Wounds.

Examples. Experiments on the Lower Animals, by various physiologists; particularly by FONTANA, BRODIE, and DELILLE. Inquiry into the mode in which the Substances operate.

§ VIII. Voluntary Actions modified by Trains of Ideas, or of Sensations and Ideas, occurring during certain Emotions.

Examples. Epidemic Convulsions. Animal Magnetism.

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§ IX. Voluntary Actions modified by a Variety of Causes not referable to any of the foregoing Classes.

II. DIFFERENCES IN INVOLUNTARY ACTIONS.

First Order, or Sympathetic Actions.

§ I. Causes which modify the Voluntary Action of a Muscle, seem also, at the same time, to modify its Sympathetic Action in the same manner. Exemplified by Coughing, Vomiting, &c.

§ II. Inquiry whether Sympathetic Stimuli lose their efficacy by Repetition or not. Instances appearing to shew that they do, but admitting of a different explanation.

Second Order, or Actions of Emotion.

§ I. The Causes which modify the Voluntary Action of a Muscle, seem also, at same time, to modify its Actions of Emotion in the same manner.

§ II. Inquiry whether or not the Stimuli to Actions of Emotion lose their efficacy by Repetition. Instances appearing to shew that they do, but admitting of a different explanation.

Third Order of Involuntary Actions.

The Actions of this Order, of which the Modifications admit of being most satisfactorily observed, are those of the Circulating System. Little comparatively has been ascertained respecting those of the Alimentary Canal, &c. A General View of them in this Section, therefore, becomes unnecessary. Proper only to notice, in a general manner, the effects of Emotion on the Actions of the Heart and Blood Vessels.

SECTION IV.

OF THE SENSIBILITY OF MUSCLE.

ARTICLE I.

§ I. Circumstances in which Muscles are Sensible in the Healthy State; and the kinds of Sensation of which they are susceptible.

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ARTICLE II.

DIFFERENCES IN THE SENSIBILITY OF MUSCLE IN THE SAME INDIVIDUAL AT DIFFERENT TIMES.

§ I. Effects of Inflammation on the Sensibility of Muscle.

§ II. The Sensibility of Muscle during Action.

§ III. Effects of long continued or violent Action on the Sensibility of Muscle.

§ IV. Insensibility of Muscles in certain Diseased States. Cases by CABANIS and Dr. YELLOLY.

SECTION V.

OF THE NOURISHMENT OF MUSCLE.

ARTICLE I.

§ I. Circumstances which shew a constant change of Particles and Nourishment to be going on in the Muscular Texture. Agents by which this is accomplished.

ARTICLE II.

DIFFERENCES IN THE NOURISHMENT OF MUSCLE DEPENDENT ON AGE.

§ I. Growth of Muscle.

§ II. Change in the Condition of Muscle in the Decline of Life.

ARTICLE III.

DIFFERENCES IN THE NOURISHMENT OF MUSCLE IN THE SAME INDIVIDUAL AT DIFFERENT TIMES.

§ I. Effects of Exercise and Rest on the Nourishment of Muscles.

§ II. Effects of Paralysis of a Muscle on its Nourishment.

§ III. Connection between Diet and the Nourishment of Muscle.

§ IV. Diseases which influence the Nourishment of Muscle. Question whether, in Wasting of Muscle, there be great diminution of Size merely, or actual loss of Fibre.

SECTION VI.

OF CERTAIN PROPERTIES ATTRIBUTED TO MUSCLE ON INSUFFICIENT GROUNDS.

ARTICLE I.

OF THE ELASTICITY ATTRIBUTED TO MUSCLE.

ARTICLE II.

OF THE PROPERTY CALLED TONE, ATTRIBUTED TO MUSCLE BY SIMPSON.

ARTICLE III.

OF THE TONE, OR TONIC POWER, ATTRIBUTED TO MUSCLE BY WHYTT.

ARTICLE IV.

OF TWO POWERS ATTRIBUTED TO MUSCLE BY HALLER; THE *VIS CONTRACTILIS IN UNIVERSUM*, AND THE *CONTRACTIO FIBRÆ ANIMALIS MORTUÆ.*

ARTICLE V.

OF THE PROPERTY CALLED INSENSIBLE ORGANIC CONTRACTILITY, ATTRIBUTED TO MUSCLE BY BICHAT.

SECTION VII.

OF EMOTIONS.

ARTICLE I.

§ I. Statement of the Phenomena constituting Emotion in general.

§ II. Statement of the Phenomena characterizing particular Emotions.

ARTICLE II.

DIFFERENCES IN EMOTION DEPENDENT ON SEX AND AGE.

ARTICLE III.

ORIGINAL DIFFERENCES IN EMOTION AMONG DIFFERENT INDIVIDUALS.

ARTICLE IV.

DIFFERENCES IN EMOTION IN THE SAME INDIVIDUAL AT DIFFERENT TIMES.

SECTION VIII.

OF SLEEP.

ARTICLE I.

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§ I. The state of the System during Perfect Sleep particularly described.

§ II. The approach and commencement of Sleep. The termination of Sleep, or Waking.

§ III. The duration of Sleep.

§ IV. Inquiry into the Causes of Sleep.

ARTICLE II.

DIFFERENCES IN SLEEP DEPENDENT ON AGE.

§ I. Differences before Maturity.

§ II. Differences after Maturity.

ARTICLE III.

ORIGINAL DIFFERENCES IN SLEEP AMONG DIFFERENT INDIVIDUALS.

ARTICLE IV.

DIFFERENCES IN SLEEP IN THE SAME INDIVIDUAL AT DIFFERENT TIMES.

§ I. Of different species of Interruptions to Sleep.

1. Of Somnambulism, or Sleep Walking.
2. Of certain Interruptions similar to Somnambulism.
3. Of Incubus, or Night Mare.

§ II. Of Imperfect Sleep.

1. Of Dreams. Their phenomena particularly considered. Their causes. The circumstances modifying them.

§ III. Things increasing the Tendency to Sleep, and favouring its Continuance.

1. Narcotic substances applied to the natural surfaces of the Body.
2. Fatigue.
3. Intense Cold.
4. Moderate Heat.
5. Causes operating primarily on the Brain; such as unusual Compression of this Organ, &c.
6. Abstraction of the causes of powerful Sensations.

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7. Inquiry how far certain Sounds promote Sleep.
8. Various Diseases.

§ IV. Things tending to prevent the Approach and Continuance of Sleep.

1. Strong Sensations.
2. Substances applied to the natural surfaces of the Body.
3. Voluntary Action.
4. Various Diseases.

§ V. Influence of Habit on Sleep.

SECTION IX.

OF THE PHYSIOLOGY OF THE PARTS CONTAINING THE BRAIN AND SPINAL CORD.

ARTICLE I.

OF THE BONES FORMING THE CRANIUM AND VERTEBRAL CANAL.

§ I. Advantages resulting from the Cranium's being composed of separate pieces.

§ II. Admirable combination of strength and mobility in the Vertebral Column. Protection, at same time, which it affords to the Spinal Cord.

ARTICLE II.

OF THE DURA MATER OF THE CRANIUM AND VERTEBRAL CANAL.

§ I. Of the Sensibility of the Dura Mater.

§ II. Of the Nourishment of the Dura Mater. Its intimate connection with the Bones of the Cranium. Ingenious practical application of this fact by Mr. ABERNETHY.

§ III. Probable mechanical uses of the Dura Mater.

§ IV. Use of the Sinuses of the Dura Mater.

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SECTION X.

OF THE NOURISHMENT AND SECRETIONS OF THE BRAIN AND SPINAL CORD.

ARTICLE I.

OF THE FUNCTIONS OF THE PIA MATER.

§ I. Of the Arterial Circulation in the Pia Mater.

1. Minute ramification of the Arteries of this Membrane before they enter the Nervous Substance. Fallacy of the calculations as to the proportion of Blood sent to the Brain.
2. Serpentine course of the Internal Carotid and Vertebral Arteries.
3. Numerous Anastomoses of the Branches of these Vessels.
4. Cause of the elevation of the Brain corresponding to each contraction of the Heart, which is seen when a part of the Cranium has been removed; and of the pulsation at the Fontanelle in Infants.

§ II. Of the Venous Circulation in the Pia Mater.

1. Small size of the Veins of this Membrane when they first emerge from the Nervous Substance of the Brain.
2. Advantages resulting from their peculiar mode of termination in the Sinuses of the Dura Mater.
3. Cause of the rising of the Brain corresponding to each Expiration, and of the sinking corresponding to each Inspiration, which are seen when a portion of the Cranium has been removed. Observations on the Human Body. Numerous experiments on the Lower Animals.

§ III. Excretion of a Serous Fluid into the meshes of the Pia Mater, and under the Arachnoid Membrane.

§ IV. Of the Granulations of the Pia Mater, or the Glands of Pacchioni.

ARTICLE II.

OF THE FUNCTIONS OF THE ARACHNOID MEMBRANE.

§ I. Excretion of a fluid on the free surface of this Membrane. Doubts as to its quantity. Its composition not known. Whether excreted by the Arachnoid Membrane alone, or partly by it and partly by the inner surface of the Dura Mater.

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§ II. Circumstances in which the Arachnoid Membrane differs from Serous Membranes, along with which it has been classed by BICHAT. Sensibility of this Membrane.

ARTICLE III.

OF THE NOURISHMENT OF THE NERVOUS MATTER OF THE BRAIN AND SPINAL CORD.

§ I. Phenomena demonstrating a constant change of particles going on in this substance, and consequently the action of Absorbents in it.

§ II. Nutrition of the White and Brown Nervous Matter compared.

ARTICLE IV.

OF THE EXCRETION OF A FLUID INTO THE VENTRICLES OF THE BRAIN AND SPINAL CORD.

§ I. Quantity of this fluid in a state of health. Observations on the Human Body. Experiments on Quadrupeds.

§ II. Composition of the fluid judged of from analyses by Dr. MARCET and BERZELIUS, of the

contents of the Ventricles in the disease called Hydrocephalus Internus.

§ III. Inquiry as to the parts by which it is formed.

§ IV. The phenomena of the disease called Hydrocephalus Internus minutely considered.

SECTION XI.

OF THE NOURISHMENT OF THE NERVES.

§ I. Inquiry whether the Nervous Matter of the Nerves be secreted by the Neurilema or not.

§ II. Repair of Nerves when destroyed. Experiments by CRUIKSHANK, HAIGHTON, ARNEMAN, and MEYER.

PART II.

OF THE FUNCTIONS IN GENERAL OF THE CIRCULATING SYSTEM.

Div. I. Part II. Sect. I.

PRELIMINARY Remarks. General Division of the Subject. 1. The Course of the Blood, and the Powers which move it. 2. The Composition and Properties of the Blood. 3. The Changes which the Blood undergoes during its Circulation, and the manner in which Substances are separated or secreted from it.

SECTION I.

OF THE COURSE OF THE BLOOD, AND THE POWERS WHICH MOVE IT.

ARTICLE I.

§ I. The Circulation of the Blood, as discovered by HARVEY, described. Observations and

experiments on the Human Body, and on the Lower Animals, by which it is demonstrated.

§ II. The Circulation of the Blood through the Heart in particular, and the Actions of this Organ.

1. The alternate Diastole and Systole of the Auricles and Ventricles of the Heart, and the phenomena accompanying them, described.

2. Causes of the Diastole and Systole, and of the phenomena accompanying them.
   A. Cause of the Diastole of the Auricles and Ventricles. Proofs of its being entirely a passive effect.
   B. Cause of the Systole of the Auricles and Ventricles. Proofs of its being an active effect, and dependent on the contraction of Muscular Fibres. Inquiry into the nature of the Stimulus.
   C. Reason why the Blood flows from right to left through the Heart. Mechanism of the Valves.
   D. Cause of the change of place in the Heart which accompanies each Systole of the Ventricles.

3. Estimate of the quantity of Blood expelled from the Heart at each Systole of the Ventricles.

4. Fruitless attempts to calculate the Power of the Heart.

5. Of the Inner and Outer Membranes of the Heart.

6. Of the Functions of the Pericardium.

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§ III. Circulation of the Blood through the Blood Vessels in particular, and the Actions of these Vessels.

I. Arterial Circulation.

1. Effects produced on the Arterial Circulation by each Systole of the Ventricles of the Heart.
   - A. Increase in the velocity of the Blood's motion in all the Arteries. Experiments.
   - B. Inquiry whether the Arteries be dilated or not. Experiments supposed to demonstrate the dilatation. Interesting experiments by Dr. PARRY, supposed to disprove it. Other experiments.
   - C. Inquiry whether the Arteries be elongated or not. Experiments.

2. The Causes of these Effects.
   - A. Cause of the increased velocity of the Blood.
   - B. Cause of the dilatation of the Arteries, if there be any.
   - C. Cause of the elongation of the Arteries, if there be any.

3. Powers exerted by the Arteries in moving forward the Blood, in addition to the action of the Heart.
   - A. The elasticity of the Arteries.
   - B. Inquiry whether or not the Arteries are possessed of an Irritable Power. Observations and experiments seeming to prove that they are. Inquiry into the time and manner in which the Irritable Fibres act, and into the nature of their Stimulus.

4. Comparative velocity of the Blood in different Arteries.

II. Venous Circulation.

1. Effects produced on the Venous Circulation by each Systole of the Ventricles of the Heart.
   A. Increase in the velocity of the Blood's motion in the Veins. Observations and experiments on the Human Body, and on the Lower Animals, proving this.
   B. Inquiry whether or not there be dilatation or elongation of the Veins in any circumstances.
2. Causes of these effects.
   A. Cause of the increased velocity of the Blood in the Veins.
3. Inquiry whether or not the Veins exert any power on the Blood, in addition to the action of the Heart and Arteries. Experiments.
4. Uses of the Valves of the Veins.
5. Comparative Velocity of the Blood in different Veins.
6. Comparative Velocity of the Blood in the Veins, and in the Arteries.

§ IV. Attempt to estimate the Period employed by any portion of the Blood in performing the whole Circulation.

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Sect. I.

ARTICLE II.

OF THE ARTERIAL PULSE, AS AN INDICATION OF THE STATE OF THE CIRCULATION, AND OF THE MOVING POWERS OF THE BLOOD.

