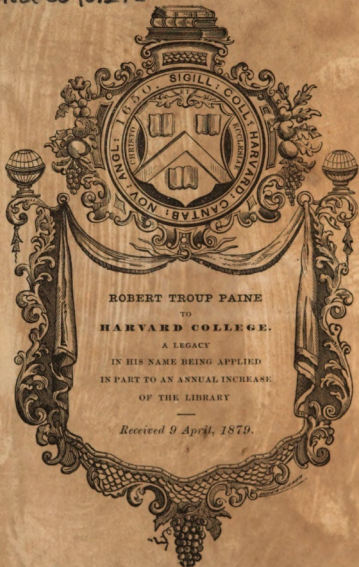


Phil 8590.2.2



ROBERT TROUP PAINE
TO
HARVARD COLLEGE.
A LEGACY
IN HIS NAME BEING APPLIED
IN PART TO AN ANNUAL INCREASE
OF THE LIBRARY

—
Received 9 April, 1879.

0

THE BRIDGEWATER TREATISES
ON THE POWER, WISDOM, AND GOODNESS OF GOD
AS MANIFESTED IN THE CREATION.

TREATISE II.

ON THE ADAPTATION OF EXTERNAL NATURE TO
THE PHYSICAL CONDITION OF MAN.

BY J. KIDD, M. D.

THOU MADEST HIM TO HAVE DOMINION OVER THE WORKS OF THY
HANDS; THOU HAST PUT ALL THINGS UNDER HIS FEET.

PSALM VIII. 6.

ON THE
ADAPTATION OF EXTERNAL
NATURE

TO THE
PHYSICAL CONDITION OF MAN,

PRINCIPALLY WITH REFERENCE TO THE SUPPLY OF HIS WANTS,
AND THE EXERCISE OF HIS INTELLECTUAL FACULTIES.

*Robert Troup Paerie
to
Harvard College.*

BY JOHN KIDD, M.D. F.R.S.

REGIUS PROFESSOR OF MEDICINE IN THE UNIVERSITY OF OXFORD.

Philadelphia:
CAREY, LEA & BLANCHARD.

.....

1833.

~~III. 655~~

Phil 8590.2.2

1879, April 9.
Pam. bequest.

Robert. Tracy. Conner
to
Harvard College.

TO
HIS GRACE
THE
ARCHBISHOP OF CANTERBURY.

MY LORD,

HAVING been appointed to write the following Treatise by the late President of the Royal Society, in consequence of your Grace's recommendation, it was natural that I should be desirous of publicly acknowledging the high honour thus conferred upon me.

I therefore request you to accept my respectful thanks for permitting me to inscribe this Treatise with your Grace's name: assuring you that, however inadequately I may have been found to answer your expectation in the execution, I have not applied myself to the task committed to me, without the exertion of much thought, and the strongest desire of so executing it, as to justify your Grace's favourable opinion.

I have the honour to be,
MY LORD,
with the greatest respect,
Your Grace's most obliged
and obedient Servant,
J. KIDD.

OXFORD, March 15, 1833.

THE GREAT

ARTICULAR OF GAMBURY

1812

I have the honor to write the following
letter to the late President of the Royal Society,
in consequence of your favor's recommendation,
and in answer to the letter of the 10th inst. which
you were good enough to send me.

I am very much obliged to you for the
letter of the 10th inst. and in answer to it
I have the honor to send you the enclosed
letter, which I have the honor to enclose
to you in the same manner as I have the honor
to do to the other members of the Society,
and in answer to the letter of the 10th inst.
I have the honor to send you the enclosed
letter, which I have the honor to enclose
to you in the same manner as I have the honor
to do to the other members of the Society.

I have the honor to be

Dear Sir,

Yours very truly,

J. GAMBURY

Secretary of the Royal Society

London

Printed by J. G. Smith, 1812

PREFACE.

THE occasion which gave rise to this and the accompanying Treatises is explained in the following notice: but the Author of the present Treatise thinks it right to add, that, although encouraged by the honour of having been recommended by His Grace the Archbishop of Canterbury, he should have shrunk from his present attempt, had he considered that any exact elucidation of the details of science was required in the execution of it.

As, however, the intention of Lord Bridgewater, and the very extent and diversified nature of the subject, seemed to him almost necessarily to exclude any great exactness of elucidation, and to require a popular rather than a scientific exposition of facts; and as the whole tenour of his pursuits during the last thirty years of his life accorded with the character of the proposed subject; he the more readily undertook a task, to the execution of which he could not but look forward with much pleasure. And if he should in any instance stimulate the reader to examine the question with any portion of the interest and satisfaction with which he has himself examined it, he is confident that he shall not have laboured in vain.

It will be for others to determine whether a judicious selection and a sufficiently natural arrangement of the materials of the following Treatise have been adopted: but to those, who may think that many of the subjects have been treated too cursorily, the Author begs leave to point out the extensive range afforded by so wide a field of inquiry; and the consequent necessity of compression in each particular; the subject of this Treatise being in fact an epitome of the subjects of almost all the others. He also considers it right to state, that it is the immediate object of the Treatise itself to unfold a train of facts, not to maintain an argument; to give a general view of the adaptation of the external world to the physical condition of man, not to attempt formally to convince the reader that this adaptation is a proof either of

the existence and omnipotence of the Deity, or of his beneficence and wisdom; though undoubtedly it is hoped by the writer, as it was intended by the munificent individual who originally proposed the general subject of this and the accompanying Treatises, that such a conviction, if not already existing, may be produced by its perusal. Without questioning, therefore, on the present occasion, the intellectual powers or the moral motives of those who profess themselves sceptics with respect to either natural or revealed religion, the Author addresses himself exclusively to those who are believers in both the one and the other. With respect indeed to a disbelief in the basis of natural religion, he must ever feel assured, as in another place he has expressed himself, that, however easy it may be to account for the external profession of a disbelief in God, the supposition of the existence of intellectual atheism involves an intellectual absurdity. With respect to the truth of revelation, although the subject of this Treatise is not directly connected with that question, he would still wish to consider himself as addressing those only who with himself believe that the objects which surround us in our present state of existence, and which are so obviously intended to advance the general powers and faculties of *Man*, without advancing the powers and faculties of any other animal, are purposely destined to produce an ulterior and higher effect; the nature of which effect is to be learnt from the doctrines of Revelation alone. And he has thought it right to say thus much on the general subject of religion, not merely for the purpose of recording his own sentiments; but that, in professing to address those only who believe in revealed as well as in natural religion, if on any occasion he should assume the truth of Revelation, he may not be with justice accused of taking that for granted, of which the reader doubts.

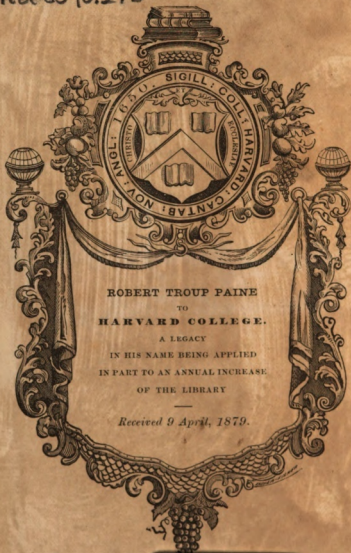
NOTICE.

THE series of Treatises, of which the present is one, is published under the following circumstances :

THE RIGHT HONOURABLE and REVEREND FRANCIS HENRY, EARL of BRIDGEWATER, died in the month of February, 1829; and by his last Will and Testament, bearing date the 25th of February, 1825, he directed certain Trustees therein named to invest in the public funds the sum of eight thousand pounds sterling; this sum, with the accruing dividends thereon, to be held at the disposal of the President, for the time being, of the Royal Society of London, to be paid to the person or persons nominated by him. The Testator further directed, that the person or persons selected by the said President should be appointed to write, print, and publish one thousand copies of a work *On the Power, Wisdom, and Goodness of God, as manifested in the Creation; illustrating such work by all reasonable arguments; as for instance the variety and formation of God's creatures in the animal, vegetable, and mineral kingdoms; the effect of digestion, and thereby of conversion; the construction of the hand of man, and an infinite variety of other arguments; as also by discoveries ancient and modern, in arts, sciences, and the whole extent of literature.* He desired, moreover, that the profits arising from the sale of the works so published should be paid to the authors of the works.

