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978-1-108-06439-2 - The History and Present State of Electricity: With Original Experiments

Joseph Priestley

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# The History and Present State of Electricity

*With Original Experiments*

JOSEPH PRIESTLEY



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Frontmatter

[More information](#)

T H E  
H I S T O R Y  
A N D  
P R E S E N T S T A T E  
O F  
E L E C T R I C I T Y ,  
W I T H  
O R I G I N A L E X P E R I M E N T S ,

By JOSEPH PRIESTLEY, LL.D. F. R. S.

*Causa latet, vis est notissima.*

OVID.

L O N D O N ,

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Frontmatter

[More information](#)

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THE RIGHT HONOURABLE  
**JAMES Earl of MORTON,**  
PRESIDENT OF THE ROYAL SOCIETY,  
This HISTORY, &c.  
IS,  
WITH THE GREATEST RESPECT,  
INSCRIBED,  
By His LORDSHIP'S  
MOST OBEYANT,  
AND MOST HUMBLE  
SERVANT,  
*JOSEPH PRIESTLEY.*

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[More information](#)

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T H E  
  
P R E F A C E

**I**N writing the *history and present state of electricity*, I flatter myself that I shall give pleasure, as well to persons who have a taste for Natural Philosophy in general, as to electricians in particular; and I hope the work will be of some advantage to the science itself. Both these ends would certainly be answered in a considerable degree, were the execution at all answerable to the design.

THE history of electricity is a field full of pleasing objects, according to all the genuine and universal principles of taste, deduced from a knowledge of human nature. Scenes like these, in which we see a gradual rise and progress in things, always exhibit a pleasing spectacle to the human mind. Nature, in all her delightful walks, abounds with such views, and they are in a more especial manner connected with every thing that relates to human life and happiness; things, in their own nature, the most interesting to us. Hence it is, that the power of association has annexed crowds of pleasing sensations

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tions to the contemplation of every object, in which this property is apparent.

THIS pleasure, likewise, bears a considerable resemblance to that of the sublime, which is one of the most exquisite of all those that affect the human imagination. For an object in which we see a perpetual progress and improvement is, as it were, continually rising in its magnitude; and moreover, when we see an actual increase, in a long period of time past, we cannot help forming an idea of an unlimited increase in futurity; which is a prospect really boundless, and sublime.

THE pleasures arising from views exhibited in *civil*, *natural*, and *philosophical* history are, in certain respects, different from one another. Each has its advantages, and each its defects: and both their advantages and defects contribute to adapt them to different classes of readers.

CIVIL history presents us with views of the strongest passions and sentiments of the human mind, into which every man can easily and perfectly enter; and with such incidents, respecting happiness and misery, as we cannot help feeling would alarm and affect us in a very sensible manner; and therefore, we are at present alarmed and affected by them to a considerable degree. Hence the pleasure we receive from civil history arises, chiefly, from the exercise it affords our passions. The imagination is only entertained with scenes which occasionally start up, like interludes, or episodes, in the great drama, to which we are principally attentive. We are presented, indeed, with the prospect of gradual improvement during the rise of great empires; but, as we read on, we are obliged to contemplate the disagreeable reverse. And the history of  
most

## THE PREFACE.

iii

most states presents nothing but a tedious uniformity, without any striking events, to diversify and embellish the prospect. Besides, if a man have any sentiment of virtue and benevolence, he cannot help being shocked with a view of the vices and miseries of mankind; which, though they be not all, are certainly the most glaring and striking objects in the history of human affairs. An attention, indeed, to the conduct of divine providence, which is ever bringing good out of evil, and gradually conducting things to a more perfect and glorious state, tends to throw a more agreeable light on the more gloomy parts of history, but it requires great strength of mind to comprehend those views; and, after all, the feelings of the heart too often overpower the conclusions of the head.