§ I. The Number of the Pulse. Dependent solely on the Heart. All varieties in it indicate corresponding varieties in the action of the Ventricles of that organ. The Number of the Heart's actions in a given time, and, therefore, the Number of the Pulse, liable to increase or diminution from,

1. Increase or diminution in the Irritability of the Heart; or,
2. Increase or diminution in the Stimulant Power of the Blood; or,
3. Increase or diminution in the velocity of the Venous Circulation.

Irregularities in the Pulse, with respect to Number, of two kinds, viz. the Unequal Pulse, and the Intermittent Pulse.

1. The Unequal Pulse explained.
2. The Intermittent Pulse illustrated. Inquiry into the cause of this Irregularity.

The affection called Palpitation considered.

§ II. Of the Size or Fulness of the Pulse. This quality illustrated. Is dependent on the quantity of Blood contained in the Artery. May be increased or diminished by,

1. Increase or diminution in the Force with which the Ventricles of the Heart contract; or,
2. Increase or diminution in the Quantity of Blood expelled from the Ventricles of the Heart; or,
3. Diminution or increase of the Resisting Power of the sides of the Artery.

§ III. Of the Duration of the Pulse. This quality illustrated. Is dependent on the length of time employed by the Ventricles in contracting; and is subject to variety from all those causes which vary the duration of their Systole.

1. Increase in the Quickness of the systole of the Ventricles accompanies either increase or diminution in the Force of their action.
2. Diminution in the Quickness of the systole commonly accompanies a slow Pulse in point of number.

§ IV. Of the Strength of the Pulse. This quality illustrated. Is dependent on the impulse which the column of Blood in the Arteries receives from the influx of the contents of the Ventricles; and is, therefore, in the compound ratio

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of the Quantity of these contents, and the Velocity with which they are expelled. Consequently may be increased or diminished by,

1. Increase or diminution in the Force with which the Ventricles act simply, whether that be dependent on varieties in the Irritability of the Heart, or in the Stimulant Power of the Blood; or,

2. Increase or diminution in the Force with which the Ventricles act, accompanied with increase or diminution in the Quantity of Blood they expel.

ARTICLE III

DIFFERENCES IN THE CIRCULATION OF THE BLOOD DEPENDENT ON SEX AND AGE.

§ I. Differences dependent on Sex.

§ II. Differences dependent on Age.

ARTICLE IV.

ORIGINAL DIFFERENCES IN THE CIRCULATION OF THE BLOOD AMONG DIFFERENT INDIVIDUALS.

ARTICLE V.

DIFFERENCES IN THE CIRCULATION OF THE BLOOD IN THE SAME INDIVIDUAL AT DIFFERENT TIMES.

I. DIFFERENCES IN THE CIRCULATION THROUGH THE HEART, AND IN THE ACTIONS OF THAT ORGAN.

Organic affections being excluded, these may be referred to three classes: *first*, Differences apparently depending on varieties in the Irritability of the Heart. *Secondly*, Differences apparently depending on varieties in the Natural Stimulus of the Heart. *Thirdly*, Differences of which the Causes are doubtful.

1. *Differences apparently depending on Varieties in the Irritability of the Heart.*

§ I. The Irritability of the Heart sometimes modified by the circulation of Morbid Blood through its fibres.

§ II. The Irritability of the Heart often modified by Causes operating primarily on the Brain and Spinal Cord.

1. Causes operating on the Brain.
   A. Destruction of portions of the Brain.
   B. Unusual Compression of the Brain.

C. Concussion of the Brain.

D. Circulation of Morbid Blood.

E. Substances applied to the Brain. Experiments on the Lower Animals.

2. Causes operating on the Spinal Cord.

A. Destruction of Portions of the Spinal Cord. Experiments on the Lower Animals, by physiologists prior to HALLER; by HALLER and his Disciples; and, of late years, by LE GALLOIS and DR. PHILIP.

B. Unusual Compression of the Spinal Cord.

C. Circulation of Morbid Blood through the Arteries of the Cord.

D. Substances applied to the Spinal Cord, in experiments on the Lower Animals.

§ III. Inquiry whether the Irritability of the Heart be ever modified by Causes operating primarily on the Nerves leading to it. Experiments.

§ IV. Inquiry whether the Irritability of the Heart be ever modified by the Blood operating through its Inner Membrane, or the fluid of the Pericardium through its outer. Experiments.

§ V. The Irritability of the Heart often modified by things applied to the various Natural Surfaces of the Body.

1. Things applied to the Alimentary Canal.
   A. Substances introduced into the Stomach and Small Intestines. Various Medicines. Articles of Food. Products of Dyspepsia.
   B. Substances introduced into the Rectum and Colon.

   Inquiry how such things operate. Whether they be conveyed into the Circulation or not. Whether or not they operate through the medium of the Nervous System.

2. Things inhaled into the Lungs. Atmospherical Air impregnated with various Substances. Gases different from Atmospherical Air. Inquiry how these operate.

3. Things applied to the Skin. Tobacco. Laudanum, &c. Inquiry how these operate.

§ VI. The Irritability of the Heart modified by things applied to the Surfaces of Wounds. Experiments of FONTANA, BRODIE, &c. Inquiry into the mode of their operation.

§ VII. The Irritability of the Heart modified by Various Sensations.

1. By Sensations of Smell, in particular Individuals. Examples. The White Lily. The Rose. The Bean.

2. By the Sensations of Cold and of Heat in the Skin.

Div. I. Part II. Sect. I.

Effects of the Cold and Hot Bath on the Actions of the Heart.

3. By the Sensation of Sickness or Nausea.

4. By various species of Pain.

§ VIII. The Irritability of the Heart modified by various Trains of Ideas, or of Sensations and Ideas, during Emotion.

§ IX. The Irritability of the Heart modified by Inflammation in various parts of the Body.

§ X. The Irritability of the Heart modified by violent Voluntary Action of Muscles. Examples. Inquiry into the mode of operation.

§ XI. The Irritability of the Heart modified by Blood-letting. Inquiry into the mode of operation.

2. *Differences apparently depending on Varieties in the Natural Stimulus of the Heart.*

Assuming the Natural Stimulus of the Heart to be the Blood, its Stimulant Power may be conceived to vary, with the Degree to which it distends the cavities of the Heart; or the Force with which it distends them; or with varieties in its Composition, independent either of its Quantity or Force.

§ I. Increase or Diminution in the Irritability of the Heart lead to increase or diminution in the Stimulant Power of the Blood. Manner in which they produce this effect.

§ II. Inquiry whether the affection of the Circulation accompanying violent Voluntary Action, may not be partly owing to Quickened Circulation in the Veins.

§ III. Changes produced on the Pulse by varying the Posture of the Body. Experiments by Dr. Macdonnel, Mr. Allen, and Professor Thomson. Additional experiments. Inquiry into the cause of these changes.

§ IV. Inquiry whether Blood-letting affects the actions of the Heart, merely by Abstraction of a quantity of the Natural Stimulus.

§ V. Instances in which it is supposed that the actions of the Heart are modified by varieties in the Composition of the Blood. Great difficulties attending this subject.

3. *Differences of which the Causes are doubtful.*

§ I. The Case of the Honourable Colonel Townshend particularly considered.

Div. I. Part II. Sect. I.

§ II. The Case of the celebrated Mr. JOHN HUNTER particularly considered.

II. DIFFERENCES IN THE CIRCULATION THROUGH THE ARTERIES AND VEINS, AND IN THE ACTIONS OF THESE VESSELS.

1. *Differences in the Arterial Circulation.*

§ I. Instances of more or less Blood circulating in a particular set of Arteries at one time than at another, the actions of the Heart remaining unchanged. Inquiry into the causes of these phenomena. Reasons for believing, that the increase in the Quantity of Blood in the Arteries, in such circumstances, is owing to Diminution in the Irritability of these vessels; and the diminution in the Quantity, to increase in the Irritability. Other hypotheses.

§ II. Particular enumeration of such varieties, with their Causes.

§ III. Effect of laying bare a portion of an Artery on its diameter.

§ IV. Effect of obstructing an Arterial Trunk, on the Branches coming off above the obstruction. They enlarge, but not by an increased pressure on them.

§ V. Singular Cases of Cessation of the Pulse in particular Arteries, the Heart continuing to act as before. Possible fallacy in such cases.

2. Differences in the Venous Circulation.

§ I. Effects of Gravity on the Circulation in the Veins.

§ II. Effects of Pressure on the Circulation in the Veins.

§ III. Inquiry whether varieties of Temperature affect the Circulation in the Veins.

SECTION II.

OF THE COMPOSITION AND PROPERTIES OF THE BLOOD.

ARTICLE I.

§ I. Attempts to estimate the Total Quantity or Weight of Blood circulating in the Vascular System.

Div. I. Part II. Sect. II.

§ II. Division of the Blood into Venous and Arterial. Parts of the Circulating System in which each species is found.

§ III. Composition and Properties of the Venous Blood in particular.

1. The Colour, Opacity, Consistence, Specific Gravity, Taste, Odour, and Temperature of Venous Blood.

2. Is discovered by the microscope to consist of two parts; a Transparent Fluid, and Red Particles.

A. The Transparent Fluid of Venous Blood. Begins to suffer a species of decomposition called Coagulation, the moment it escapes from the Veins of the Living Body, and therefore cannot be examined in its natural state. Its properties judged of by an examination of the products of this decomposition. These products are Serum and Fibrin.

a. Of the Serum.

α. Its Colour, Taste, Consistence, and Specific Gravity.

β. Its proportion to the Fibrin and to the whole Blood. Experiments.

γ. Its Chemical Properties.

b. Of the Fibrin.

α. Its Colour, Consistence, and Specific Gravity.

β. Its proportion to the Serum and to the whole Blood.

γ. Its Chemical Properties.

B. The Red Particles of Venous Blood.

a. Their proportion to the Transparent Fluid in which they are immersed.

b. Their Form and Colour. The observations of Haller, Hewson, and Dr. Young.

c. Their Size.

d. Their Specific Gravity.

e. Their Structure. Various hypotheses on this subject.

f. Their Chemical Properties. Interesting experiments of Brande, Berzelius, and Vauquelin, on their Colouring Matter.

g. The Cause of their Red Colour investigated, according to the theory of Colours proposed by Kepler and Zucchius, and supported by Delaval.

3. The Specific Heat of Venous Blood. Has not been ascertained. Difficulties in ascertaining it. Attempts to ascertain it in Quadrupeds. The experiments of Crawford and Dr. Davy. Objections to these.

§ IV. Composition and Properties of the Arterial Blood in particular.

(Considered exactly according to the same Arrangement as those of the Venous Blood.)

ARTICLE II.

OF THE COAGULATION OF THE BLOOD, AND ITS CAUSES.

§ I. Preliminary remarks.

§ II. The usual progress of the Coagulation described.

§ III. Question whether during the Coagulation, as much Caloric be extricated as is sufficient to affect the thermometer. Experiments seeming to prove that there is, by Fourcroy, an Anonymous Author in Rees' Cyclopædia, Mr. Ellis, and myself. Opposite experiments by Dr. John Davy. Additional experiments by myself. Further experiments by Dr. J. Davy on the Blood of the Turtle, which appear satisfactory, and decisive of this point.

§ IV. Effects of varying the Temperature of the Blood on its Coagulation.

§ V. Influence of Atmospheric Air on the Coagulation.

§ VI. Influence of Motion and Rest on the Coagulation.

§ VII. Effects of the Admixture of various Substances with the Blood on its Coagulation.

§ VIII. Inquiry into the Causes of the Coagulation.

ARTICLE III.

DIFFERENCES IN THE COMPOSITION AND PROPERTIES OF THE BLOOD DEPENDING UPON SEX AND AGE.

§ I. Differences depending on Sex.

§ II. Differences depending on Age.

ARTICLE IV.

ORIGINAL DIFFERENCES AMONG DIFFERENT INDIVIDUALS IN THE COMPOSITION AND PROPERTIES OF THE BLOOD.

ARTICLE V.

DIFFERENCES IN THE COMPOSITION AND PROPERTIES OF THE BLOOD IN THE SAME INDIVIDUAL AT DIFFERENT TIMES.

§ I. Varieties in the Tendency of the Blood to coagulate, and their Causes.

Div. I. Part II. Sect. II.

§ II. The Buffy Coat, or Inflammatory Crust, of the Blood, and the cause of its formation.

§ III. Loss of Coagulability in the Blood, and its cause.

§ IV. Varieties in the Density of the Crassamentum.

§ V. State of the Blood in Typhus.

§ VI. State of the Blood in Scurvy.

§ VII. State of the Blood in certain Inflammatory Disorders.

§ VIII. State of the Blood in Diabetes.

ARTICLE VI.

INFLUENCE OF ALTERATIONS IN THE QUANTITY AND COMPOSITION OF THE BLOOD ON THE FUNCTIONS OF THE BODY.

§ I. Effects of varying the quantity of the Circulating Blood.

§ II. The effects of the Transfusion of Blood from a Quadruped into the Human Body, and from one Animal into another.

§ III. Experiments on Man and the Lower Animals, in which Substances were mingled directly with the Circulating Blood.

§ IV. Effects of Alterations in the Blood, supposed to be produced by Absorption of Substances from Natural Surfaces.

§ V. Effects of Alterations in the Blood, supposed to be produced by the Introduction of Substances from the Surfaces of Wounds.

§ VI. Effects of Alterations in the Blood, produced by Imperfect Respiration.

SECTION III.

OF THE CHANGES WHICH THE BLOOD UNDERGOES DURING ITS CIRCULATION.

Division of the Subject. 1. Part of the Blood is abstracted from the Circulation, and converted into New Substances. 2. It undergoes Alterations of Colour. 3. It suffers Changes with respect to Heat.

Div. I. Part II. Sect. III.

I. OF SECRETION, OR THE ABSTRACTION OF PART OF THE BLOOD FROM THE CIRCULATION, AND ITS CONVERSION INTO NEW SUBSTANCES.

ARTICLE I.

§ I. Proofs that there is a Continual Abstraction of part of the Blood going on, and Conversion of it into New Substances.

§ II. Secretion the general name for this Process. The Process of two kinds, Nutritive and Excretive.

§ III. Inquiry into the Channel by which the Blood passes off from the Circulation in Secretion.

1. Reasons for believing, that in all Secretions the Blood passes off through Capillary Arteries. Doubts with respect to the Liver alone.
2. Inquiry into the Manner in which the Blood passes off by the Capillary Arteries.
   - A. In Nutritive Secretion.
     - *a.* Theory of Nutrient Vessels.
     - *b.* Theory of Lateral Pores ingeniously maintained by MASCAGNI.
   - B. In Excretive Secretion.
     - *a.* Excreting Organs divisible into Three Classes.