The late President of the Royal Society, Davies Gilbert, Esq. requested the assistance of his Grace the Archbishop of Canterbury and of the Bishop of London, in determining upon the best mode of carrying into effect the intentions of the Testator. Acting with their advice, and with the concurrence of a nobleman immediately connected with the deceased, Mr. Davies Gilbert appointed the following eight gentlemen to write separate Treatises on the different branches of the subject, as here stated :

hil 8590.2.2



ROBERT TROUP PAINE
TO
HARVARD COLLEGE.
A LEGACY
IN HIS NAME BEING APPLIED
IN PART TO AN ANNUAL INCREASE
OF THE LIBRARY

Received 9 April, 1879.

THOU MADEST HIM TO HAVE DOMINION OVER THE WORKS OF THY
HANDS; THOU HAST PUT ALL THINGS UNDER HIS FEET.

PSALM VIII. 6.

○

THE BRIDGEWATER TREATISES
ON THE POWER, WISDOM, AND GOODNESS OF GOD
AS MANIFESTED IN THE CREATION.

TREATISE II.

ON THE ADAPTATION OF EXTERNAL NATURE TO
THE PHYSICAL CONDITION OF MAN.

BY J. KIDD, M. D.

THOU MADEST HIM TO HAVE DOMINION OVER THE WORKS OF THY
HANDS; THOU HAST PUT ALL THINGS UNDER HIS FEET.

PSALM VIII. 6.

ON THE
ADAPTATION OF EXTERNAL
NATURE

TO THE
PHYSICAL CONDITION OF MAN,

PRINCIPALLY WITH REFERENCE TO THE SUPPLY OF HIS WANTS, *
AND THE EXERCISE OF HIS INTELLECTUAL FACULTIES.

Robert Troup Paine
to
Harvard College.

BY JOHN KIDD, M.D. F.R.S.

REGIUS PROFESSOR OF MEDICINE IN THE UNIVERSITY OF OXFORD.

Philadelphia:
CAREY, LEA & BLANCHARD.

.....

1833.

~~III. 655~~

Phil 8590.2.2

1879, April 9.
Pam. bequest.

NATURE

Robert. Truop. Co. Inc.
to
Harvard College.

TO
HIS GRACE
THE
ARCHBISHOP OF CANTERBURY.

MY LORD,

HAVING been appointed to write the following Treatise by the late President of the Royal Society, in consequence of your Grace's recommendation, it was natural that I should be desirous of publicly acknowledging the high honour thus conferred upon me.

I therefore request you to accept my respectful thanks for permitting me to inscribe this Treatise with your Grace's name: assuring you that, however inadequately I may have been found to answer your expectation in the execution, I have not applied myself to the task committed to me, without the exertion of much thought, and the strongest desire of so executing it, as to justify your Grace's favourable opinion.

I have the honour to be,
MY LORD,
with the greatest respect,
Your Grace's most obliged
and obedient Servant,
J. KIDD.

OXFORD, March 15, 1833.

THE GREAT

THE HISTORY OF THE

... of the ...
... of the ...
... of the ...

... of the ...
... of the ...
... of the ...

... of the ...
... of the ...
... of the ...

PREFACE.

THE occasion which gave rise to this and the accompanying Treatises is explained in the following notice; but the Author of the present Treatise thinks it right to add, that, although encouraged by the honour of having been recommended by His Grace the Archbishop of Canterbury, he should have shrunk from his present attempt, had he considered that any exact elucidation of the details of science was required in the execution of it.

As, however, the intention of Lord Bridgewater, and the very extent and diversified nature of the subject, seemed to him almost necessarily to exclude any great exactness of elucidation, and to require a popular rather than a scientific exposition of facts; and as the whole tenour of his pursuits during the last thirty years of his life accorded with the character of the proposed subject; he the more readily undertook a task, to the execution of which he could not but look forward with much pleasure. And if he should in any instance stimulate the reader to examine the question with any portion of the interest and satisfaction with which he has himself examined it, he is confident that he shall not have laboured in vain.

It will be for others to determine whether a judicious selection and a sufficiently natural arrangement of the materials of the following Treatise have been adopted: but to those, who may think that many of the subjects have been treated too cursorily, the Author begs leave to point out the extensive range afforded by so wide a field of inquiry; and the consequent necessity of compression in each particular; the subject of this Treatise being in fact an epitome of the subjects of almost all the others. He also considers it right to state, that it is the immediate object of the Treatise itself to unfold a train of facts, not to maintain an argument; to give a general view of the adaptation of the external world to the physical condition of man, not to attempt formally to convince the reader that this adaptation is a proof either of

the existence and omnipotence of the Deity, or of his beneficence and wisdom; though undoubtedly it is hoped by the writer, as it was intended by the munificent individual who originally proposed the general subject of this and the accompanying Treatises, that such a conviction, if not already existing, may be produced by its perusal. Without questioning, therefore, on the present occasion, the intellectual powers or the moral motives of those who profess themselves sceptics with respect to either natural or revealed religion, the Author addresses himself exclusively to those who are believers in both the one and the other. With respect indeed to a disbelief in the basis of natural religion, he must ever feel assured, as in another place he has expressed himself, that, however easy it may be to account for the external profession of a disbelief in God, the supposition of the existence of intellectual atheism involves an intellectual absurdity. With respect to the truth of revelation, although the subject of this Treatise is not directly connected with that question, he would still wish to consider himself as addressing those only who with himself believe that the objects which surround us in our present state of existence, and which are so obviously intended to advance the general powers and faculties of *Man*, without advancing the powers and faculties of any other animal, are purposely destined to produce an ulterior and higher effect; the nature of which effect is to be learnt from the doctrines of Revelation alone. And he has thought it right to say thus much on the general subject of religion, not merely for the purpose of recording his own sentiments; but that, in professing to address those only who believe in revealed as well as in natural religion, if on any occasion he should assume the truth of Revelation, he may not be with justice accused of taking that for granted, of which the reader doubts.

NOTICE.

THE series of Treatises, of which the present is one, is published under the following circumstances:

The RIGHT HONOURABLE and REVEREND FRANCIS HENRY, EARL of BRIDGEWATER, died in the month of February, 1829; and by his last Will and Testament, bearing date the 25th of February, 1825, he directed certain Trustees therein named to invest in the public funds the sum of eight thousand pounds sterling; this sum, with the accruing dividends thereon, to be held at the disposal of the President, for the time being, of the Royal Society of London, to be paid to the person or persons nominated by him. The Testator further directed, that the person or persons selected by the said President should be appointed to write, print, and publish one thousand copies of a work *On the Power, Wisdom, and Goodness of God, as manifested in the Creation; illustrating such work by all reasonable arguments; as for instance the variety and formation of God's creatures in the animal, vegetable, and mineral kingdoms; the effect of digestion, and thereby of conversion; the construction of the hand of man, and an infinite variety of other arguments; as also by discoveries ancient and modern, in arts, sciences, and the whole extent of literature.* He desired, moreover, that the profits arising from the sale of the works so published should be paid to the authors of the works.

The late President of the Royal Society, Davies Gilbert, Esq. requested the assistance of his Grace the Archbishop of Canterbury and of the Bishop of London, in determining upon the best mode of carrying into effect the intentions of the Testator. Acting with their advice, and with the concurrence of a nobleman immediately connected with the deceased, Mr. Davies Gilbert appointed the following eight gentlemen to write separate Treatises on the different branches of the subject, as here stated:

THOU MADEST HIM TO HAVE DOMINION OVER THE WORKS OF THY
HANDS; THOU HAST PUT ALL THINGS UNDER HIS FEET.

PSALM VIII. 6.

ON THE
ADAPTATION OF EXTERNAL
NATURE

TO THE
PHYSICAL CONDITION OF MAN,

PRINCIPALLY WITH REFERENCE TO THE SUPPLY OF HIS WANTS,
AND THE EXERCISE OF HIS INTELLECTUAL FACULTIES.

*Robert Troup Parrie
to
Harvard College.*

BY JOHN KIDD, M.D. F.R.S.

REGIUS PROFESSOR OF MEDICINE IN THE UNIVERSITY OF OXFORD.

Philadelphia:
CAREY, LEA & BLANCHARD.

.....
1833.

~~III. 655~~

Phil 8590.2.2

1879, April 9.
Pam. bequest.

Robert. Truop. Service
to
Harvard College.

TO
HIS GRACE
THE
ARCHBISHOP OF CANTERBURY.

MY LORD,

HAVING been appointed to write the following Treatise by the late President of the Royal Society, in consequence of your Grace's recommendation, it was natural that I should be desirous of publicly acknowledging the high honour thus conferred upon me.

I therefore request you to accept my respectful thanks for permitting me to inscribe this Treatise with your Grace's name: assuring you that, however inadequately I may have been found to answer your expectation in the execution, I have not applied myself to the task committed to me, without the exertion of much thought, and the strongest desire of so executing it, as to justify your Grace's favourable opinion.

I have the honour to be,
MY LORD,
with the greatest respect,
Your Grace's most obliged
and obedient Servant,
J. KIDD.

Oxford, March 15, 1833.

THE HISTORY OF THE UNIVERSITY OF CAMBRIDGE

The following is a list of the names of the members of the University of Cambridge who were elected to the office of Chancellor in the year 1534. The names are given in the order in which they were elected, and are taken from the original records of the University.

I have the honor to be
Your obedient servant
John Clerk

PREFACE.

THE occasion which gave rise to this and the accompanying Treatises is explained in the following notice: but the Author of the present Treatise thinks it right to add, that, although encouraged by the honour of having been recommended by His Grace the Archbishop of Canterbury, he should have shrunk from his present attempt, had he considered that any exact elucidation of the details of science was required in the execution of it.

As, however, the intention of Lord Bridgewater, and the very extent and diversified nature of the subject, seemed to him almost necessarily to exclude any great exactness of elucidation, and to require a popular rather than a scientific exposition of facts; and as the whole tenour of his pursuits during the last thirty years of his life accorded with the character of the proposed subject; he the more readily undertook a task, to the execution of which he could not but look forward with much pleasure. And if he should in any instance stimulate the reader to examine the question with any portion of the interest and satisfaction with which he has himself examined it, he is confident that he shall not have laboured in vain.

It will be for others to determine whether a judicious selection and a sufficiently natural arrangement of the materials of the following Treatise have been adopted: but to those, who may think that many of the subjects have been treated too cursorily, the Author begs leave to point out the extensive range afforded by so wide a field of inquiry; and the consequent necessity of compression in each particular; the subject of this Treatise being in fact an epitome of the subjects of almost all the others. He also considers it right to state, that it is the immediate object of the Treatise itself to unfold a train of facts, not to maintain an argument; to give a general view of the adaptation of the external world to the physical condition of man, not to attempt formally to convince the reader that this adaptation is a proof either of

the existence and omnipotence of the Deity, or of his beneficence and wisdom; though undoubtedly it is hoped by the writer, as it was intended by the munificent individual who originally proposed the general subject of this and the accompanying Treatises, that such a conviction, if not already existing, may be produced by its perusal. Without questioning, therefore, on the present occasion, the intellectual powers or the moral motives of those who profess themselves sceptics with respect to either natural or revealed religion, the Author addresses himself exclusively to those who are believers in both the one and the other. With respect indeed to a disbelief in the basis of natural religion, he must ever feel assured, as in another place he has expressed himself, that, however easy it may be to account for the external profession of a disbelief in God, the supposition of the existence of intellectual atheism involves an intellectual absurdity. With respect to the truth of revelation, although the subject of this Treatise is not directly connected with that question, he would still wish to consider himself as addressing those only who with himself believe that the objects which surround us in our present state of existence, and which are so obviously intended to advance the general powers and faculties of *Man*, without advancing the powers and faculties of any other animal, are purposely destined to produce an ulterior and higher effect; the nature of which effect is to be learnt from the doctrines of Revelation alone. And he has thought it right to say thus much on the general subject of religion, not merely for the purpose of recording his own sentiments; but that, in professing to address those only who believe in revealed as well as in natural religion, if on any occasion he should assume the truth of Revelation, he may not be with justice accused of taking that for granted, of which the reader doubts.

NOTICE.

THE series of Treatises, of which the present is one, is published under the following circumstances :

The RIGHT HONOURABLE and REVEREND FRANCIS HENRY, EARL of BRIDGEWATER, died in the month of February, 1829; and by his last Will and Testament, bearing date the 25th of February, 1825, he directed certain Trustees therein named to invest in the public funds the sum of eight thousand pounds sterling; this sum, with the accruing dividends thereon, to be held at the disposal of the President, for the time being, of the Royal Society of London, to be paid to the person or persons nominated by him. The Testator further directed, that the person or persons selected by the said President should be appointed to write, print, and publish one thousand copies of a work *On the Power, Wisdom, and Goodness of God, as manifested in the Creation; illustrating such work by all reasonable arguments; as for instance the variety and formation of God's creatures in the animal, vegetable, and mineral kingdoms; the effect of digestion, and thereby of conversion; the construction of the hand of man, and an infinite variety of other arguments; as also by discoveries ancient and modern, in arts, sciences, and the whole extent of literature.* He desired, moreover, that the profits arising from the sale of the works so published should be paid to the authors of the works.

The late President of the Royal Society, Davies Gilbert, Esq. requested the assistance of his Grace the Archbishop of Canterbury and of the Bishop of London, in determining upon the best mode of carrying into effect the intentions of the Testator. Acting with their advice, and with the concurrence of a nobleman immediately connected with the deceased, Mr. Davies Gilbert appointed the following eight gentlemen to write separate Treatises on the different branches of the subject, as here stated :

THE REV. THOMAS CHALMERS, D. D.

Professor of Divinity in the University of Edinburgh.

**ON THE ADAPTATION OF EXTERNAL NATURE TO THE MORAL AND
INTELLECTUAL CONSTITUTION OF MAN.**

JOHN KIDD, M. D. F. R. S.

Regius Professor of Medicine in the University of Oxford.

**ON THE ADAPTATION OF EXTERNAL NATURE TO THE PHYSICAL
CONDITION OF MAN.**

THE REV. WILLIAM WHEWELL, M. A. F. R. S.

Fellow of Trinity College, Cambridge.

ON ASTRONOMY AND GENERAL PHYSICS.

SIR CHARLES BELL, K. H. F. R. S.

**THE HAND: ITS MECHANISM AND VITAL ENDOWMENTS AS EVINCING
DESIGN.**

PETER MARK ROGET, M. D.

Fellow of and Secretary to the Royal Society.

ON ANIMAL AND VEGETABLE PHYSIOLOGY.

THE REV. WILLIAM BUCKLAND, D. D. F. R. S.

Canon of Christ Church and Professor of Geology in the University of Oxford.

ON GEOLOGY AND MINERALOGY.

THE REV. WILLIAM KIRBY, M. A. F. R. S.

ON THE HISTORY, HABITS, AND INSTINCTS OF ANIMALS.

WILLIAM PROUT, M. D. F. R. S.

ON CHEMISTRY, METEOROLOGY, AND THE FUNCTION OF DIGESTION.

HIS ROYAL HIGHNESS THE DUKE OF SUSSEX, President of the Royal Society, having desired that no unnecessary delay should take place in the publication of the above mentioned treatises, they will appear at short intervals, as they are ready for publication.

CONTENTS.