1. Those in which the Excreted Substances are poured out through a Tube or Tubes, formed like a Vein by the union of lesser tubes within the substance of the Organ. Ex. The Lachrymal Gland; the Parotid, Submaxillary, and Sublingual Glands; the Liver; the Pancreas; the Kidneys; the Testes; the Prostate Gland; Cowper's Glands; and the Mammæ.
2. Those in which the Excreted Substances escape by Pores of various sizes, the communications of which, within the Organ, are not known. Ex. The Skin; the Meibomian Glands, and Caruncula Lachrymalis; the Ceruminous Glands; the Labial, Buccal, Lingual, Palatine, Laryngeal, and Pharyngeal Glands; the Tonsils; and the Glands of the Alimentary Canal. 3. Those in which the excreted substances cannot be perceived to escape either through Tubes or Pores. Ex. Serous Membranes; Synovial Membranes; Membranes of Internal Canals and Passages; Arachnoid Membrane; Surface of the Ventricles of the Brain; Parts secreting the Humours of the Eye; Parts secreting the Fluids of the Labyrinth; the Air-cells of the Lungs; the Thymus Gland; the Renal Capsules; and the Ovarian Vesicles.

b. Inquiry into the manner in which the Blood is conveyed from the Capillary Arteries in each of these three classes of Organs.

Div. I. Part II. Sect. III.

§ IV. Inquiry into the Nature and Causes of the Conversion which the Blood, removed from the Circulation, undergoes.

1. Inquiry into the point at which the Conversion begins.

2. Proof that the Conversion is, in every instance, a Chemical Change, not a Mechanical Straining.

3. The Causes of this Chemical Change.

   A. The species of Blood generally destined for this purpose is Arterial. Exceptions, real or probable, in the Lungs and Liver.

   B. The Chemical Change is produced by the Addition of something to the Blood, or the Abstraction of something from it, or by both ; but by which is not known.

   C. Various unsatisfactory hypotheses ascribing the change to the operation of Electricity, Nervous Influence, a principle called the Vital Principle, &c. briefly noticed.

ARTICLE II.

DIFFERENCES IN SECRETION DEPENDENT ON SEX AND AGE.

ARTICLE III.

ORIGINAL DIFFERENCES IN SECRETION AMONG DIFFERENT INDIVIDUALS.

ARTICLE IV.

DIFFERENCES IN SECRETION IN THE SAME INDIVIDUAL AT DIFFERENT TIMES.

Preliminary remarks on the use of the terms Stimulant and Sedative, as applied to Secreting Organs; and on the state called Inflammation.

§ I. Secretion often modified by Agents operating directly on the Secreting Part. Examples.

§ II. Secretion modified by Causes operating on the Nerve leading to the Secreting Part.

§ III. Secretion modified by Causes operating on the Brain or Spinal Cord.

1. Causes operating on the Brain.
2. Causes operating on the Spinal Cord.

§ IV. Secretion in a part often modified by a Particular Sensation in a part distant from it, or by the Idea of that Sensation. Examples.

§ V. Secretion often modified by certain Trains of Ideas, or of Sensations and Ideas; as during Emotion. Examples. Animal Magnetism.

Div. I. Part II. Sect. III.

§ VI. Secretion often modified by substances applied to the various Natural Surfaces of the Body.

1. Substances applied to the surface of the Alimentary Canal. Effects of Sudorifics, Expectorants, Diuretics, Purgatives, Stimulants, Sedatives, Mercury, &c., when swallowed or injected, on the Secretions of various parts. Question how these Substances operate. Whether by being absorbed and mixed with the Blood,—or through the medium of the Nervous System,—or partly in the one mode and partly in the other.

2. Substances inhaled into the Lungs. Effects of the Effluvia or Vapours of various articles of the Materia Medica, such as Stimulants, Sedatives, Purgatives, Mercury, &c. Effects of respiring a confined Atmosphere. Effects of Vegetable Miasmata. Effects of Contagious Effluvia. Question how all these operate. Whether by being absorbed, or through the medium of the Nervous System.

3. Substances applied to the surface of the Skin. Mercury, Diluted Acids, Purgative Medicines, &c. Question how they operate. Whether by being absorbed, or through the medium of the Nervous System.

§ VII. Secretion often modified by Substances applied to the Surfaces of Wounds.

1. Animal Substances.

A. Derived from the Human Body. Inoculation of Variolous and Vaccine Matter. Syphilitic Matter, &c. Question how these operate. Whether by being conveyed into the Circulation, or through the medium of the Nervous System.

B. Derived from the Lower Animals. Various Poisons.

2. Vegetable Substances. Various Poisons.

3. Mineral Substances.

§ VIII. Modifications of Secretion depending upon Causes not known.

II. OF THE CHANGES OF COLOUR WHICH THE BLOOD UNDERGOES DURING ITS CIRCULATION.

§ I. Statement of the Points ascertained on this subject.

§ II. Reasons for deferring the consideration of the Causes of the Changes of Colour till Respiration.

III. OF THE CHANGES WITH RESPECT TO HEAT WHICH THE BLOOD UNDERGOES DURING ITS CIRCULATION.

§ I. Our knowledge on this subject very limited. Experiments on the Lower Animals.

§ II. Reasons for deferring the farther consideration of the subject till Respiration.

PART III.

OF THE FUNCTIONS IN GENERAL OF THE ABSORBENT SYSTEM.

Div. I. Part III. Sect. I.

PRELIMINARY Observations. Arrangement of the Subject. 1. The Course of the Lymph, and the Powers which move it. 2. The Composition and Properties of the Lymph. 3. The Sources from which the Elements of the Lymph are derived; the Manner of their Introduction into the Absorbent Vessels; and their subsequent Chemical Changes. 4. The Functions of the Absorbent and Circulating Systems reciprocally considered.

SECTION I.

OF THE COURSE OF THE LYMPH, AND THE POWERS WHICH MOVE IT.

ARTICLE I.

§ I. Observations and experiments, by which the flow of the Lymph from the Branches to-

wards the Trunks of the Absorbent Vessels is demonstrated.

§ II. The Velocity with which the Lymph moves.

§ III. The Powers which move it not known. Opinions on this subject.

1. Hypothesis that Elasticity of the Vessels is the power, disproved.

2. Hypothesis that the power is Irritability of the Vessels, examined. Experiments by SCHREGER, SHELDON, HALLER, HEWSON, HUNTER, CRUIKSHANK, MASCAGNI, BICHAT, FLANDRIN, MAGENDIE, and myself.

ARTICLE II.

DIFFERENCES IN THE FLOW OF THE LYMPH DEPENDENT UPON DIFFERENT CIRCUMSTANCES.

Whether there be any differences in the flow of the Lymph dependent upon Age, Sex, or Original Constitution, or in the same Individual at Different Times, has not been ascertained.

SECTION II.

OF THE COMPOSITION AND PROPERTIES OF THE LYMPH.

ARTICLE I.

§ I. Division of the Lymph into White or Lacteal, and Colourless. Where, and in what circumstances, each kind is to be found.

§ II. Of the White or Lacteal Lymph in particular.

1. Its Colour, Consistence, Taste, Specific Gravity.
2. Discovered by the miscroscope to consist of a Transparent Fluid and small White Particles immersed in it.
   - A. Of the Transparent Fluid. Undergoes a Decomposition similar to the Coagulation of the Blood, as soon as it escapes from the Vessels. Therefore cannot be examined in its natural state. Products of the Coagulation.
     - *a.* The Coagulum. Experiments of BRANDE, VAUQUELIN, EMMERT, and MARCET.
     - *b.* The Serum. Experiments of FORDYCE, BRANDE, VAUQUELIN, EMMERT, and MARCET.

B. Of the White Particles. Microscopical observations of FORDYCE and CRUIKSHANK. Chemical Experiments of MARCET.

§ III. Of the Colourless Lymph.

1. Its Transparency, Consistence, Specific Gravity, &c. Observations of MAGENDIE.

2. Said by HEWSON to consist of Colourless Particles and a Colourless Fluid. But doubtful.

3. Coagulates on being withdrawn from the Vessels like the White Lymph. The Products of the Coagulation.

   A. The Coagulum. Observations by MAGENDIE.

   B. The Serum.

4. Analysis of the whole Lymph by CHEVREUL.

ARTICLE II.

OF THE COAGULATION OF THE LYMPH, AND ITS CAUSES.

ARTICLE III.

DIFFERENCES IN THE COMPOSITION AND PROPERTIES OF THE LYMPH IN DIFFERENT CIRCUMSTANCES.

Nothing known on this subject, excepting the results of a few interesting experiments, by MARCET and MAGENDIE, on the Lymph of Quadrupeds.

SECTION III.

OF THE SOURCES FROM WHICH THE ELEMENTS OF THE LYMPH ARE DERIVED; THE MANNER OF THEIR INTRODUCTION INTO THE ABSORBENT VESSELS; AND THEIR SUBSEQUENT CHEMICAL CHANGES.

ARTICLE I.

OF THE SOURCES OF THE LYMPH.

§ I. The Elements of the Lymph derived from two kinds of Matter: 1. Matter which has already formed a part of the Body; and, 2. Foreign Matter, or Matter introduced into the System for the first time.

§ II. The first kind of Matter consists either of Particles of the Internal Substance of the different vascular parts of the Body, or of Substances which have been Excreted. The second kind, or Foreign Matter, is introduced by the Alimentary Canal and Lungs. Whether or not by the Skin is doubtful.

Ancient opinion revived, and defended with great in-

genuity, by MAGENDIE, that the Lacteal Lymph alone is absorbed by Absorbent Vessels; that the Vessels which contain the Colourless Lymph possess no absorbent power, but take their origin from the terminations of Arteries; that the Colourless Lymph is a part of the Blood returning to the Heart by these Vessels instead of the Veins; and, finally, that all the absorptions hitherto ascribed to these Vessels, are performed by Capillary Veins. Objections to this doctrine.

ARTICLE II.

OF THE MANNER IN WHICH THE ELEMENTS OF THE LYMPH ARE INTRODUCED INTO THE ABSORBENT VESSELS.

§ I. Commencements of Absorbent Vessels seen only in the Intestinal Canal, but presumed to be similar in other parts.

§ II. Reason of the entrance of the Lymph into these Commencements not known. Opinions on this subject.

1. Hypothesis that the Mouths of the Vessels have a Power of Selection. Experiments of LOWER, WINTERBOTTOM, CRUIKSHANK, and SCHREGER.

Div. I. Part III. Sect. IV.

2. Hypothesis that the Lymph enters by Capillary Attraction.

§ III. Instances of supposed Increase or Diminution in the Absorption of a Part examined. Doubts and fallacies attending all such.

ARTICLE III.

OF THE CHEMICAL CHANGES WHICH THE LYMPH UNDERGOES DURING ITS COURSE.

On this subject nothing ascertained. Opinions. Use of the Absorbent Glands.

ARTICLE IV.

THE FUNCTIONS OF THE ABSORBENT AND CIRCULATING SYSTEM RECIPROCALLY CONSIDERED.

§ I. Waste of Blood by Excretion repaired by Absorption of Foreign Matter.

§ II. Waste of Blood demonstrated by continual addition of Foreign Matter without accumulation.

§ III. Continual Nourishment of Parts demonstrated, by constant Absorption from them without diminution. According to the proportion between the Action of Deposition and the Action of Absorption, there is Growth, or Wasting, or Permanency of Bulk in the Part.

§ IV. Existence of Absorbents in a Part inferred, though not seen, from existence of Blood Vessels in that Part.

PART IV.

OF THE FUNCTIONS IN GENERAL OF CELLULAR SUBSTANCE.

Div. I. Part IV.

§ I. Its Sensibility. Its Secretions. Its Absorptions. Its Uses.

§ II. Differences in its Functions in Different Circumstances.

PART V.

OF THE FUNCTIONS IN GENERAL OF ADIPOSE SUBSTANCE.

Div. I. Part V.

§ I. Its Sensibility. Its Secretions. Its Absorptions. Its Uses.

§ II. Differences in its Functions in Different Circumstances.

PART VI.

OF THE FUNCTIONS IN GENERAL OF THE SKIN.

Div. I. Part VI. Sect. I.

ARRANGEMENT of the Subject. 1. The Sensations of the Skin. 2. Insensible Impressions on the Skin. 3. The Nourishment of the Skin. 4. The Excretions from the Surface of the Skin. 5. The Absorptions from the Surface of the Skin.

SECTION I.

OF THE SENSATIONS OF THE SKIN.

Division of the Subject. 1. Sensations of Touch. 2. Sensations of Pain. 3. Sensations of Heat and Cold. 4. Sensations of Itching. 5. Sensations accompanying certain Emotions. 6. Certain Anomalous Sensations.

I. OF THE SENSATIONS OF TOUCH.

Div. I. Part VI.
Sect. I.

ARTICLE I.

§ I. Qualities of the Sensations of Touch.

1. Intensity.
2. Position.
3. Magnitude.
4. Form.

§ II. Causes of the Sensations of Touch. Preceded by Pressure on the Skin. More not known. Proof that the Cuticle is not concerned.

§ III. Circumstances on which the Qualities of Touch depend.

§ IV. Judgments formed from Sensations of Touch of the Hardness, Size, Form, &c. of Bodies.

ARTICLE II.

DIFFERENCES IN TOUCH DEPENDENT ON SEX AND AGE.

§ I. Differences dependent on Sex.

§ II. Differences dependent on Age.

ARTICLE III.

ORIGINAL DIFFERENCES IN TOUCH AMONG DIFFERENT INDIVIDUALS.

These more rare than some have imagined. Alleged remarkable instances of this kind examined.

ARTICLE IV.

DIFFERENCES IN TOUCH IN THE SAME INDIVIDUAL AT DIFFERENT TIMES.

§ I. Sensibility to Touch often modified by Causes operating directly on the Skin.

1. Effects of Violent Pressure.
2. Effects of varying the Temperature of the Skin.
3. Effects of different Species of Inflammation in the Skin.
4. Effects of certain Drugs.

§ II. Sensibility to Touch in a Part often modified by Causes operating primarily on the Nerve leading to the Part.

1. Effects of Compression of the Nerve.
2. Effects of Destruction of a part of the Nerve.

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§ III. Sensibility to Touch often modified by Causes operating primarily on the Brain and Spinal Cord.