	Page
CHAP. I. INTRODUCTION	13
SECT. I. The Physical Condition of Man	ib.
II. The general Constitution of external Nature	15
CHAP. II. THE PHYSICAL CHARACTER OF MAN	19
SECT. I. The Physical Character of Man, compared with that of other Animals	ib.
II. Differences in the Form of the Infant and of the the Adult; particularly with reference to the Spine	21
III. Physical Superiority of Man, on what Principle to be estimated	25
IV. Early and gradual Developement of the intellectual Faculties of Man	28
CHAP. III. ON THE POWERS OF THE HUMAN HAND, CONSIDERED AS A CORPOREAL ORGAN	32
CHAP. IV. ON THE BRAIN, CONSIDERED AS THE ORGAN OF THE INTELLECTUAL FACULTIES	42
CHAP. V. THE NERVOUS SYSTEM OF ANIMALS IN GENERAL	46
SECT. I. The Nervous System of the inferior Animals	ib.
II. The Nervous System of Man	50
III. Indications of natural Talent and Disposition deducible from the Structure of the Brain	54
IV. The general Doctrine of Physiognomy, as connected with the Form of the Body	59
V. The Developement of the Human Brain, compared with that of other Animals	64
VI. Cursory View of the Extent of Human Power over the Objects of the external World	66
CHAP. VI. ADAPTATION OF THE ATMOSPHERE TO THE WANTS OF MAN	69
SECT. I. The general Constitution of the Atmosphere	ib.
II. Light	71
III. Heat	79
IV. The general Uses of Water	87
V. Baths	91
VI. The Fluidity of Water	95
VII. The natural Sources of Water	99
VIII. The Air of the Atmosphere, as connected with Respiration	101
IX. Effects of the Motion of the Air, as connected with Human Health, &c.	106
X. Effects of the Motion of the Air, as connected with the Arts, &c.	113

	Page
CHAP. VII. ADAPTATION OF MINERALS TO THE PHYSICAL CONDITION OF MAN - - -	119
SECT. I. The general Characters of Minerals -	ib.
II. Application of Minerals to Architecture and Sculpture - - -	120
III. Gems and precious Stones - -	130
IV. The Distribution and relative Proportions of Sea and Land; and the geological Arrange- ment and physical Character of some of the superficial Strata of the Earth -	134
V. Beds of Gravel - - -	136
VI. Metals - - -	143
VII. Common Salt, &c. - - -	152
CHAP. VIII. ADAPTATION OF VEGETABLES TO THE PHYSI- CAL CONDITION OF MAN - -	154
SECT. I. General Observations on the Vegetable King- dom - - -	ib.
II. The Cocoa-nut Tree, including the Formation of Coral Reefs - - -	156
III. Vegetables as a Source of Food -	164
IV. Vegetables as applicable to Medicine -	171
V. Vegetables as applicable to the Arts, &c.	176
CHAP. IX. ADAPTATION OF ANIMALS TO THE PHYSICAL CONDITION OF MAN - - -	183
SECT. I. General Observations on the Animal Kingdom	ib.
II. Geographical Distribution of Animals -	187
III. The Camel - - -	188
IV. Domestication of Animals - - -	194
V. Animals as a Source of Food - - -	198
VI. Manufacture of Sal Ammoniac - -	200
VII. Animals as a Source of Clothing, &c. -	203
CHAP. X. ADAPTATION OF THE EXTERNAL WORLD TO THE EXERCISE OF THE INTELLECTUAL FACULTIES OF MAN - - -	205
SECT. I. On the Rise and Progress of Human Know- ledge - - -	ib.
II. Opinions of Lucretius on the constitution of Matter in general; and on the Nature of Light, Heat, Water, and Air - -	214
III. Opinions of the Ancients on the Organization and Classification of Animals - -	223
IV. On those Animal Forms called Monsters, or Lusus Nature - - -	248
CHAP. XI. CONCLUSION - - -	251
APPENDIX - - -	257

ON THE
ADAPTATION OF EXTERNAL NATURE

TO THE
PHYSICAL CONDITION OF MAN.

CHAPTER I.
INTRODUCTION.

SECTION I.

The Physical Condition of Man.

WHEN Hamlet, in contemplating the grandeur of creation, breaks forth into that sublime apostrophe on man—"How noble in reason! how infinite in faculties! in form and moving, how express and admirable! in action, how like an angel! in apprehension, how like a God! the beauty of the world! the paragon of animals!" who does not feel elated by the description? who does not feel conscious of its truth?

Nor is its truth the less admissible, because the poet, in concentrating the powers of his imagination on the excellences of that work of creation which bears the stamp of the Creator's image, has omitted to present to our view the reverse of the impression, the frailty namely of our fallen nature: for although, on moral and religious considerations, each indivi-

dual is bound habitually to take the one view in conjunction with the other; in a simply philosophical contemplation of human nature we are not precluded by any reasonable barrier, from taking such a partial view of the subject as the occasion may suggest.

In the present instance, indeed, I am strictly called upon to consider, not the moral, but *the physical condition of man*: and to examine how far *the state of external nature is adapted* to that condition; whether we regard the provisions made for *the supply of man's wants, either natural or acquired*; or those which are made for *the exercise of his intellectual faculties*. The following treatise naturally, therefore, divides itself into two parts: in the first of which it is intended to investigate and describe the physical condition of man; in the second, the adaptation of external nature to that condition.

But a wide field here opens to our view: for man cannot, under any circumstances, be considered as an insulated being; or unconnected with the rest of animated nature. He is indeed but one link in the great chain of animal creation; and not only does the contemplation of his condition lose half its interest, if separated from the contemplation of the condition of other animals; but it cannot be satisfactorily investigated without that aid. And, again, animal life itself is but one among many modes of existence, by which the Creator has manifested his omnipotence; and which it is necessary to contemplate in connexion with the general phenomena of nature, in order to show the superiority of that province, at the head of which human beings have been placed.

In attempting however to form a just estimate of the physical condition of man, we must not regard him merely under the aspect of savage or uncivilized life, and consider this as his natural state: for it may be presumed that, at the present day, such a puerile view of the question is not for a moment entertained by any one capable of philosophical reflection. In fact, in as many different states as man does actually

exist, civilized or savage, so many are his natural states. If any indeed could be pre-eminently called his natural state, it would be that of civilization: for not only does experience show that his natural tendency is towards such a state; but we know, from the highest authority, that the existence of man is connected with a moral end; (with more indeed than a moral end; since morals have immediately a relation to this life only, while man is destined for a future;) and a moral end is hardly attainable in an uncivilized state of society.

SECTION II.

The general Constitution of external Nature.

THE more familiar objects of that external world by which man is surrounded are usually distributed into three kingdoms, as they are called; the *animal*, *vegetable*, and *mineral*: but for the purpose of this treatise it will be necessary to take into our account the phenomena of the *atmosphere* also.

The *atmosphere* principally consists of the *air* which we respire; (a form of matter so subtle, in all its states, as to be invisible;) together with a variable proportion of *water*, of which a part is always retained in close combination with the air; and, like the air itself, exists always in an invisible state. There are also diffused through the atmosphere those still more subtle agents, *heat* and *electricity*. But all these, though of so subtle a substance, are in their occasional effects the most powerful agents of nature. For, omitting the consideration of their silent but wonderful operation, as exhibited in the process of vegetation, and in many other processes less open to observation, let us consider the occasional effects of air in the violence of a tornado; or of water, in the inundation of a rapid river: or let us contemplate the effect of either an indefinite diminution or increase of heat; on the one hand, the natural process of animal

decomposition arrested by its abstraction, so that the imbedded mammoth remains at this moment in the same state that it was four thousand years ago; and in which, under the same circumstances, it undoubtedly would be, four thousand or four millions years hence; on the other hand, the possibility of the dissipation of all the constituent parts of matter, or their fixation in the state of glass, resulting from the agency of indefinitely increased heat: or, lastly, let us consider the tremendous effects of condensed electricity in the form of lightning:—and we shall necessarily acknowledge that though in their usual state the constituents of the atmosphere are among the most tranquil agents of nature, yet, when their power is concentrated, they are the most awfully energetic.

In the *mineral kingdom* the most characteristic property of the several species appears to be a disposition to a peculiar mode of mutual attraction among the particles composing the individuals belonging to them; from which attraction, when exerted under the most favourable circumstances, result that symmetry and regularity of form, to which the term *crystal* has been applied. The transparency and degree of hardness of crystals are various, and depend much upon external circumstances. The form is fundamentally the same for each species, though capable of being modified according to known laws; and the substance is chemically the same throughout its whole extent. Every atom of a crystallized mass of gypsum consists of water, lime, and sulphuric acid, united in the same proportions as are found to exist in the whole mass, or in any given part of it.

The individuals of the *vegetable kingdom* differ very remarkably from those of the mineral, both in form and substance. In their form we see nothing like the mathematical precision of crystallization; and in their substance they differ widely, according to the part of the vegetable which is examined: so that, independently of previous knowledge of the species, we could hardly discover any natural relation between the

several constituent parts of the individual. What is there in the insulated leaf of a rose or of a peach tree, that would lead us to expect the fruit of the one or the flower of the other? But the most remarkable line of distinction between vegetables and the individuals of the preceding kingdom consists in their mode of increase and reproduction. Minerals can only increase, as such, by the apposition of particles specifically similar to themselves; and can only be originally produced by the immediate combination of their constituent elements. But vegetables have an apparatus within them, by means of which they can assimilate the heterogeneous particles of the surrounding soil to their own nature; and they have also the power of producing individuals specifically the same as themselves: in common language, they are capable of contributing to their own growth, and to the continuation of their species. And as they produce these effects by means of internal organs adapted to the purpose, they are hence denominated organized bodies.

The individuals of the *animal kingdom* very closely resemble those of the vegetable in the two properties just described. The respective organs differ, as we might expect, in their form and position; but in their functions or mode of action, there is a strong analogy, and even similarity, throughout. But animals differ from vegetables more remarkably than these do from every unorganized form of matter, in being endowed with sensation and volition; properties which extend the sphere of their relations to such a degree, as to raise them immeasurably above all other forms of matter in the scale of existence.

In distributing the individuals of the material world among these four kingdoms of nature, there occasionally prevails considerable obscurity, not only with respect to the true place which an individual ought to occupy in the scale of a particular kingdom; but even with respect to the question, under which of the four kingdoms it ought to be arranged;

this obscurity arising of course from the points of resemblance apparently balancing, or more than balancing, the points of difference. Let us for instance, in the atmospherical kingdom, take a fragment of a perfectly transparent crystal of pure ice; and, under ordinary circumstances, it would be difficult, either by the sight or the touch, to distinguish it from a fragment of transparent quartz, or rock crystal: indeed the transfer of the original term κρύσταλλος, from the one to the other, shows the close resemblance of the two. Some minerals again so nearly resemble vegetables in form, as to have given rise to specific terms of appellation, derived from the vegetable kingdom; as *flos ferri*, *mineral agaric*, &c. And, lastly, many of the animals called sea-anemones so far resemble the flower called by the same name, that their real character is at first very doubtful to those who are unacquainted with the animals of that genus. But, omitting these rare and equivocal instances, and avoiding the confinement of abstract definitions, we may safely affirm that, of all the kingdoms of nature, the individuals of the animal kingdom have the most extensive and important relations to the surrounding universe. And I need not here insist on the obvious inference, that if among the kingdoms of nature animals hold the first rank, in consequence of the importance of these relations, among animals themselves the first rank must be assigned to man.

CHAPTER II.

THE PHYSICAL CHARACTER OF MAN.

SECTION I.

The Physical Character of Man, compared with that of other Animals.

ALTHOUGH, when viewed in the aggregate of his faculties, moral as well as physical, man confessedly holds the first rank among animals; yet, if we exclude from our consideration those intellectual powers and moral qualities by which he is essentially characterized, and confine our view to his mere animal nature, we find that he scarcely differs in any important point from any of the species of the higher classes. In each there is the same necessity for air, and sleep, and food; and the nature of the food and the mode of its digestion are not materially different: the nutrient fluid extracted by the process of digestion is converted into blood of the same character, and distributed in the same manner through the system: the constituent parts of the body and their mode of growth are almost precisely the same; for the bone, muscle, tendon, skin, hair, and brain of the horse, or deer, or tiger, or bear, scarcely differ in their physical or chemical characters from the corresponding parts in man: similar secretions, as the bile, tears, and saliva, are separated by similarly constructed organs; and similar parts become similarly diseased: the special senses of sight, hearing, taste, and smell, are exercised through the medium of similar organs, simply modified according to the particular wants of individual species: the sources of mere bodily pain or pleasure are generally the same: the instinctive affections, passions, and propensities

are the same, and are manifested in the same way; the angry look of a dog, for instance, bespeaking the internal feeling as strongly as that of a man; and the playful and rapid movements of the young puppy resembling the careless hilarity of childhood, no less than the stayed motions and wary eye of the aged hound resemble the sedateness of the aged human being.

Probably, however, it would be nearer the truth, were we to say that man, if divested of his intellectual powers, and endued merely with his animal nature, would be inferior to the brutes; for, possessing, as is the case, very few of the prospective or preservative instincts, he would be unable, without the aid of his intellectual powers, to provide for some of his most imperious wants.

But we may go even further than this. Let us suppose, for instance, a community of human individuals, who, though not gifted with a sufficient degree of intellectual powers to instruct others, or improve themselves, were yet endued with them to a degree sufficient to render them, if the opportunity offered, docile to a certain extent, and capable of executing many of the common offices of life; (and what town or village does not present to our observation individual instances of such unhappy shadows of human nature?) how could a community like this exist; in which, though all, by the terms of the supposition, were capable of learning something, yet none would be capable of teaching any thing? of what use under these circumstances would be that "instrument of instruments" the human hand, where there was no presiding mind to direct its movements? And, with respect to that wonderful auxiliary of the human powers, how incorrect is the reflection of those who have asserted that men are superior to brutes, only because they possess this instrument: and how truly philosophical is the opposite reflection, that man is not superior to other animals because he possesses this instrument; but he is provided with such an in-

strument precisely because he is already superior to all other animals. And the converse is equally true, that, with intellectual powers of even a higher order than those which they already possess, human beings could not live in a state of society, could hardly indeed exist in any state, unless furnished with such an instrument as the hand.

SECTION II.

Differences in the Form of the Infant and of the Adult; particularly with reference to the Spine.

AND yet, notwithstanding the confessed superiority of man, if we view him only in the infancy of his individual existence, what is there that is calculated to give an earnest of his future vigour and activity, either with respect to bodily or mental powers; and what are all the advantages of the external world to a creature so utterly helpless, so utterly incapable of using or even passively enjoying them? In fact, with the exception of a very few instinctive rather than voluntary acts, such as that of deriving its nutriment from the mother's breast, the infant is, from the feebleness of its powers, incapable of efficient exertion; and depends entirely on the assistance of those around it.

The physical differences, observable in comparing the structure of the infant with that of the adult, which enable the one to execute many operations of which the other is incapable, exist to a certain extent in every part of the body; but are perhaps more remarkable in the spine than in any other part: and the spine therefore may be selected as a fit term of comparison.

In considering the office of the adult spine, with a view to the present subject, we find that great strength, combined with great flexibility, is particularly requisite. With reference to strength, the pyramidal form of this natural column is obviously

conducive to the purpose intended; and the arrangement of the solid matter, of which it is composed, is such as to contribute to the same effect: for that solid matter, instead of being collected into one compact mass, is diffused in such a manner as to resemble the structure of sponge; and it is well known, with reference to the strength of artificial columns, that, the same quantity of matter being given for each, and their height being the same, those columns which are hollow are stronger than those which are solid. Again, the whole column is made up of numerous parts, called *vertebræ*, which are so firmly bound together as to lessen the chance of being broken in the act of bending; and these *vertebræ* being applied to each other, throughout, by broad horizontal surfaces, are thus best calculated to support the perpendicular pressure of the superincumbent parts. The effect of general strength is further accomplished by the mutual locking in of the projecting portions, or processes, of the several *vertebræ*; and the same effect is accomplished to an additional extent among these *vertebræ* which belong to the thorax or chest, by the mode of articulation between them and the ribs; each rib being united, not entirely to a single vertebra, but partially to two contiguous *vertebræ*, near their line of junction.