1. Causes operating primarily on the Brain.
2. Causes operating primarily on the Spinal Cord.

§ IV. Sensibility to Touch sometimes modified by Substances applied to the other Natural Surfaces of the Body.

1. Substances applied to the Alimentary Canal.
2. Substances inhaled into the Lungs.

§ V. Sensibility to Touch sometimes modified in a manner unknown, during Disease.

ARTICLE V.

INFLUENCE OF SENSATIONS OF TOUCH IN THE SKIN ON THE FUNCTIONS OF OTHER PARTS.

Inquiry how far the effects of Friction and Pressure, in the cure of Local Disease, are owing to the Sensations of Touch they produce.

II. OF THE SENSATIONS OF PAIN.

ARTICLE I.

Observations on the variety of these Sensations. Their Qualities. Their Causes.

ARTICLE II.

DIFFERENCES IN THE SENSIBILITY OF THE SKIN TO PAIN IN DIFFERENT CIRCUMSTANCES.

All those Causes which modify the Sensibility of the Skin to Touch, seem also to modify its Sensibility to Pain at same time, and in a similar manner. Remarkable case by Dr. YELLOLY. Case with some peculiarities, by Dr. VIEUSSIEUX.

ARTICLE III.

INFLUENCE OF SENSATIONS OF PAIN IN THE SKIN ON THE OTHER FUNCTIONS OF THE BODY.

III. OF THE SENSATIONS OF HEAT AND COLD.

ARTICLE I.

§ I. Qualities of these Sensations.

§ II. Causes of them.

ARTICLE II.

DIFFERENCES IN THE SENSIBILITY TO HEAT AND COLD IN DIFFERENT CIRCUMSTANCES.

§ I. All those Causes which modify the Sensibility of the Skin to Touch and Pain, seem also to modify its Sensibility to Heat and Cold at same time, and in a similar manner. Cases by Dr. YELLOLY and others.

§ II. Some singular modifications of the Sensibility to Heat and Cold. Case of Dr. VIEUSSIEUX.

ARTICLE III.

INFLUENCE OF SENSATIONS OF HEAT AND COLD IN THE SKIN ON THE OTHER FUNCTIONS OF THE BODY.

§ I. Influence of these Sensations on Sensibility in general.

§ II. Influence of these Sensations on the Train of Thought.

§ III. Influence of these Sensations on Muscular Actions.

§ IV. Influence of these Sensations on Sleep.

§ V. Influence of these Sensations on Emotion.

§ VI. Influence of these Sensations on the Circulation of the Blood.

§ VII. Cases and experiments illustrating the influence of these Sensations on all these Functions together.

Excursion of Dr. SOLANDER and Sir JOSEPH BANKS into Terra del Fuego. Very instructive Case by Dr. KELLIE of Leith. Observations by SAUSSURE. Cases and experiments by Dr. CURRIE. Experiments of Sir C. BLAGDEN, Dr. FORDYCE, and Dr. DELAROCHE.

IV. OF THE SENSATIONS OF ITCHING.

ARTICLE I.

§ I. Observations on the Nature and Causes of these Sensations.

ARTICLE II.

DIFFERENCES IN THE SENSATIONS OF ITCHING IN DIFFERENT CIRCUMSTANCES.

ARTICLE III.

INFLUENCE OF THE SENSATIONS OF ITCHING ON OTHER FUNCTIONS OF THE BODY.

V. OF SENSATIONS ACCOMPANYING CERTAIN EMOTIONS.

§ I. Peculiar Sensation accompanying the Emotion of Sublimity.

§ II. Inquiry into its Causes. Is accompanied with the appearance called Cutis Anserina.

VI. OF CERTAIN ANOMALOUS SENSATIONS.

SECTION II.

OF INSENSIBLE IMPRESSIONS ON THE SKIN.

Preliminary Remarks. These Impressions are indicated by the Effects which they produce on the Functions of other Parts.

§ I. Effects of Tobacco applied to the Skin.

§ II. Effects of the application of Opium.

SECTION III.

OF THE NOURISHMENT OF THE SKIN.

ARTICLE I.

§ I. Nourishment of the Cutis Vera.

§ II. Formation of the Cuticle and Nails.

ARTICLE II.

DIFFERENCES IN THE NOURISHMENT OF THE SKIN IN THE SAME INDIVIDUAL AT DIFFERENT TIMES.

§ I. Differences produced by Causes operating directly on the Skin. Ex. Sun's Rays. Heat. Pressure. Various Drugs.

§ II. Differences produced over the Whole Skin, by Inoculation with Substances at one point.

§ III. Differences produced by Substances introduced into the Alimentary Canal, or inhaled into the Lungs.

§ IV. Differences depending on Causes not known.

SECTION IV.

OF THE EXCRETIONS FROM THE SURFACE OF THE SKIN.

Arrangement of the Subject. 1. The Excretion of the Sweat. 2. The Excretion of a Peculiar Oily Matter. 3. The Excretion of Sebaceous Matter into the Cutaneous Follicles. 4. Excretions supposed to take place from the Skin, but not established.

I. OF THE EXCRETION OF THE SWEAT.

ARTICLE I.

§ I. Composition and Properties of the Sweat. Experiments of THENARD and BERZELIUS.

§ II. Manner in which the Sweat appears on the surface of the Skin. Observations by LEEUWENHOECK.

§ III. Proofs that the Secretion of the Sweat is continual. Is only rendered Imperceptible from the solution of its Watery Part in the Air. Interesting experiments, first made by LEEUWENHOECK, LISTER, KAAN, and BOERHAAVE. No dis-

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tinction between Sensible and Insensible Perspiration. Conjecture of BOERHAAVE's confirmed by the French Mathematicians at Torneo; by Dr. SOMERVILLE in Canada; and by Dr. FERGUSON in St. Petersburgh.

§ IV. The Quantity of Sweat secreted in a given time. Difficulty of ascertaining this. Experiments of SEGUIN and LAVOISIER.

§ V. In what manner the Sweat is secreted. The Cuticle not concerned in its formation. By what Vessels of the Cutis Vera not known. How conveyed to the External Surface. Hypotheses.

§ VI. Uses of the Excretion of the Sweat. Its cooling effect. Experiments of Sir CHARLES BLAGDEN, Dr. FORDYCE, and Dr. DELAROCHE.

ARTICLE II.

DIFFERENCES IN THE EXCRETION OF SWEAT DEPENDING ON SEX AND AGE.

ARTICLE III.

ORIGINAL DIFFERENCES AMONG DIFFERENT INDIVIDUALS IN THE EXCRETION OF SWEAT.

ARTICLE IV.

DIFFERENCES IN THE EXCRETION OF SWEAT IN THE SAME INDIVIDUAL AT DIFFERENT TIMES.

§ I. The Excretion of Sweat modified by Causes operating directly on the Skin.

1. Effects of varying the Temperature of the Skin on the Excretion of the Sweat.
2. Effects of Friction.
3. Effects of Oily Inunctions.

§ II. The Excretion of the Sweat modified by certain Sensations.

§ III. The Excretion of the Sweat modified by certain Trains of Ideas, or of Ideas and Sensations, during Emotion.

§ IV. The Excretion of the Sweat modified by Voluntary Muscular Actions.

§ V. The Excretion of the Sweat modified by Substances operating primarily on the Alimentary Canal or Lungs.

1. Effects of Substances operating primarily on the Alimentary Canal.
   A. Effects of Agents called by writers on the Materia Medica Sudorifics.

B. Effects of Antisudorifics.

C. Effects of Mal-digested Food.

2. Effects of Substances operating primarily on the Lungs.

§ VI. The Excretion of the Sweat modified in a manner unknown, in a variety of Diseases.

ARTICLE V.

INFLUENCE OF THE EXCRETION OF THE SWEAT ON THE OTHER FUNCTIONS OF THE BODY.

§ I. Influence of the Excretion of Sweat on the Sensibility to Pain.

§ II. Supposed influence of the Excretion of Sweat on the Nourishment of the Adipose Substance.

§ III. Influence of the Excretion of Sweat on the Alimentary Function.

§ IV. Influence of the Excretion of the Sweat on the Urinary Function.

§ V. Ill effects attributed to the Sudden Checking of the Excretion of the Sweat.

II. OF THE EXCRETION OF A PECULIAR OILY MATTER.

ARTICLE I.

§ I. Proofs of the existence of this Excretion.

§ II. Properties of the Oily Matter.

§ III. Inquiry into the Manner of its Formation.

ARTICLE II.

DIFFERENCES IN THE EXCRETION OF OILY MATTER IN DIFFERENT CIRCUMSTANCES.

III. OF THE EXCRETION OF SEBACEOUS MATTER INTO THE CUTANEOUS FOLLICLES.

ARTICLE I.

§ I. Properties of the Sebaceous Matter.

§ II. Manner in which it is formed.

ARTICLE II.

DIFFERENCES IN THE EXCRETION OF THE SEBACEOUS MATTER IN DIFFERENT CIRCUMSTANCES.

Div. I. Part VI. Sect. IV.

IV. EXCRETIONS SUPPOSED TO TAKE PLACE FROM THE SKIN, BUT NOT ESTABLISHED.

§ I. Supposed Excretion of various Elastic Gases.

1. Of Carbonic Acid Gas, Nitrogen Gas, and Carbonic Acid and Nitrogen Gas; by the COUNT DE MILLY, INGENHOUZ, JURINE, ABERNETHY, and TROUSSET.
2. Objections to these Hypotheses.
3. Experiments seeming to disprove the existence of any Excretion of this Nature; by Dr. KLAPP, PRIESTLY, GATTONI, and myself.

§ II. Supposed Excretion of Carbonaceous Matter, which afterwards combines with the Oxygen of the Atmosphere to form Carbonic Acid Gas.

1. Experiments by CRUIKSHANK, Dr. MACKENZIE, and Mr. ELLIS, in support of this Hypothesis.
2. Experiments of PRIESTLY and others, unfavourable to it.

SECTION V.

OF THE ABSORPTIONS FROM THE SURFACE OF THE SKIN.

§ I. Observations and experiments which seem to disprove the occurrence of Absorption from the Surface of the Skin.

1. Observations and Experiments by Dr. KLAPP, ROSSEAU, DANGERFIELD, CHAPMAN, and myself.
2. Observations and experiments by SEGUIN, CURRIE, and GERARD. These, however, equivocal.

§ II. Observations and experiments adduced in support of the opinion, that there is Absorption from the Surface of the Skin.

1. Observations and experiments by KEIL, HALLER, PERCIVAL, HOME, CRUIKSHANK, WATSON, FORD, ABERNETHY, and KELLIE.
2. Interesting experiments recently made by Dr. N. YOUNG.

PART VII.

OF THE FUNCTIONS IN GENERAL OF HAIR.

Div. I. Part VII. § I. The Sensibility of Hair. The Nourishment of Hair. The Uses of Hair.

§ II. Differences in the Functions of Hair in different circumstances.

PART VIII.

OF THE FUNCTIONS IN GENERAL OF CARTILAGE.

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§ I. The Sensibility of Cartilage. Its Nourishment. Its Uses.

§ II. Differences in the Functions of Cartilage in different circumstances.

PART IX.

OF THE FUNCTIONS IN GENERAL OF OSSEOUS SUBSTANCE, OR BONE.

ARTICLE I.

§ I. The Sensibility of Bone.

§ II. The Nourishment of Bone. Experiments with Madder Root on the Lower Animals. Ingenious hypothesis founded on these experiments by Professor RUTHERFORD. Different hypothesis by Mr. GIBSON, but not satisfactory. Experiments of Dr. DICK.

§ III. Uses of Bone in general.

ARTICLE II.

DIFFERENCES IN THE FUNCTIONS OF BONE DEPENDENT ON AGE.

§ I. Manner in which Bone is formed.

§ II. Causes of the Change in the constitution of Bone in Old Age.

Div. I. Part X.

ARTICLE III.

MODIFICATIONS IN THE FUNCTIONS OF BONE INDEPENDENT OF AGE.

PART X.

OF THE FUNCTIONS IN GENERAL OF TENDINOUS SUBSTANCE.

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§ I. The Sensibility of Tendinous Substance. Its Nourishment. Its Uses.

§ II. Differences in the Functions of Tendinous Substance in different circumstances.

PART XI.

OF THE FUNCTIONS IN GENERAL OF SEROUS MEMBRANE.

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§ I. Its Sensibility. Circumstances modifying it.

§ II. Its Nourishment. Circumstances modifying it.

§ III. Its Excretion.

1. Properties and Composition of the Serous Fluid.
2. Manner of its Formation.
3. Circumstances modifying the Excretion.

§ IV. Absorption from its surface. Circumstances modifying it.

§ V. Its Uses in general.

PART XII.

OF THE FUNCTIONS IN GENERAL OF SYNOVIAL MEMBRANE.

Div. I. Part XII.

§ I. Its Sensibility. Circumstances modifying it.

§ II. Its Nourishment. Circumstances modifying it.

§ III. Its Excretion.

1. Composition and Properties of the Synovia.
2. Manner of its Formation.
3. Circumstances modifying the Excretion.

§ IV. Absorption from its Surface. Circumstances modifying it.

§ V. Its Uses in general.

SECOND DIVISION.

SECOND DIVISION.

OF THE FUNCTIONS OF THE SKELETON IN GENERAL, AND OF ATTITUDE AND PROGRESSION.

THIS DIVISION comprehends Two Parts. The First Part treats of the Bones in general, during their Living State; and the Second, of the various Motions of which the different Parts of the Skeleton are susceptible, and the Muscles which produce them.

PART I.

OF THE BONES IN GENERAL DURING THEIR LIVING STATE.

Arrangement of the Subject. 1. Of the Osseous Substance of the Bones. 2. Of the Mar-

row of the Bones. 3. Of the Periosteum of the Bones. 4. Of the Connections of the Bones.

SECTION I.

OF THE OSSEOUS SUBSTANCE OF THE BONES.

ARTICLE I.

Advantages resulting from the Form of the Osseous Substance of the Bones in different parts of the Skeleton.

ARTICLE II.

THE OSSEOUS SUBSTANCE OF THE BONES AT DIFFERENT PERIODS OF LIFE.

§ I. The Growth of the Osseous Substance.

§ II. Changes which the Osseous Substance undergoes after Maturity.

ARTICLE III.

DIFFERENCES IN THE OSSEOUS SUBSTANCE OF THE BONES IN THE SAME INDIVIDUAL AT DIFFERENT TIMES.