The flexibility of the spine is secured to the utmost requisite extent, by the great number of articulations or joints which it possesses, amounting to more than twenty; as well as by the elasticity of the substance constituting those joints: and the projecting parts or processes of the several *vertebræ*, which serve for the insertion of the muscles and tendons which are to move the whole, are differently disposed in the neck, the back, and the loins; so as to be accommodated to the degree and kind of motion required in each: thus the *vertebræ* of the neck admit of a lateral motion to a greater extent than those of the back; and the *vertebræ* of the back admit of flexion and extension to a greater degree than those of the neck;

while the vertebræ of the loins, being intended for support rather than flexibility, have their processes so distributed, as to contribute principally to the former of those effects.

Thus far we have considered the conditions of the adult spine, and have seen that they are calculated most admirably both for flexibility and for strength. Let us now examine the same column in the age of early infancy; and here we shall see, that, although at that period the parts, in which the conditions of strength and flexibility are so remarkably developed in the adult state, are not yet formed, or not completed; those parts which are essential to the security of the life of the individual are nearly in as perfect a state as at the age of manhood: so that in the midst of the most decided marks of weakness and imperfection in the rest of the column, there is an extraordinary instance of strength and perfect growth, in precisely that part of it which could not have been left in an incomplete state, without manifest, immediate, and constant danger to the individual. In other words, the bodies and processes of the several vertebræ on which the strength and flexibility of the spine depend, are in early infancy still in a soft or cartilaginous state; while the annular portions, which with their intervening ligaments constitute the spinal canal, are completely ossified; so as to give as great a degree of security to the spinal marrow as at the age of manhood.

Nor need we spend much time in ascertaining the final cause of this remarkable difference. Is it not indeed obvious on a moment's reflection, that the very helplessness and imperfect state of the physical powers in infancy, so ill understood and appreciated, though so beautifully described by Lucretius, contribute to the fuller developement of the moral character, not only of the individual, but of his parents also, and of all his immediate connexions. The mutual affection, for instance, that takes place and is cemented between the infant and its mother, during

the lengthened period in which the latter nurses her offspring; the stimulus, which is given to the exertions of the other parent in supplying the increasing wants of those who depend on him for support; and the general feeling and expression of good-will and attachment, which bind together the numerous individuals of the same family; all coincide to increase the sum of human happiness and virtue. Whereas, were the infant born with all its powers complete, and capable of exerting those powers as soon as born, independently of the assistance of parent, or sister, or brother; what would then remain of those endearing relations, but the empty name?

How incorrect then is the conclusion of the poet in that otherwise most beautiful passage of his poem! "The new-born babe, which, like the shipwrecked mariner, lies prostrate on the ground, naked and destitute of every assistance required for the support of life, pierces the surrounding air with its incessant cries; as if foreseeing the long train of miseries which it must hereafter encounter. And yet the tender foal and lamb not only begin to crop the grass, but play about the mother almost as soon as born. The nurse's soothing lullaby is not wanted by them, nor the excitement of the rattle or of any other toy: nor do they require a change of dress accommodated to the changing temperature of the surrounding atmosphere; nor arms for their defence, nor walled cities for their protection; kind nature supplying to them in bountiful profusion whatever is necessary to satisfy their wants."* As if it might not have been reasonably and safely concluded, that that same power, (call it "nature," or by any other name,) which provided so amply for the early wants of the lower species of animals, had some good and special reason for leaving the human infant in a temporary state of helpless weakness.

* Tum porro Puer, ut sævis projectus ab undis
Navita, nudus humi jacet, infans, indigus omni

SECTION III.

Physical Superiority of Man, on what Principle to be estimated.

FROM this helplessness in his early years, and from the occasional inferiority of some of his physical organs to the corresponding organs of brutes, it has sometimes been absurdly asked what claim man has, from his physical structure or powers, to be placed first in the scale of animal beings. His strength, what is it to that of the elephant or of the horse, or even of some species of reptiles or fish? his powers of sight and motion, what are they to those of the bird? his sense of odours, to that of the dog? his touch, to that of the spider?

And yet, even if we entirely omit the consideration of the soul, that immaterial and immortal principle which is for a time united to his body, and view him only in his merely animal character, man is still the most excellent of animals. How confined are the powers of other animals, considered generally, when compared with those of the human species. The comb of the bee indeed is in its construction wonderful; and so is even the nest of the bird, or the habitation of the beaver: but these animals could never be taught to fabricate, or to use, the simplest of those machines or instruments, which man, even in a very partially civilized state, is in the daily habit of making

Vitali auxilio, cum primum in luminis oras
 Nixibus ex alvo matris natura profudit;
 Vagituque locum lugubri complet, ut æquum 'st
 Cui tantum in vita restet transire malorum.
 At variæ crescunt Pecudes, Armenta, Feræque;
 Nec crepitacula eis opu' sunt, nec cuiquam adhibenda 'st
 Almæ nutricis blanda atque infracta loquela:
 Nec varias quærent Vesteis pro tempore Cæli.
 Denique non Armis opus est, non Mænibus altis,
 Queis sua tutentur, quando omnibus omnia large
 Tellus ipsa parit, naturaque dædala rerum.

Lib. v. 223—235.

and employing: much less could they be taught to perform those complicated operations which result from their employment.

But, it may perhaps be said, it is the mind, the intellectual power of man, which enables him to produce the effects in question. His mind indeed enables him to conceive the plan of those operations which he executes, but it does no more: and were his form deficient by one of the smallest of its present members, he would be rendered nearly helpless. Take from his hand but one of the fingers, and he could do nothing. It is the human hand which gives the power of execution to the human mind; and it is the relative position of one of the fingers to the other four, which principally stamps the character of the hand; for the thumb, by its capability of being brought into opposition with each of the other fingers, enables the hand to adapt itself to every shape; and gives it that complete dominion which it possesses over the various forms of matter.*

Give all the intelligence therefore that you please to the horse, or to the elephant, yet with hoofs instead of hands it is physically impossible that they could construct the simplest instrument: nor could the organs even of the beaver, were that animal gifted with the highest intellectual powers, enable it to effect much more than it is capable of effecting at present.

Man then is in every sense superior, in organization as well as in intellectual powers, to all other animals; and the degree of resemblance to him, as thus superior, is the main principle of classification adopted at the present day: and upon the whole it will be found that, in proportion as the powers and relations of animals are extensive, their structure resembles that of man. And, with respect to the degrees of this resemblance, it may be observed that

* The term *poltroon*, if not of fancied etymology, (*pollice truncatus*,) verifies this statement; the Roman soldier who had been deprived of his thumb, being deemed unfit for service.

occasionally it is so strong, as to constitute all but identity of form, as in some of the quadrumanous animals, or apes; while in others it is so faint, as to render it questionable whether we are viewing an animate or inanimate body, as in several varieties of sponge. It is evident that the stability of the principle of classification, now described, depends on the permanency of the specific form of animals: and it will be found that nature has guarded this point in so sacred a manner, that after the lapse of thousands of years, the identity of the species may be not only traced, but demonstrated, when nothing but the almost mouldering bones of the individual remain. But this subject will be considered more at large hereafter.

As then, in estimating the moral or intellectual characters of particular men, we are not influenced by the consideration of insulated defects or excellences, but of the aggregate powers and qualities of the individual; so, in comparing other animals with man, we ought not to affirm that they approach nearer to the standard of his perfection in proportion as they approach nearer to him in the structure of this or that part, or in the developement of particular powers or qualities; but in proportion to that approximation which results from the balance of their structure and powers considered collectively. And on this principle, however nearly a few of them may resemble him, they never can approach even the confines of an equality of nature; whatever some speculative individuals have presumptuously supposed, or others in their simplicity have feared. Thus the resemblance to the human form, as well internally as externally, is so remarkable in particular species of the ape, that while some philosophers (who however proceeded without a knowledge or a due consideration of the true principles of the science concerned in their reasonings) have maintained that the ape and man are but varieties of the same species, or at most but different species of the same genus; others, with

an unnecessary anxiety, have laboured to vindicate the supposed insult thus offered to the dignity of human nature, by searching for some fixed and invariable difference in the structure of corresponding parts of each.

But the question is puerile: for let us even suppose that the whole and every part of the structure of the ape were the same as that of man; let every bone, and every muscle, and every fibre of the one correspond exactly with those of the other, not only in form and situation, but also in size and proportion; let the brain itself, that tangible instrument of the intellectual powers, be in structure the counterpart of the human; yet, unless in its functions it resembled that of man, in other words, unless there were associated with it his intellectual peculiarities and the moral and religious sense, to what dreaded conclusion would the closest resemblances lead? However near the approximation in their form, in their nature there must ever be an immeasurable distance between the two. The ape, compared with man, may indeed be among other animals "*proximus huic:*" still however it must be added, "*longo sed proximus intervallo.*"

SECTION IV.

Early and gradual Developement of the intellectual Faculties of Man.

THE helplessness of infancy then is but temporary: and a new scene soon opens to the contemplation of those who have sufficient opportunities of watching the developement of the human character: for, long as is the period, compared with the natural term of his own life, and longer still, compared with the corresponding period in the life of other animals, before man attains the full stature of his mind as well as of his body; he at a very early season begins to manifest the superiority of his intellectual nature: he very soon begins to collect those materials for future

use, which, though he will never hereafter be able to call to mind the moment or the circumstances of their accession, he will use as effectually as if he had originally acquired them by industrious and direct attention.

It does not fall within the intention of this treatise to attempt to ascertain the period when the first dawn of intelligence enlightens the countenance of the infant; but, undoubtedly, among its earliest beams are those expressive smiles, which, although they are occasioned by the aspect of the mother, and are perhaps only connected with the expectation of an animal pleasure, namely the simple enjoyment of nourishment, yet are soon elicited by other individuals also, who may understand how to win the attention, and amuse the faculties of the infant mind.

It seems as if there were implanted in the young of all animals, of the higher orders, an instinctive propensity to those actions which are naturally determined by their specific form when fully developed; in order perhaps, among other purposes, to give occasion for that exercise of the limbs which is necessary to the health of the individual. Hence the young ram couches his head, and tilts at his adversary, long before his horns have appeared; and the young pheasant assails his antagonist with his projected legs, long before his spurs have begun to bud. And, following this analogy, may we not reasonably suppose that the sports of childhood have a natural tendency to prefigure the occupations of manhood; and that by the extension of the same principle, independently of the impulse given by systematic education, or spontaneous imitation of their parents and others, there are instinctive differences in the amusements of children of different temperaments, connected with their future destinations in life? Thus while the boy is engaged in the mimicry of military parade or equestrian exercises, the girl devotes her time to more feminine occupations, and busies herself in acting the various duties which her nursery or house-

hold will hereafter require. The recorded attempt to conceal Achilles in female attire, whether founded in fact, or, as is probable, merely a fictitious anecdote, will serve to illustrate the present point; inasmuch as the use of the means, said to have been employed by Ulysses to detect the hero, was evidently suggested by the principle just now advanced.

At this early period of life then, the judgment being not sufficiently matured for deeper observation, the mind is satisfied with a view of the form and surface of objects presented to it; with their anatomy, as it were, rather than with their physiology: but, in the mean time, it is thus acquainting itself undistractedly with those sensible qualities, with which it must necessarily be familiar before it can proceed to reason on causes and relations. And although it may appear at first view that a very disproportionately long period of our life is devoted to the mere exercise of the senses, it is yet highly probable that important mental operations may be simultaneously going on, though we are at the time unconscious of them: for something analogous is observable throughout the whole course of our existence. How few there are, for instance, who, at any period of life, can call to mind a tenth part of what they have even recently heard or observed. And if this may be correctly affirmed of the adult age of life, and of those individuals whose original powers of mind are great, how much more strongly will it apply to those whose original powers of mind are not above the common standard, or not yet matured by age. So that there can be very little doubt that the general principles and rules, which regulate the reasoning and conduct of men on ordinary occasions, have been originally deduced by each individual from much of what has been long forgotten.

It has been asserted by persons,* whose intellectual

* Lord chief justice Hale; (see Boswell's Life of Johnson, vol. ii. p. 511, 4to. London, 1791;) not to mention living authorities.

powers were of the highest order, and whose industry was as remarkable as their abilities, that more than six or eight hours in each day could not be employed effectively by the generality of young men for the purpose of mental improvement. If this however be the case, and as a general position it probably is not very far from the truth, in vain does the ambitious student rob nature of that sleep which Providence has made necessary for the renovation of the exhausted powers of our mind, as well as of our body; and in vain also does he attempt to combine simultaneously the efforts of mental attention with bodily exercise, or to pursue his severer studies during the hour of meals: in both which cases, they, who adopt the custom, not only err in employing too continuous an application of the powers of the mind; but in impeding to a certain and often very inconvenient degree the process of natural respiration; and, consequently, of other functions of the body, particularly of digestion. How main a point ought it to be therefore with those who superintend the education of young persons, to avoid the application of too great a strain on the natural spring of the intellectual powers.

It is questionable whether at any period of life the correspondence between the external world and the sensitive and intellectual faculties of man, is so rapid, so vivid, and so effectual, as during that space which is intermediate to infancy and adolescence: and this fact, if it be so, may be explained by that principle of our nature, on which depends the love of novelty; namely, that susceptibility of the nerves which makes them capable of being stimulated more vehemently by new, than by accustomed impressions: for certainly this principle is likely to be more exercised in proportion as we are nearer the period of infancy; since every impression is then either absolutely new, or has not yet rendered the nerves dull by too frequent a repetition of its application. Another happy instance of the harmony that exists between the na-

ture of man and the external world, is the readiness and confidence with which at this early period of life the impressions of sense are received. Where all is new, and therefore equally matter of wonder, there is yet no room for doubt. Nature teaches the mind to receive every thing without distrust, and to rely implicitly on those inlets to knowledge, the impressions of sense, which are destined to be its only guides in the first years of life. Scepticism is not the tendency of childhood: and perhaps it is with reference to the analogy between the eye of faith and the eye of sense at this early period of life, that our Saviour pronounces a blessing upon those who receive the evidences of our religion with the simplicity of little children.

CHAPTER III.

ON THE POWERS OF THE HUMAN HAND, CONSIDERED AS A CORPOREAL ORGAN.

At length however, having passed the preparatory discipline both of natural and of parental education, and having arrived at the maturity of his powers, man is fitted to exercise his empire over the external world.

But before we consider the character of the materials provided for the supply of his various wants, or for the exercise of his intellectual faculties, let us examine more closely than hitherto the condition of those corporeal organs, by the agency of which he is enabled to produce the results intended.

There can be no doubt that those organs are, if not exclusively, at least pre-eminently, the *brain* and the *hand*: of the latter of which, not only are the uses of the several parts and of the whole made practically manifest every moment of our lives; but its antecedent capabilities are so open to the investigat-

ing eye of reason, as to afford one of the readiest subjects of physical demonstration. And although, with respect to the brain, we not only have no satisfactory evidence, but cannot even form a probable conjecture, of the use or mode of action of any particular part; yet we cannot doubt that it is the instrument by which our intellectual powers hold communion with external nature. I shall dedicate therefore this and the following chapter to the consideration of the general history of these organs.

It would be an invasion of the province of others to give an anatomical description of the several constituent parts of the human hand: but in saying that its adaptation to the various purposes to which it is applicable is so open to the investigating eye of reason, as to afford one of the readiest subjects of physical demonstration, a tacit reference was made to that remarkable part of the writings of Galen, in which he expatiates upon the capabilities of this wonderful instrument: and that that extraordinary writer could hardly have selected a better subject, for the exercise of his powers in intellectual analysis, will be readily granted on a perusal of the following passages; provided they correctly represent the spirit of the original.