Observations on Morbid Enlargement of the Osseous Substance with and without Inflammation. On Sloughing of the Osseous Substance. On Ulceration of the Osseous Substance. On Necrosis. On Rickets. On Mollities Ossium. On Fracture.

SECTION II.

OF THE MARROW OF THE BONES.

§ I. The Sensibility of the Marrow. Its Nourishment. Its Uses.

§ II. Differences in its State in different circumstances.

Div. II. Part I. Sect. III.

SECTION III.

OF THE PERIOSTEUM OF THE BONES.

§ I. Periosteum possesses all the Living Properties of Tendinous Substance. Its Uses.

§ II. Differences in its State in different circumstances. Its connection with the Osseous Substance and Marrow.

SECTION IV.

OF THE CONNECTIONS OF THE BONES.

ARTICLE I.

OF THE MOVEABLE CONNECTIONS.

First Species of Moveable Connection, viz. Joint or Articulation.

§ I. Cartilages of Joints. Their Uses. Question whether they excrete Synovia.

§ II. Ligaments of Joints. Their Uses. Question whether some of them do not excrete Synovia.

§ III. Synovial Membrane of Joints. Its Use.

§ IV. Motions of Joints. Divisible into Two Species, viz. Revolving and Sliding. Examples.

*Second Species of Moveable Connection.**

Properties of the Intermediate Flexible Substance.

ARTICLE II.

OF THE IMMOVEABLE CONNECTIONS.

A few remarks on the Strength of these Connections.

* See System of Anatomy, Vol. I. Part II.

PART II.

OF THE VARIOUS MOTIONS OF WHICH THE DIFFERENT PARTS OF THE SKELETON ARE SUSCEPTIBLE, AND THE MUSCLES WHICH PRODUCE THEM.

Div. II. Part II. Sect. I.

Division of the Subject. 1. Motions of the Head, and Muscles producing them. 2. Motions of the Trunk, and Muscles producing them. 3. Motions of the Extremities, and Muscles producing them.

SECTION I.

OF THE MOTIONS OF THE HEAD, AND THE MUSCLES PRODUCING THEM.

§ I. Of Flexion of the Head, and the Muscles producing it.

§ II. Of Extension of the Head, and the Muscles producing it.

SECTION II.

OF THE MOTIONS OF THE TRUNK, AND THE MUSCLES PRODUCING THEM.

§ I. Of the Rotatory and Twisting Motions of the Trunk, and the Muscles producing them.

1. The Rotatory Motion. Limited to the Atlas.
2. The Twisting Motion.

§ II. Of the Flexion of the Trunk, and the Muscles producing it.

1. Of the Flexion Forwards.
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3. Of the Flexion Laterally.

§ III. Use of the Trunk as a Pillar of Support.

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SECTION III.

OF THE MOTIONS OF THE EXTREMITIES, AND THE MUSCLES PRODUCING THEM.

ARTICLE I.

OF THE MOTIONS OF THE UPPER EXTREMITIES, AND THE MUSCLES PRODUCING THEM.

§ I. Motions of the different Parts of the Upper Extremities separately.

§ II. Prehension.

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OF THE MOTIONS OF THE LOWER EXTREMITIES, AND THE MUSCLES PRODUCING THEM.

§ I. Motions of the different Parts of the Lower Extremities separately.

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THIRD DIVISION.

THIRD DIVISION.

OF VISION; HEARING; RESPIRATION; THE ALIMENTARY FUNCTION; THE URINARY FUNCTION; AND THE GENERATIVE FUNCTION.

THIS Division comprehends Six Parts;—One corresponding to each of the Subjects mentioned in the Title.

PART I.

OF VISION.

Arrangement of the Subject. 1. Functions of the Eye-Ball. 2. Functions of the Appendages of the Eye.

SECTION I.

FUNCTIONS OF THE EYE-BALL.

Div. III. Part I. Sect. I.

ARTICLE I.

§ I. Qualities of Sensations of Light.

a. Intensity, or Brightness.
b. Colour, or Hue.
c. Direction, or Position.
d. Magnitude, Extent, or Size.
e. Figure, Shape, or Form.

§ II. Causes of Sensations of Light.

1. Facts from which the Inference has been made, that they depend, in the first instance, on some Effect produced on the Retina by an Agent or Matter called Light, which is Propagated from Bodies denominated Luminous to that Membrane.

2. Nature of the Effect produced on the Retina not known. Similar Effects produced by Pressure, Galvanism, &c. Permanency of the Effect. Ocular Spectra. Experiments of D'Arcy, Darwin, &c.

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§ III. Effects produced on the Rays of Light

by the Transparent Parts of the Eye, in their Progress through these Parts to the Retina.

1. Effects produced by the Cornea.
2. Effects produced by the Aqueous Humour.
3. Effects produced by the Chrystalline Humour, or Lens.
4. Effects produced by the Vitreous Humour.
5. Total Effect produced by the Transparent Parts. Proofs that it is similar to what a Double Convex Lens of Glass would produce; and, therefore, that an Inverted Image will be formed on the Retina, of Objects placed at a certain distance from the Eye. Experiments on the Dead Eye by SCHEINER, MAGENDIE, &c.
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§ IV. Proof, that what we call Distinct Vision of an Object is owing to a Distinct Image of that Object being formed on the Retina. Insufficiency of the common demonstration of this Point, which was first proposed by MAUROLYCUS and KEPLER.

§ V. Advantages resulting from the peculiar Structure, Form, Position, &c. of the Transparent Parts of the Eye and Retina.

1. Advantages resulting from the Structure, &c. of the Cornea.

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2. Advantages resulting from the Structure, &c. of the Aqueous Humour.

3. Advantages resulting from the Structure, &c. of the Lens. Question whether or not the Eye be Achromatic. Experiments and arguments of MASKELYNE, WOLLASTON, and Dr. YOUNG, on the one hand; and of HALDAT, &c. on the other.

§ VI. Of the Sphere of Vision, when the Eye-Ball is fixed.

1. The Sphere of General Vision. Observations of Dr. YOUNG.

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SOEMMERRING's discovery of a Small Hole in the centre of the Retina. Inquiry why this Hole does not cause the Sensation of a Black Spot on Luminous Objects.

MARIOTTE's curious discovery of what he called an Insensible Spot in the Retina, corresponding to the entrance of the Optic Nerve. Experiments by which it is demonstrated. Proofs that this Spot is not Insensible.

§ VII. Motions of the Eye-Ball, and Muscles producing them.

§ VIII. Adaptation of the Eye for the Distinct Vision of Objects at different Distances.

1. Distance from the Eye at which the Power of Seeing Objects distinctly commences.

2. Proofs that for the distinct Vision of Objects, placed at different Distances, within a range of from six inches to two and a half feet from the Eye, this Organ changes its State. This range may be called the Range of Adaptation.

3. Inquiry into the Nature of the Change causing the Adaptation.

A. Proofs that it is dependent on the Will.

B. Three General Modes in which the Adaptation may be produced. 1. By a Change in the Relative Distance of the Transparent Parts of the Eye from the Retina. 2. By an Increase or Diminution in the Refractive Powers of these Parts without Change of Distance. 3. By a Combination of these two Changes.

a. By a Change in the Relative Distance of the Transparent Parts from the Retina. Examples. Hypotheses of PORTERFIELD, OLBERS, HOME, RAMSDEN, and HOSACK.

b. By a Change in the Refractive Powers of the Transparent Parts. Examples. Opinion of Dr. YOUNG.

c. By a Combination of these two Modes. Examples.

§ IX. Secretion, Nourishment, &c. of the Humours of the Eye.

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§ X. Nourishment, Sensibility, &c. of the Retina.

§ XI. Functions of the Iris.

1. Uses of the Black Pigment lining its Posterior Surface.

2. Cause of the Varied Colour of its Anterior Surface. Proof that it is not owing to the Pigmentum Nigrum.

3. Changes in the Diameter of the Pupil. Changes depending on the Quantity of Light admitted to the Retina. Changes accompanying the Adaptation of the Eye to the Vision of Objects at different Distances.

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   B. Uses of the Contraction and Dilatation of the Pupil.

4. Sensibility, Nourishment, Excretions, &c. of the Iris.

§ XII. Functions of the Choroid Coat.

1. Effects of the Pigmentum Nigrum in Suffocating the Rays of Light.

2. Sensibility, Nourishment, &c. of the Choroid Coat.

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   A. Division of Colours into Simple and Compound. Proofs that the only Simple Colours are Red, Yellow, and Blue. Other hypotheses on this Subject.

   B. PORTERFIED's hypothesis as to the Cause of Colours founded on a Query of NEWTON's, and an Experiment by DE LA HIRE. Not satisfactory.

   C. Singular experiments by RITTER, in which the perception of Colour is said to have been remarkably modified by the agency of Galvanism on the Eye.

3. Circumstances on which the Position or Direction of Sensations of Light depends.

   A. Proofs that it depends on different Points of the Retina being affected by the Rays of Light. Particular demonstration of the Points connected with the Positions Above and Below, Right and Left.

   B. Misconception which has given rise to the ques-

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tion, why we see Objects erect since the Images of them on the Retina are inverted.

4. Circumstances on which the Magnitude of Sensations of Light depends.

A. Proof that it depends on the Extent of the Retina acted upon by the Rays of Light. Experiments. Effects of Glasses in Magnifying and Diminishing the appearance of Objects.

B. Estimates of the Minimum Visibile. By Hooke, Smith, Jurin, Dr. Young, &c.

5. Circumstances on which the Figure of Sensations of Light depends.

Proof that it depends on the Relative Position of the Points of the Retina acted upon by the Rays of Light.

§ XVI. Vision with both Eyes. Term Corresponding Points of the Retinæ explained.

1. Vision with both Eyes considered with reference to the Number of Objects seen.

Proof that when an Image of any Object is formed on Corresponding Points of the two Retinæ, that Object is seen Single; but that when the Image is not formed on Corresponding Points, the Object is seen Double. Reason of this not known.

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different Colour, the Sensation of Light experienced, is different in Colour from what either of the Rays separately operating upon either Eye, would have produced.

3. Vision with both Eyes considered with reference to the Brightness of the Objects seen.

Experiments by JURIN, with a view to determine the difference in the Brightness of an Object seen with one Eye and with both. Fallacy in these experiments.

§ XVII. Inquiry into the Judgments which we are capable of forming from Sight, of the Real or Tangible Direction, Magnitude, Figure, Distance, and Motion of Bodies.

1. Judgments as to the Real Direction of Bodies.

Three kinds of Direction to be judged of, viz. Direction with respect to the Eyes or Optic Axes; Direction with respect to the whole Body; and Direction with respect to the Earth. Each of these considered separately; and proof that in none of them, can we judge of the Real Direction of a Body by its Visible Appearance alone; but by this, combined with a Knowledge of other circumstances.

2. Judgments as to the Real Magnitude of Bodies.

Proof that this cannot be judged of by Visible Magnitude alone; but by this, combined with a Knowledge of other circumstances. Application to

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Drawing and Painting. Camera Obscura. Horizontal Sun and Moon.

3. Judgments as to the Real Figure of Bodies.
Doubts whether this may not be judged of by Visible Figure alone.

4. Judgments as to the Real Distance of Bodies.
Proof that this cannot be judged of by the Visible Appearance of a Body alone; but by this, combined with a knowledge of other circumstances.

5. Judgments as to the Real Motion of Bodies.
Proof that this cannot be judged of by the Apparent Motion of the Object alone; but by this, combined with a knowledge of other circumstances. Ingenious and satisfactory explanation of the Apparent Motion of Objects during Giddiness, by Dr. WELLS.

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DIFFERENCES IN THE FUNCTIONS OF THE EYE-BALL DEPENDENT UPON AGE.

Preliminary Remarks. On the Nature of the Affections called Long and Short Sight.

§ I. Functions of the Eye-Ball before Maturity.

§ II. Functions of the Eye-Ball after Maturity. Div. III. Part I. Sect. I.

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ORIGINAL DIFFERENCES IN THE FUNCTIONS OF THE EYE-BALL AMONG DIFFERENT INDIVIDUALS.

§ I. Singular Peculiarities with respect to Colour, in the Vision of certain Individuals.

Case of Mr. DALTON, and other Instances mentioned by that Philosopher. Case by Dr. NICHOLL.

§ II. Inquiry whether some Individuals do not possess from Birth, a susceptibility of pleasurable Emotion from certain Arrangements or Successions of Colours.

§ III. Of the Short Sight, or Myopia, to which many Persons are subject from an early Period of Life. Excellent Observations on this Subject by Mr. WARE.

§ IV. On Squinting. Dr. REID's satisfactory Investigations relative to this Subject.

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§ V. Of the Functions of the Eye-Ball in the Albino.

ARTICLE IV.

DIFFERENCES IN THE FUNCTIONS OF THE EYE-BALL IN THE SAME INDIVIDUAL AT DIFFERENT TIMES.

§ I. The Sensibility of the Eye to Light is diminished by its having been previously exposed to Light.

Experiments proving this Position. The phenomena of Accidental Colours minutely considered. The experiments relative to this Subject prior to those of Dr. Brewster. Dr. Brewster's interesting investigation of the Phenomena. Other experiments.

§ II. The Sensibility of the Eye to Light often modified by Causes operating primarily on the Brain.

Amaurosis. Muscæ Volitantes. Intolerance of Light, &c.

§ III. The Sensibility of the Eye to Light often modified by Substances introduced into the Alimentary Canal, or Lungs.

§ IV. The Motions of the Eye-Ball often affected by Causes operating primarily on the Brain.

Squinting and Vertigo.

§ V. The Motions of the Eye-Ball often affected by Substances introduced into the Alimentary Canal, or Lungs.

Effects of Intoxicating Substances.

§ VI. The Motions of the Eye-Ball affected by the Rotatory Motion of the Body.

§ VII. The Adapting Power of the Eye affected by Substances introduced into the Alimentary Canal, or rubbed on the Brow, or introduced between the Eye-Lids. Effects in particular of Belladona, Hyoscyamus, and Stramonium.

§ VIII. The Actions of the Iris modified by Causes operating primarily on the Brain.

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§ X. Modifications in the Actions of the Iris, of which the Causes are not known.

Remarkable Case by WARE.

SECTION II.

FUNCTIONS OF THE APPENDAGES OF THE EYE.

ARTICLE I.

§ I. Functions of the Eye-Lids.

1. Motions of the Eye-Lids. Muscles producing them. Uses of them.
2. Excretion from the Tunica Conjunctiva.
3. Excretion from the Sebaceous Tollicles, or Mubomian Glands.