In that portion of his works which bears this title, "On the Use of the various Parts of the Body," after having defined what is to be understood by the term *part*, or *member*, as applied to an animal body, Galen proceeds in the following manner:* "But all these parts of the body were made for the use of the soul, that sentient and intelligent principle which animates the body, and of which the body is merely the organ; and on this account the component parts of animals differ according to the nature of this principle: for some animals are bold and fierce; others are timid and gentle: some are gregarious, and co-operate for their mutual sustenance and defence; others are soli-

* Lib. i. cap. 2.

tary, and avoid the society of their fellows: but all have a form or body accommodated to their natural dispositions and habits. Thus the lion has powerful fangs and claws; the hare has swiftness of foot, but in other points is defenceless. And the fitness of this arrangement is obvious: for those weapons with which the lion is furnished are as appropriate to his nature, as they would be useless to the timid hare; whose safety, depending entirely on flight, requires that swiftness of foot for which she is so remarkable. But to man, the only animal that partakes of divine intelligence, the Creator has given, in lieu of every other natural weapon or organ of defence, that instrument, *the hand*; an instrument applicable to every art and occasion, as well of peace as of war. Man therefore wants not a hoof, or horn, or any other natural weapon; inasmuch as he is able with his hand to grasp a much more effective weapon, the sword or spear. Besides which, natural weapons can be employed only in close conflict; while some of the weapons employed by man, as javelins or arrows, are even more effectual at a distance. And, again, though man may be inferior to the lion in swiftness, yet by his dexterity and skill he breaks in to his use a still swifter animal, the horse; mounted on whose back he can escape from or pursue the lion, or attack him at every advantage. He is enabled moreover by means of this instrument to clothe himself with armour of various kinds, or to entrench himself within camps or fenced cities. Whereas were his hands encumbered with any natural armour, he would be unable to employ them for the fabrication of those instruments and means, which give him such a decided advantage over all the other animals of creation.

“Nor have we yet enumerated the most important of those privileges which the hand imparts to man. With this he weaves the garment that protects him from the summer’s heat, or winter’s cold; with this he forms the various furniture of nets and snares,

which give him dominion over the inhabitants as well of the water as of the air and earth: with his hand he constructs the lyre and lute, and the numerous instruments employed in the several arts of life; with the hand he erects altars and shrines to the immortal gods; and, lastly, by means of the same instrument he bequeaths to posterity, in writing, the intellectual treasures of his own divine imagination: and hence we, who are living at this day, are enabled to hold converse with Plato and Aristotle, and all the venerable sages of antiquity."

In reasoning on the utility of the hand, as characteristic of the human species, Galen thus expresses himself:* "Man being naturally destitute of corporeal weapons, as also of any instinctive art, has received a compensation, first in the gift of that peculiar instrument the hand, secondly in the gift of reason; by the employment of which two gifts he arms and protects his body in every mode, and adorns his mind with the knowledge of every art. For since, had he been furnished with any natural weapon, he would have possessed the use of this alone on all occasions; or had he been gifted with any instinctive art, he would never have attained to the exercise of other arts; hence he was created destitute of those insulated and individual means and arts, which characterize other animals; inasmuch as it is manifestly preferable to have the power of making use of various means and various arts. Rightly, therefore, has Aristotle defined the hand to be the instrument antecedent to, or productive of, all other instruments: and rightly might we, in imitation of Aristotle, define reason, as opposed to instinct, to be the art antecedent to, or productive of, all other arts. For as the hand, though itself no particular organ, is yet capable of being adapted to all other organs, and is consequently antecedent to them; so reason, though itself no particular art, is yet capable of comprehend-

* Lib. i. cap. 4.

ing and applying all; and may therefore be considered as an art antecedent to all others. Thus man alone, of all animals, possessing in his soul this general and original capacity, is justly endued in his body with this general and original instrument."

* "Let us then scrutinize this member of our body; and inquire, not simply whether it be in itself useful for all the purposes of life, and adapted to an animal endued with the highest intelligence; but whether its entire structure be not such, that it could not be improved by any conceivable alteration.

"In the first place, it possesses in an eminent degree a leading quality of an organ of grasp; since it readily applies itself to, and securely holds, bodies of every form and size that are capable of being moved by human strength. Nor need we inquire whether it be better for this purpose that it should be divided into several parts; or, that it should be altogether undivided: for is it not apparent without further reasoning, that had it been undivided, it could have grasped only just such a portion of every object presented to it, as was equal to itself; but that, being divided into many parts, it can both easily grasp bodies much larger than itself; and can accurately search out, and lay hold of, the smallest particles of matter? For to the former it is capable of generally applying itself so, as to encompass them by the separation of the fingers; while in laying hold of very minute objects, the entire hand is not employed, but only the tips of two of the fingers: because from the grasp of the whole hand minute objects would easily escape.

"Thus then the hand is framed in the manner most convenient for laying a firm hold on objects both greater and less than itself. And in order to enable it to apply itself to objects of various shapes, it is evidently most convenient that it should be divided into many parts, as it is: and it seems to be better

* Lib. i. cap. 5.

constituted for this purpose than any similar instrument; for it not only can apply itself to substances of a spherical form, so as to touch them with every part of itself; but it also can securely hold substances of a plane or of a concave surface; and, consequently, it can hold substances of any form.

“And, because many bodies are of too great a size to be held by one hand alone, nature has therefore made each hand an assistant to its fellow; so that the two, when together laying hold of bodies of unusual bulk, on opposite sides, are fully equivalent to a single hand of the very largest dimensions: and, on this account, the hands are inclined towards, and in every point are made equal to, each other; which is at least desirable, if not necessary, in instruments intended to have a combined action.

“Take then any one of those unwieldy bodies, which a man can only lay hold of by means of both his hands, as a millstone or a rafter; or take one of the smallest objects, as a millet-seed or a hair, or a minute thorn; or, lastly, reflect on that vast multitude of objects of every possible size, intermediate to the greatest and the least of those above mentioned; and you will find the hands so exactly capable of grasping each particular one, as if they had been expressly made for grasping that alone. Thus the smallest things of all we take up with the tips of the fingers; those which are a little larger we take up with the same fingers, but not with the tips of them; substances still larger we take up with three fingers, and so on with four, or with all the five fingers, or even with the whole hand: all which we could not do, were not the hand divided, and divided precisely as it is. For suppose the thumb were not placed as it is, in opposition to the other four fingers, but that all the five were ranged in the same line; is it not evident that in this case their number would be useless? For in order to have a firm hold of any thing, it is necessary either to grasp it all round, or at least to grasp it in two opposite points; neither of which

would have been possible, if all the five fingers had been placed in the same plane: but the end is now fully attainable, simply in consequence of the position of the thumb; which is so placed, and has exactly such a degree of motion, as, by a slight inclination, to be easily made to co-operate with any one of the four fingers. And no one can doubt that nature purposely gave to the hands a form adapted to that mode of action, which they are observed to have;* while in the feet, where extent of surface is wanted for support, all the toes are arranged in the same plane. † But, to return to a point which we were just now considering, it is not merely necessary in laying hold of minute objects to employ the extremities of the fingers opposed to each other, but that those extremities should be exactly of the character they are, namely soft, and round, and furnished with nails: for if the tips of the fingers were of bone, and not of flesh, we could not then lay hold of such minute bodies as thorns or hairs; or if they were of a softer and moister substance than flesh, neither then could such small bodies have been secured. For, in order that a body may be firmly held, it is necessary that it be in some degree infolded in the substance holding it; which condition could not have been fulfilled by a hard or bony material; and on the other hand, a material too soft would easily yield to substances of which it attempted to lay hold, and would continually let them escape: whereas the extremities of the fingers are just of that intermediate degree of consistence, which is calculated for their intended use.

‡ “But, since tangible substances vary much in their degree of hardness, nature has adapted the structure of the extremities of the fingers to that circumstance: for they are not formed either entirely of flesh, or of the substance called nail; but of a most convenient combination of the two: thus those parts which are capable of being mutually brought in appo-

* Lib. ii. cap. 9.

† Lib. i. cap. 6.

‡ Lib. i. cap. 7.