§ II. Functions of the Eye-Brows. Motions of the Eye-Brows. Muscles producing them. Uses of them.

§ III. Functions of the Lachrymal Organs.

1. Composition and Properties of the Tears.
2. Parts by which they are formed, Lachrymal Gland. Question as to the Caruncula Lachrymalis and Tunica Conjunctiva.

3. Uses of the Tears.

4. Apparatus by which the residual Tears are conveyed into the Nose.

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DIFFERENCES IN THE FUNCTIONS OF THE APPENDAGES OF THE EYE DEPENDENT ON AGE.

ARTICLE III.

DIFFERENCES IN THE FUNCTIONS OF THE APPENDAGES OF THE EYE IN THE SAME INDIVIDUAL AT DIFFERENT TIMES.

PART II.

OF HEARING.

ARTICLE I.

§ I. Qualities of Sensations of Sound.

a. Strength, Intensity, or Loudness.
b. Tone or Pitch.
c. Tymbre.
d. Direction.
e. Magnitude.
f. Figure.

§ II. Causes of Sensations of Sound.

1. Facts from which the inference has commonly been drawn, that all Sensations of Sound depend, in the first instance, on the communication of what are called Sonorous Vibrations to the Auditory Nerve within the Labyrinth. Imperfections in this induction.

2. What Effects are produced on the Nerve by these Vibrations, and whether or not they are propagated to other parts of the Nervous System, not known.

§ III. Sonorous Vibrations communicated to the Labyrinth in Two Ways, viz. either by the External Ear and Tympanum, or by the Solid Parts of the Head. Div. III. Part II.

§ IV. Progress of Sonorous Vibrations which are communicated to the Labyrinth by the External Ear and Tympanum.

1. Effects of the External Ear on the Vibrations.
   A. Effects of the Auricle. Limited Motions of the Auricle.
   B. Effects of the External Meatus.

2. Progress of the Vibrations across the Tympanum to the Fluid of the Labyrinth.
   A. Facts from which the inference has been drawn, that the Sonorous Vibrations are communicated from the Membrane of the Tympanum to the opposite Wall of that Cavity, not by the small Tympanal Bones, but by the Air contained in the Tympanum. Use of the Eustachian Tube. Proof by Experiment that it does not convey Sonorous Vibrations into the Tympanum. Use of the Mastoid Cells.
   B. Inquiry into the Manner in which the Sonorous Vibrations are communicated from the Inner Wall of the Tympanum to the Fluid of the Labyrinth. Whether by the Membranes of the Round and Oval Fenestræ, or by these and the whole Osse-

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ous Partition which they perforate, together with the Base of the Stapes.

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5. Inquiry into the Uses of the Membrane of the Tympanum, and the Tympanal Bones.
   A. Motions of each of the Tympanal Bones separately, and the Muscles producing them.
   B. The Conjunct Motions of these Bones, and their Effects on the Membrane of the Tympanum on the one hand, and the Fluid of the Labyrinth on the other. Experiments.
   C. Probability that the whole Apparatus is intended to moderate, or to facilitate, the communication of Sonorous Vibrations to the Auditory Nerve. Facts which seem to show the slight importance of the Apparatus in any point of View.

6. Inquiry into the Uses of the Aqueducts of Cotunnius.

§ V. Sonorous Vibrations which are communicated to the Labyrinth by the Solid Parts of the Head.

Facts proving the Existence of this Mode of Communication. Experiments of Chladni. Experiments

by myself. Experiments by the Rev. J. Robertson. Application of these Experiments in deciding on the Nature of Deafness; and in teaching Deaf-Mutes to Speak.

§ VI. Excretion of Ceruminous Matter into the External Meatus. Sensibility of this Tube.

§ VII. Excretion of a Fluid into the Cavity of the Tympanum. Sensibility of the Membrane of the Tympanum, and of the Surface of the Cavity.

§ VIII. Excretion of the Fluid of the Labyrinth.

§ IX. Causes of the different Qualities perceptible in Sensations of Sound.

1. Circumstances on which the Tone or Pitch of Sensations of Sound depends.

A. Connection established by Experiment to exist in the case of certain Sounding Bodies, between the Tone of the Sensations of Sound they occasion, and the Number of Vibrations they perform in a given time. Hence inferred to exist in all Sounding Bodies.

B. Inquiry into the Sensation experienced, when two or more Sounding Bodies are made to emit Sounds of Different Tones at the same moment, but are

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are so placed with respect to the Ear, that a difference of Direction cannot be perceived in the Sounds which they emit. A Compound Sound defined. Application of this Subject to the regulating of the Position of the Performers in a Musical Concert.

2. Circumstances on which the Loudness, or Intensity, or Strength of Sensations of Sound depends.

A. Connection established by Experiment to exist, in the case of certain Sounding Bodies, between the Loudness of the Sensations of Sound they occasion, and the Width or Extent of the Vibrations they describe in a given time. Hence inferred to exist in all Sounding Bodies.

B. Inquiry into the Sensation experienced, when two or more Sounding Bodies are made to emit Sounds of the same or different Intensities at the same moment, but are so placed with respect to the Ear, that a difference of Direction cannot be perceived in the Sounds which they emit.

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Proofs that it depends, in the first instance, on the Angular Position of the Sounding Body with respect to the Ear. Beyond this nothing known. Mr. GOUGH's hypothesis not satisfactory. Quality of Direction not perceptible in Sounds communicated through the Solid parts of the Head.

4. Circumstances on which the Tymbre of Sensations of Sound depends.

A. Little known on this subject.

B. Inquiry into the Sensation experienced, when two or more Sounding Bodies are made to emit Sounds of different Tymbres at the same moment, but are so placed with respect to the Ear, that a difference of Direction cannot be perceived in the Sounds they emit.

5. Circumstances on which the Magnitude of Sensations of Sound depends.

Proof that it depends, in the first instance, on the Number of Parts in the Sounding Body emitting Sonorous Vibrations. More not known.

6. Circumstances on which the Figure of Sensations of Sound depends.

Proof that it depends, in the first instance, on the Relative Position of the Vibrating Parts of the Sounding Body. More not known.

§ X. Hearing with both Ears.

1. Considered with reference to the Number of Sounding Bodies heard.

2. Considered with reference to the Loudness of the Sounds heard.

3. Considered with reference to the Tone of the Sounds heard.

§ XI. Inquiry into the Judgments which we are capable of forming from Hearing, of the

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1. Judgments as to the Nature or Kind of the Sounding Body.

This always judged of by the Tymbre of the Sensation of Sound it occasions.

2. Judgments as to the Distance of the Sounding Body.

This always judged of by the Loudness of the Sensation of Sound it emits. But subject to much uncertainty. 1. Because Sounds of many Bodies vary in Loudness more or less. 2. Because Sonorous Vibrations are liable to be so influenced before they reach the Ear, as materially to affect the Loudness of the Sound they occasion.

3. Judgments as to the Direction of the Sounding Body with respect to the Ear.

This always judged of by the Audible Direction of the Sound it occasions. Loudness in no respect concerned, as some have stated.

4. Judgments as to the Magnitude of the Sounding Body.

This always judged of by the Audible Magnitude of the Sound it occasions. But subject to uncertainty.

5. Judgments as to the Form of the Sounding Body.

This always judged of by the Audible Form of the Sound it occasions. But subject to uncertainty.

6. Observations on Ventriloquism. Proofs that this

Art consists entirely in an Imitation of the Qualities of Tymbre and Intensity in Sounds, and in no instance of Direction.

ARTICLE II.

DIFFERENCES IN THE FUNCTIONS OF THE EAR DEPENDENT ON AGE.

ARTICLE III.

ORIGINAL DIFFERENCES IN THE FUNCTIONS OF THE EAR AMONG DIFFERENT INDIVIDUALS.

§ I. Original differences with respect to the Perception of Tone.

Term Nice Ear explained, and distinguished from the Nice Musical Ear. Delicacy possessed by some, in perceiving the elements of Compound Sounds.

§ II. Original differences with respect to the Perception of Loudness.

Excellent experiment by Mr. GOUGH. Natural mistake with regard to the Powers of Blind Persons in this respect.

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§ III. Original differences with respect to the Perception of the other Qualities of Sound.

§ IV. Some Individuals susceptible, from Birth, of a peculiar pleasurable Emotion from Certain Successions of Sounds. These Successions called Music, and the Individuals to whom they give pleasure, said to have a Musical Ear.

1. Musical Successions of Sounds of two kinds, viz. Successions of Simple Sounds, or Melody; and Successions of Compound Sounds, or Harmony.

2. Characteristics of Musical Successions of Sounds.

A. Of Successions of Simple Sounds.

a. All the Simple Sounds must belong to a Series, rising successively in point of Acuteness, according to a fixed Ratio. This Ratio particularly explained. Two Selections made from this Series, to one or other of which the Succession must be confined, viz. Major and Minor Scales. Deviations from this Rule, and the objects of them.

b. All the Simple Sounds must possess a character, (more easily illustrated than defined,) by which they are distinguished from what Writers on Sound call Noises.

B. Of Successions of Compound Sounds.

a. All the Simple Sounds of which the Compound Sounds are composed, must have the Musical Relations and Qualities above stated.

b. The Compound Sounds must consist of certain of these Simple Sounds only. Such combinations called Concords. Examples. Occasional Deviations from this rule, called Discords. Objects of these.

c. A Succession of Compound Sounds regulated by the same rules as to the Major and Minor Scales, as a Succession of Simple Sounds. Occasional Deviations from this principle. Reasons for these.

3. Inquiry why such Successions of Sounds give pleasure more than others.

4. Proofs that the Musical Ear is an Original Peculiarity.

5. Acquired Tastes and Original Peculiarities, from which the Musical Ear must be distinguished.
   A. From an Acquired Taste for Musical Sounds.
   B. From an Original Nicety in the perception of Tone in Sounds.
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6. Advantages of possessing the Musical Ear.

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DIFFERENCES IN THE FUNCTIONS OF THE EAR IN THE SAME INDIVIDUAL AT DIFFERENT TIMES.

§ I. Circumstances affecting the Strength of

Div. III. Part II. the Sensations of Sound produced by any given Sounding Body.

Various Species of Deafness.

§ II. Instances in which the power of distinguishing Tone appears to have been modified.

§ III. Inquiry into the Cause of the Affection called Tinnitus Aurium.

PART III.

OF RESPIRATION.

Introductory Observations. Arrangement of the Subject. 1. Respiration properly so called. 2. The Sensibility, Nourishment, Excretions, and Absorptions of the Windpipe. 3. The Windpipe considered as a Regulator of the Quantity of Air Inspired or Expired. 4. Of Voice and Speech. 5. Of the Sensibility and Sensations of the Nose. 6. Of the Nourishment, Excretions, and Absorptions of the Nose.

SECTION I.

OF RESPIRATION, PROPERLY SO CALLED.

Division of the Subject. 1. Inspiration and Expiration. 2. Changes produced by Respiration on the Air Respired. 3. Changes produced

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on the Blood by Respiration. 4. The Sensibility, Nourishment, Excretions, and Absorptions of the Lungs. 5. Insensible Impressions on the Lungs. 6. Functions of the Pleura.

I. OF INSPIRATION AND EXPIRATION.

ARTICLE I.

§ I. Terms Natural State, or Capacity, of the Chest and Lungs, explained.

§ II. Of Inspiration in particular.

1. Changes in the State of the Walls of the Chest, which produce Enlargement of its Cavity; and Effects of this Enlargement on the Lungs.
2. Muscles by which this Enlargement is produced.
3. Bulk of Air inhaled.
   - A. At an Ordinary Inspiration. Various estimates.
   - B. At an Extreme Inspiration. Various estimates.
4. Force with which Inspiration may be performed. Satisfactory Experiment by HALES.

§ III. Of Expiration in particular.

1. Changes in the State of the Walls of the Chest which produce Diminution of its Cavity; and Effects of this Diminution on the Lungs.
2. Powers by which this Diminution is produced.

3. Bulk of Air Expired.

A. At an Ordinary Expiration. Various Estimates.

B. At an Extreme Expiration. Various Estimates.

4. Force with which Expiration may be performed. Satisfactory Experiment by HALES.

§ IV. Number of Inspirations and Expirations performed in a given time.

§ V. Inquiry into the Nature of the Stimulus which excites the Respiratory Muscles to act in Inspiration and Expiration.

1. Stimulus to Inspiration.

Reasons for considering this to be, the Presence of Venous Blood in the Capillary Vessels of the Lungs.

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DIFFERENCES IN INSPIRATION AND EXPIRATION DEPENDENT ON SEX AND AGE.

ARTICLE III.

ORIGINAL DIFFERENCES IN INSPIRATION AND EXPIRATION AMONG DIFFERENT INDIVIDUALS.

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ARTICLE IV.

DIFFERENCES IN INSPIRATION AND EXPIRATION IN THE SAME INDIVIDUAL AT DIFFERENT TIMES.

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§ II. Inspiration and Expiration modified by the Various Emotions.

§ III. Inspiration apparently modified by Causes varying the power of the Natural Stimulus to Inspiration in the Lungs; viz. the Venous Blood.

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§ VI. Inspiration and Expiration modified by various Agents applied to the Natural Surfaces of the Body.

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§ VIII. Modifications of the Actions of the Respiratory Muscles occurring during Disease, and of which the Causes have not been ascertained.

§ IX. Causes modifying the Bulk of Air Inspired, independent of the Actions of the Respiratory Muscles.

1. Circumstances affecting the Capacity of the Lungs themselves.
2. Circumstances affecting the Capacity of the Cavities in which they are lodged.

II. OF THE CHANGES PRODUCED BY RESPIRATION ON THE AIR RESPIRED.

ARTICLE I.

§ I. The Air heated by Respiration, provided it be respired at a Temperature below the medium Heat of the Human Body.

§ II. The Air Respired altered in its Chemical Composition.

Div. III. Part III. Sect. I.

1. Facts which seem to prove, that it loses part of its Oxygen, and gains an exactly equal bulk of Carbonic Acid Gas, and that its Azote remains unchanged.

2. Experiments by which it has been endeavoured to ascertain the proportion of Oxygen lost, and of Carbonic Acid Gas gained.

3. Inquiry into the Manner in which this Change in the Chemical Composition of the Respired Air is brought about.

A. Theory of Ellis on this subject the most probable; viz. that Carbonaceous Matter is excreted into the Air-cells of the Lungs by the Blood-vessels of these Organs;—that in these Cells, this Matter combines directly with part of the Oxygen of the Air Respired, and forms Carbonic Acid Gas;—that all the Oxygen which the Inspired Air loses, is employed in the formation of this Acid;—and that all the Oxygen contained in this Acid, has been derived from the Inspired Air.

B. Objections to other theories on this subject.

§ III. The Air Respired is charged with Watery Vapour.

1. Experiments by which this is shewn.

2. Chemical Analysis of the Fluid.

3. Estimates of its Quantity.

4. Inquiry into its Source. Facts which seem to shew that it is an Excretion from the Air-cells of the Lungs

§ IV. The Air Respired is altered in its Electrical State.

Experiments of READ and others.

§ V. Hypothesis of ELLIS, that part of the Air Respired suffers Condensation in the Lungs.

Curious Facts on which this Hypothesis is founded.

ARTICLE II.

DIFFERENCES IN THE CHANGES INDUCED ON THE AIR BY RESPIRATION, DEPENDENT ON SEX AND AGE.

ARTICLE III.

ORIGINAL DIFFERENCES IN THE CHANGES INDUCED ON THE AIR BY RESPIRATION, AMONG DIFFERENT INDIVIDUALS.

ARTICLE IV.

DIFFERENCES IN THE CHANGES INDUCED ON THE AIR BY RESPIRATION, IN THE SAME INDIVIDUAL AT DIFFERENT TIMES.

Div. III. Part III. Sect. 1.

§ I. Differences in the Degree in which it is heated.

§ II. Differences in the Proportion of Oxygen lost, and Carbonic Acid Gas formed.

§ III. Differences in the Quantity of Watery Vapour with which it is charged.

§ IV. Differences in the Degree in which its Electrical State is altered.

§ V. Differences in the Extent of its Apparent Condensation.

ARTICLE V.

CHANGES PRODUCED BY RESPIRATION, ON GASES DIFFERING IN CHEMICAL COMPOSITION FROM ATMOSPHERIC AIR.

Changes produced by Respiration, on Oxygen, Azote, Nitrous Oxide, Hydrogen, Carbonic Acid Gas mixed with other Gases, Carbonated Hydrogen.

III. OF THE CHANGES PRODUCED ON THE BLOOD BY RESPIRATION.

ARTICLE I.

§ I. The Colour of the Blood circulating through the Lungs, altered by Respiration from Modena to Scarlet.

1. Inquiry into the Cause of this Change.

A. Numerous Observations and Experiments relative to this Point, made on Man and the Lower Animals by HOOKE, LOWER, CIGNA, PRIESTLY, CRAWFORD, GIRTANNER, HASSENFRATZ, HUNTER, FOURCROY, BEDDOES, DAVY, WELLS, BOSTOCK, ELLIS, T. THOMSON, THENARD, VOGEL, and myself.

B. These lead only to one conclusion, viz. that the Change depends, in the first instance, on the disappearance of Oxygen from the Air Inspired, and the simultaneous formation of an equal bulk of Carbonic Acid Gas. How this Chemical Process operates, not easy to conjecture. Objections to attributing the Effect to the Carbonic Acid thus formed; or to a Change induced in the Blood by the Excretion of Carbonaceous Matter; or to any Combination of Oxygen with the Blood; or to the Caloric set free during the Combination of the Oxygen with the Carbon. ELLIS's Hints on this subject.

2. Inquiry into the Cause of the opposite change of Colour, from Scarlet to Modena, in the other Parts of the Circulation.

§ II. Probable, that the Temperature of the Blood is raised, during its Circulation through the Lungs, in consequence of receiving a portion of the Caloric extricated during the formation of the Carbonic Acid Gas in these Organs;—that the Blood afterwards communicates this additional Heat to the different Parts of the Body through which it flows;—and that this Chemical Process going on in the Lungs, is the chief, if not the only source of the Caloric, which enables the System to maintain its High Temperature.

1. Observations and Experiments on Man and the Lower Animals by Black, Lavoisier, La Place, Crawford, Martine, Hunter, Carlisle, Ellis, Hale, Dr. Davy, and others, which lead to this theory.

2. Other theories on this subject, and on the Source of Animal Heat in general. Objections to which they are liable.

§ III. Along with the Change of Colour, the Blood, during its Circulation through the Lungs, seems to undergo a change of Composition, of the utmost importance to the Economy; and which, for the sake of brevity, may be called its Essential Change.

1. This Change inferred to take place, from the Effects which are observed invariably to follow, when Blood, which has not been exposed to Respiration, is circulated throughout the System. These Effects described. Interesting experimental induction of Bichat on this point.

2. The Remote Causes of this Change the same as those which alter the Colour of the Blood. The more Immediate Cause quite unknown.

ARTICLE II.

DIFFERENCES IN THE CHANGES PRODUCED ON THE BLOOD BY RESPIRATION, DEPENDENT ON SEX AND AGE.

ARTICLE III.

ORIGINAL DIFFERENCES IN THE CHANGES PRODUCED ON THE BLOOD BY RESPIRATION, AMONG DIFFERENT INDIVIDUALS.

ARTICLE IV.

DIFFERENCES IN THE CHANGES PRODUCED ON THE BLOOD BY RESPIRATION, IN THE SAME INDIVIDUAL AT DIFFERENT TIMES.

§ I. Differences in its Changes with respect to Colour.

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§ II. Differences in its Changes with respect to Temperature.

§ III. Differences in the Degree in which its Essential Change takes place.

ARTICLE V.

CHANGES PRODUCED ON THE BLOOD, BY THE RESPIRATION OF GASES DIFFERING IN CHEMICAL COMPOSITION FROM ATMOSPHERIC AIR.

Changes produced on the Blood by the Respiration of Oxygen, Azote, Nitrous Oxide, Hydrogen, Carbonic Acid Gas mixed with other Gases, and Carbonated Hydrogen.

IV. OF THE SENSIBILITY, NOURISHMENT, EXCRETIONS, AND ABSORPTIONS OF THE LUNGS.

§ I. Of the Sensibility of the Lungs.

1. Kinds of Sensation of which the Lungs are susceptible.
2. Circumstances varying the Sensibility of the Lungs.

§ II. Of the Nourishment of the Lungs.

1. Inquiry into the Vessels by which this Process is carried on.

2. Circumstances varying the Process.

§ III. Of the Excretions of the Lungs.

1. Inquiry whether or not there be any other Excretions into the Air-cells and Bronchial Tubes, than the Carbonaceous Matter and Watery Fluid already noticed.

2. Morbid Excretions into the Air-cells and Bronchial Tubes.

§ IV. Of the Absorptions of the Lungs.

1. Observations and Experiments by which it is demonstrated, that Substances introduced into the Lungs along with the Air inspired, are often conveyed into the Circulation; and reasons for believing that it is by the Absorbent Vessels they are conveyed.

2. Reasons for supposing a constant action of Absorbents on the surface of the Air-cells and Air-tubes of the Lungs.

V. OF INSENSIBLE IMPRESSIONS ON THE LUNGS.

Preliminary Observations on the General Nature of these Impressions, and on the evidence on which they rest.

§ I. Insensible Impressions produced by Substances impregnating the Air inhaled.

Div. III. Part III. Sect. I.

1. Effects of Impregnations of Alcohol, Ether, Opium, Tobacco, Stramonium, Mercury, Lead, &c.

2. Effects of Breathing the Air of Confined or Crowded Apartments. Question whether or not there be any Impregnation concerned in this case. The disease called Scurvy satisfactorily traced to this cause by Ellis.

3. Effects of Breathing the Air of an Apartment, in which the Combustion of Charcoal, or Carbonaceous Matter, is going on.

4. Effects of Impregnations of Vegetable Miasmata.

5. Effects of Impregnations of Contagious Effluvia.

§ II. Insensible Impressions produced by Gases inhaled instead of Atmospherical Air.

1. Effects of respiring Oxygen Gas.

2. Effects of respiring Nitrous Oxide Gas.

3. Effects of respiring Carbonated Hydrogen Gas.

§ III. Insensible Impressions produced by Mixtures of Atmospheric Air and other Gases.

1. Effects of respiring Mixtures of Atmospheric Air and Carbonic Acid Gas.

2. Effects of respiring Mixtures of Atmospheric Air and Carbonated Hydrogen.

§ IV. Question whether or not any of the Effects produced by the Respiration of Hot or

Cold Air are to be ascribed to Insensible Impressions.

1. Respiration of Hot Air. Experiments of TILLET, FORDYCE, BLAGDEN, DOBSON, and DELAROCHE.

2. Respiration of Cold Air.

VI. OF THE FUNCTIONS OF THE PLEURA.

§ I. Of the Sensibility of the Pleura.

§ II. Of the Nourishment of the Pleura.

§ III. Of the Serous Excretion from the Pleura.

§ IV. Of the Absorption from the Surface of the Pleura.

SECTION II.

OF THE SENSIBILITY, NOURISHMENT, EXCRETIONS, AND ABSORPTIONS OF THE WINDPIPE.*

§ I. Of the Sensibility of the Windpipe, and circumstances modifying it.

* Under the term *Windpipe* is included the Larynx and Trachea.—See System of Human Anatomy, Vol. III.

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§ II. Of the Nourishment of the Windpipe, and circumstances modifying it.

§ III. Of the Excretions of the Windpipe, and circumstances modifying them.

§ IV. Inquiry whether or not there be any Absorptions naturally going on, on the Surface of the Windpipe.

§ V. Inquiry into the Functions of the Thyroid Gland.

SECTION III.

OF THE WINDPIPE AS A REGULATOR OF THE QUANTITY OF AIR INSPIRED AND EXPIRED.

ARTICLE I.

§ I. Of the Changes in the Position of the Parts forming the Larynx, by which Diminution or Enlargement of the Glottis is produced.

§ II. Of the Muscles capable of producing these Changes.

§ III. Of the different Occasions on which these Changes take place, and the Stimuli exciting the Muscles to act in each Case.

ARTICLE II.

DIFFERENCES IN THE FUNCTIONS OF THE WINDPIPE AS A REGULATOR OF THE RESPIRED AIR, IN DIFFERENT CIRCUMSTANCES.

§ I. Various Causes exciting Spasmodic Action in the Muscles varying the diameter of the Glottis.

§ II. Causes contributing to diminish the Glottis, independent of the Action of these Muscles.

SECTION IV.

OF VOICE AND SPEECH.

Preliminary Observations relative to the number of Organs concerned in the production of these Phenomena.

I. OF VOICE.

ARTICLE I.

§ I. Qualities perceptible in the Sounds of the Voice.

Div. III. Part III. Sect. IV.

§ II. Causes of the Sounds of the Voice in general.

1. Proof, from Experiment and Observation, that they depend on the Glottis.

2. Reasons adduced by MAGENDIE for believing, that they depend on an Action of the Glottis similar to that of a Reed-Instrument.

§ III. Circumstances on which the Qualities of the Sounds of the Voice depend.

1. Circumstances on which the Tone of the Voice depends.

2. Circumstances on which the Intensity, or Loudness, of the Voice depends.

3. Circumstances on which the Tymbre of the Voice depends.

§ IV. The Stimuli which excite the Muscles of the Voice to Act.

1. The Will, or Volition.

2. Various Sympathetic Stimuli.

3. Various Stimuli of Emotion.

ARTICLE II.

DIFFERENCES IN THE VOICE, DEPENDENT ON SEX AND AGE.

ARTICLE III.

ORIGINAL DIFFERENCES IN THE VOICE, AMONG DIFFERENT INDIVIDUALS.

ARTICLE IV.

DIFFERENCES IN THE VOICE OF THE SAME INDIVIDUAL AT DIFFERENT TIMES.

§ I. Voice modified by Circumstances affecting the Muscles.

§ II. Voice modified by Changes in the Vocal Organs independent of the Muscles.

II. OF SPEECH.

ARTICLE I.

§ I. LANGUAGE, a System of Sounds, produced by the Vocal Organs and other Parts; and connected by the principle of Previous Association

Div. III. Part III. Sect. IV.

with certain Ideas, or Trains of Ideas. SPEECH, the production of these Sounds, by these Organs.

§ II. Analysis of the Sounds of which the English Language is composed, and the Manner in which they are produced.

1. The Meaning of the Simple Sounds, of which the whole Language is composed, determined, not by the Tone or the Intensity of these Sounds, but by their Tymbre, and the Manner in which they are begun or ended.

2. The English Language composed of twenty-six Simple Sounds, all differing from each other in Tymbre; and these occasionally varied in their meaning, by five different Modes of beginning or ending them.

A. Of the Sounds themselves. These divisible into two classes, viz. Laryngeal and Oral.

a. The Laryngeal Sounds. These produced in the Larynx. Are twenty-one in number. Illustration of each of them individually; and description of the configuration of the Mouth, Fauces or Nose, upon which the peculiar Tymbre of each depends.

b. The Oral Sounds. These produced by the Mouth. Are five in number. Illustration of each of them individually; and description of the configuration of the Mouth, by which each

of them is produced, and on which the difference of their Tymbre depends.

B. Of the Modes in which the Sounds are occasionally begun or ended.

These are five in number. Illustration of each of them Individually; and description of the configuration of the Mouth, or Fauces, on which each of them depends.

§ III. Combination of the Simple Sounds into Words.

§ IV. Rules observed in Speech, with respect to the Tones and Loudness of the Words.

§ V. Words considered with relation to their Meaning, or the Ideas they excite.

ARTICLE II.

DIFFERENCES IN SPEECH DEPENDENT ON AGE.

§ I. Progress of the Child in acquiring the Pronunciation of Words.

§ II. Induction by which the Meaning of Words is acquired in Early Life.

SECTION V.

OF THE SENSIBILITY AND SENSATIONS OF THE NOSE.

Div. III. Part III. Sect. V.

Introductory Remarks. Arrangement of the Subject. 1. Sensations of Smell. 2. Sensations of Touch. 3. Sensations of Heat and Cold. 4. Sensations of Taste. 5. Sensations of Pain.

I. OF THE SENSATIONS OF SMELL.

ARTICLE I.

§ I. Qualities of Sensation of Smell.

1. Intensity, or Strength.
2. A Quality to which the term Odour may be appropriated.
3. No Direction, Magnitude, or Form.

§ II. Causes of Sensation of Smell.

1. Are always preceded by the passage through the Nose of Air of a particular Quality.
2. Reasons for believing that this Quality is derived from the addition of certain Subtile Particles, called Effluvia, which have emanated from particular Bodies, hence denominated Odorous.
3. Reasons for believing that it is by Acting upon the

Parts comprehended within the Upper Meatus alone of the Nose, that this Air produces the Sensations of Smell.

§ III. Circumstances on which the Qualities of the Sensations of Smell seem to depend.

1. Circumstances connected with the Intensity or Strength of these Sensations.
2. Circumstances connected with the Odour of these Sensations.

§ IV. Inquiry how far we are capable of judging of the Nature, Distance, Direction, &c. of Odorous Bodies by Sensations of Smell.

§ V. Inquiry into the Uses of the Ethmoidal, Frontal, Sphenoidal, and Maxillary Sinuses.

ARTICLE II.

DIFFERENCES IN SENSATIONS OF SMELL DEPENDING ON SEX AND AGE.

ARTICLE III.

ORIGINAL DIFFERENCES IN SENSATIONS OF SMELL AMONG DIFFERENT INDIVIDUALS.

Div. III. Part III. Sect. V.

ARTICLE IV.

DIFFERENCES IN THE SENSATIONS OF SMELL IN THE SAME INDIVIDUAL AT DIFFERENT TIMES.

§ I. Causes modifying the Sensibility to Smell, apparently by affecting the Mucous Membrane of the Nose alone.

§ II. Causes modifying the Sensibility to Smell, operating primarily on Parts different from the Mucous Membrane.

ARTICLE V.

INFLUENCE OF SENSATIONS OF SMELL ON THE OTHER FUNCTIONS OF THE BODY.

§ I. Influence of Sensations of Smell on the Voluntary Actions of the Limbs.

§ II. Influence of Sensations of Smell on the Actions of the Heart.

§ III. Alleged influence of Sensations of Smell on the Actions of the Intestines.

II. SENSATIONS OF TOUCH EXPERIENCED IN THE NOSE. Div. III. Part III. Sect. V.

Extent of the Organ in which these Sensations are felt.

III. SENSATIONS OF HEAT AND COLD EXPERIENCED IN THE NOSE.

§ I. Extent of the Organ over which these Sensations are felt.

§ II. Influence of these Sensations on the Functions of other Parts.

IV. SENSATIONS OF TASTE EXPERIENCED IN THE NOSE.

§ I. Extent of the Organ over which these are felt.

§ II. Kind of Sensations of Taste experienced.

V. SENSATIONS OF PAIN EXPERIENCED IN THE NOSE.

Circumstances in which these Sensations are felt

SECTION VI.

OF THE NOURISHMENT, EXCRETIONS, AND ABSORPTIONS OF THE NOSE.

Div. III. Part III. Sect. VI.

§ I. Nourishment of the Mucous Membrane lining the Meatuses and Sinuses of the Nose.

§ II. Excretions from the Membrane of the Passages and Sinuses.

1. Properties and Composition of the Nasal Mucus.
2. Manner of its Formation.
3. Its Uses.
4. Modifications in it, depending on different circumstances.

§ III. Reasons for believing that there is an Absorption continually going on, on the Surface of the Mucous Membrane of the Passages and Sinuses of the Nose.

PART IV.

OF THE ALIMENTARY FUNCTION.

Preliminary Observations. On the General Object of this Function, and the various Organs concerned in accomplishing it. Arrangement of the Subject. 1. The Actions of each Individual Part of the Alimentary Organs on the Food. 2. General Facts and Phenomena relative to the Alimentary Function. 3. Influence of the Alimentary Function on the other Functions of the Body.

SECTION I.

OF THE ACTIONS OF EACH INDIVIDUAL PART OF THE ALIMENTARY ORGANS ON THE FOOD.

Arrangement of the Subject. 1. Action of the Mouth on the Food. 2. Deglutition. 3. Action of the Stomach on the Food, or Digestion. 4. Action of the Small Intestine, and the Organs connected with it, on the Food. 5. Action of the Large Intestine on the Food.

Div. III. Part IV. Sect. I.

I. OF THE ACTION OF THE MOUTH ON THE FOOD.

I. Introduction of the Food into the Mouth.

§ I. The Introduction of Solid Substances.

§ II. The Introduction of Fluid Substances. Two Species of Suction described.

II. Sensations produced by the Food in the Mouth.

§ I. Of the Sensations of Taste.

1. Qualities of these Sensations.
   - A. Intensity, or Strength.
   - B. Quality to which the term Savour may be appropriated.
   - C. Position.
   - D. Magnitude.
   - E. Figure.
2. Extent of the Mouth over which these Sensations are felt.
3. Causes of these Sensations.
   - A. Application of certain Bodies called Sapid to the Sensible Part.
   - B. Inquiry whether partial Solution of these Bodies be necessary.
   - C. More not known.

4. Circumstances on which the Qualities of these Sensations depend.

5. Differences in these Sensations depending on Sex, Age, and other circumstances.

6. Influence of these Sensations on the other Functions of the Body.

7. The Flavour of Food not dependent on the Taste of it, but on the Sensation of Smell it occasions.

§ II. Of the Sensations of Touch produced by the Food in the Mouth.

§ III. Of the Sensations of Heat and Cold, produced by the Food in the Mouth.

§ IV. Of Sensations of Pain, and other Sensations, produced by the Food in the Mouth.

III. Substances mingled with the Food in the Mouth.

Excretion of the Saliva.

1. Chemical Composition and Properties of this Fluid.

2. Organs by which it is formed.

3. Quantity of it excreted.

4. Circumstances modifying its Excretion.

IV. Mastication.

§ I. Functions of the Teeth.

Div. III. Part IV. Sect. I.

1. Nourishment and Sensibility of the Teeth inquired into. Reasons for believing that no part of them possesses Vessels, or Sensibility, except the Inner Membrane.

2. Uses of each Class.

3. Circumstances modifying the Functions of the Teeth.

A. Differences in the Functions of the Teeth depending on Age.

a. The Formation of the Temporary Teeth.

b. The Formation of the Permanent Teeth, and the Shedding of the Temporary Teeth.

c. The Shedding of the Permanent Teeth in Old Age.

B. Differences in the Functions of the Teeth depending on Use.

a. The Wearing of the Teeth.

b. The Decay called improperly Caries.

§ II. Motions of the Lower Jaw, and the Muscles producing them.

§ III. Actions of the Tongue in Mastication.

II. OF DEGLUTITION

I. Introduction of the Food into the Pharynx.

Powers by which this is accomplished, and circumstances modifying their Action.

II. Introduction of the Food into the Esophagus.

§ I. Actions by which this is accomplished, and circumstances modifying them.

§ II. Sensibility, Nourishment, Excretions, &c. of the Pharynx, and circumstances modifying them.

III. Introduction of the Food into the Stomach.

§ I. Actions of the Esophagus by which this is accomplished, and circumstances modifying them.

§ II. Sensibility, Nourishment, Excretions, &c. of the Esophagus.

III. OF DIGESTION, OR THE ACTION OF THE STOMACH ON THE FOOD.

§ I. State of the Stomach with respect to Capacity before the Food is introduced into it.

§ II. Sensations of which the Stomach is susceptible

§ III. Chemical Changes produced on the Food while in the Stomach.

1. Particular description of the Chemical Changes which different kinds of Food undergo.

Div. III. Part IV. Sect. I.

2. Inquiry into the Causes of these Changes.

3. Circumstances modifying these Changes.

§ IV. Propulsion of the Food from the Stomach into the Small Intestine.

1. Action by which this Propulsion is accomplished, particularly described.

2. Inquiry into the nature of the Stimulus exciting these Actions.

3. Circumstances modifying these Actions. Eructation, Vomiting, Operation of Emetics, &c.

IV. ACTION OF THE SMALL INTESTINE AND THE ORGANS CONNECTED WITH IT ON THE FOOD.

§ I. State of the Small Intestine as to Capacity, before the Contents of the Stomach are introduced into it.

§ II. Inquiry into the Sensibility of the Small Intestine.

§ III. Chemical Changes produced on the Food while in the Small Intestine.

1. Particular Description of these Changes, and of the Formation of the Chyle to which they lead.

2. Inquiry into the Causes of these Changes. The Agents concerned are,

A. The Bile.

a. Chemical Composition and Properties of this Fluid.

b. Inquiry whether it be secreted by the Vena Portarum or the Hepatic Artery. Arguments in favour of the latter hypothesis.

c. When it flows into the Intestine, and in what quantity. Functions of the Gall-Bladder.

d. Circumstances modifying the Excretions of the Bile. In Quantity. In Quality. Obstructions to its Flow. Jaundice.

e. Sensibility, Nourishment, &c. of the Liver.

B. Supposed Function of the Spleen.

a. Nothing satisfactory known on this subject.

b. Sensibility, Nourishment, &c. of this Organ.

C. The Pancreatic Fluid.

a. The Chemical Composition and Properties of this Fluid.

b. Mode of its Formation.

c. When, and in what quantity it flows into the Intestine.

d. Sensibility, Nourishment, &c. of the Pancreas.

D. Fluid excreted by the surface of the Intestine itself.

E. Other Agents.

Inquiry in what manner all these Agents operate.

3. Circumstances modifying the Chemical Changes produced on the Food in the Small Intestine.

§ IV. Propulsion of the Food from the Small into the Large Intestine.

Div. III. Part IV. Sect. I.

1. Actions by which this Propulsion is accomplished particularly described.

2. Inquiry into the Nature of the Stimulus exciting these Actions.

3. Circumstances modifying these Actions. Inverted Action, as it is called, considered.

V. ACTION OF THE LARGE INTESTINE ON THE FOOD.

§ I. State of the Large Intestine as to Capacity, before the Contents of the Small Intestine are introduced into it.

§ II. Inquiry into the Sensibility of the Large Intestine.

§ III. Chemical Changes produced on its Contents.

1. Particular Description of these Changes.

2. Inquiry into the Causes of these Changes.

3. Circumstances modifying these Changes. Action of Purgative Medicines considered.

§ IV. Expulsion of the Contents of the Large Intestine.

1. Actions by which the Expulsion is accomplished particularly described.

2. Inquiry into the Nature of the Stimuli concerned in producing them.

3. Circumstances modifying these Actions.

SECTION II.

GENERAL FACTS AND PHENOMENA RELATIVE TO THE ALIMENTARY FUNCTION.

Arrangement of the Subject. 1. Of the Sensations of Hunger and Thirst. 2. Of the Necessity of the Series of Changes to which the Food is subjected. 3. Of Aliment. 4. Of the Functions of the Peritonæum and Omentum.

I. OF THE SENSATIONS OF HUNGER AND THIRST.

§ I. Of the Nature, Causes, and Modifications of the Sensation of Hunger.

§ II. Of the Nature, Causes, and Modifications of the Sensation of Thirst.

II. OF THE NECESSITY OF THE SERIES OF CHANGES TO WHICH THE FOOD IS SUBJECTED.

Numerous Observations on the Human Body, from which this Necessity has been inferred.

Div. III. Part IV. Sect. II.

III. OF ALIMENT.

§ I. Of the Various Substances which have been, or may be, used as Food, and their Comparative Nutrient Powers.

§ II. Of the Quantity of Food necessary to be taken daily.

§ III. Of the Periods of the Day at which Food ought to be taken.

IV. OF THE FUNCTIONS OF THE PERITONÆUM AND OMENTUM.

I. Of the Peritonæum.

§ I. Sensibility of the Peritonæum.

§ II. Nourishment of the Peritonæum, and circumstances modifying it.

§ III. Excretion and Absorption from the Surface of the Peritonæum.

1. Chemical Composition and Properties of the Serous Fluid.
2. Manner in which it is formed.
3. Quantity of it excreted.
4. Uses of the Excretion.

5. Circumstances modifying the Excretion. Ascites considered. Div. III. Part IV. Sect. III.

II. Of the Omentum.

Sensibility, Nourishment, Excretions, Absorptions, and Uses of this Membrane.

SECTION III.

INFLUENCE OF THE ALIMENTARY FUNCTION ON THE OTHER FUNCTIONS OF THE BODY.

I. EFFECTS PRODUCED BY THE FOOD ON THE OTHER FUNCTIONS OF THE BODY, WHEN IT IS NOT PROPERLY ALTERED IN COMPOSITION IN THE STOMACH OR INTESTINES.

§ I. Symptoms of Dyspepsia particularly described, and their Causes inquired into.

§ II. Symptoms of what are often called Bilious Disorders considered.

§ III. Effects produced by Accumulation of Feculent Matter.

Div. III. Part IV. Sect. III.

II. EFFECTS PRODUCED ON THE FUNCTIONS OF THE BODY BY THE PRESENCE OF WORMS IN THE ALIMENTARY CANAL.

§ I. Symptoms produced by Tæniæ.

§ II. Symptoms produced by Ascarides.

III. EFFECTS PRODUCED ON THE OTHER FUNCTIONS OF THE BODY BY THE INTRODUCTION OF VARIOUS MEDICINES INTO THE ALIMENTARY CANAL.

The general question considered, in what manner these Substances operate. Whether they operate on the Alimentary Canal directly, and afterwards, through the medium of the Nervous System, on the other Parts of the Body;—or are Absorbed into the Blood, and so produce their Effects:—or operate partly in the one way, and partly in the other.

PART V.

OF THE URINARY FUNCTION.

Preliminary Observations on the various Organs concerned in this Function. Arrangement of the Subject. 1. Of the Functions of the Kidneys. 2. Of the Accumulation and Expulsion of the Urine.

SECTION I.

OF THE FUNCTIONS OF THE KIDNEYS.

ARTICLE I.

§ I. Of the Chemical Composition and Properties of the Urine.

§ II. Of the Manner in which it is secreted and conveyed into the Bladder.

1. Inquiry into the Part of the Kidney chiefly concerned in the Secretion.

2. Inquiry into the Action of the Ureter.

Div. III. Part V. Sect. I.

§ III. Of the Quantity of Urine secreted.

§ IV. Of the Sensibility, Nourishment, &c. of the Kidney.

§ V. Inquiry into the Functions of the Supra-Renal Gland.

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FOURTH DIVISION.

FOURTH DIVISION.

OF THE SIGNS OF LIFE AND DEATH; THE PHENOMENA OF NATURAL DECAY; AND THE RATE OF MORTALITY AMONG MANKIND.

THIS DIVISION comprehends Three Parts; one corresponding to each of the Subjects mentioned in the Title.

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CONCLUSION OF THE COURSE.

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