NATURAL history exhibits a boundless variety of scenes, and yet infinitely analogous to one another. A naturalist has, consequently, all the pleasure which the contemplation of uniformity and variety can give the mind; and this is one of the most copious sources of our intellectual pleasures. He is likewise entertained with a prospect of gradual improvement, while he sees every object in nature rising by due degrees to its maturity and perfection. And while new plants, new animals, and new fossils are perpetually pouring in upon him, the most pleasing views of the unbounded power, wisdom, and goodness of God are constantly present to his mind. But he has no direct view of human sentiments and human actions; which, by means of their endless associations, greatly heighten and improve all the pleasures of taste.

THE history of philosophy enjoys, in some measure, the advantages both of civil and natural history, whereby it is

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relieved

relieved from what is most tedious and disgusting in both. Philosophy exhibits the powers of nature, discovered and directed by human art: it has, therefore, in some measure, the boundless variety with the amazing uniformity of the one and likewise every thing that is pleasing and interesting in the other. And the idea of continual rise and improvement is conspicuous in the whole study, whether we be attentive to the part which nature, or that which men are acting in the great scene.

It is here that we see the human understanding to its greatest advantage, grasping at the noblest objects, and increasing its own powers, by acquiring to itself the powers of nature and directing them to the accomplishment of its own views; whereby the security, and happiness of mankind are daily improved. Human abilities are chiefly conspicuous in adapting means to ends, and in deducing one thing from another by the method of analogy; and where shall we find instances of greater sagacity, than in philosophers diversifying the situations of things, in order to give them an opportunity of showing their mutual relations, affections, and influences; deducing one truth and one discovery from another, and applying them all to the useful purposes of human life.

If the exertion of human abilities, which cannot but form a delightful spectacle for the human imagination, give us pleasure, we enjoy it here in a higher degree than while we are contemplating the schemes of warriors, and the stratagems of their bloody art. Besides, the object of philosophical pursuits throws a pleasing idea upon the scenes they exhibit; whereas a reflection upon the real objects and views of  
most

## THE PREFACE.

v

most statesmen and conquerors cannot but take from the pleasure, which the idea of their sagacity, foresight, and comprehension would otherwise give to the virtuous and benevolent mind. Lastly, the investigation of the powers of nature, like the study of Natural History, is perpetually suggesting to us views of the divine perfections and providence, which are both pleasing to the imagination, and improving to the heart.

BUT though other kinds of history may, in some respects, vie with that of philosophy, nothing that comes under the denomination of history can exhibit instances of so fine a rise and improvement in things, as we see in the progress of the human mind, in philosophical investigations. To whatever height we have arrived in natural science, our beginnings were very low, and our advances have been exceeding gradual. And to look down from the eminence, and to see, and compare all those gradual advances in the ascent, cannot but give the greatest pleasure to those who are seated on the eminence, and who feel all the advantages of their elevated situation. And considering that we ourselves are, by no means, at the top of human science; that the mountain still ascends beyond our sight, and that we are, in fact, not much above the foot of it, a view of the manner in which the ascent has been made cannot but animate us in our attempts to advance still higher, and suggest methods and expedients to assist us in our further progress.

GREAT conquerors, we read, have been both animated, and also, in a great measure, formed by reading the exploits of former conquerors. Why may not the same effect be expected from the history of philosophy to philosophers. May not

not even more be expected in this case? The wars of many of those conquerors, who received this advantage from history, had no proper connection with former wars: They were only analogous to them. Whereas the whole business of philosophy, diversified as it is, is but one; it being one and the same great scheme, that all philosophers, of all ages and nations have been conducting, from the beginning of the world; so that the work being the same, the labours of one are not only analogous to those of another, but in an immediate manner subservient to them; and one philosopher succeeds another in the same field; as one Roman proconsul succeeded another, in carrying on the same war, and pursuing the same conquests, in the same country. In this case an intimate knowledge of what has been done before us cannot but greatly facilitate our future progress, if it be not absolutely necessary to it.

THESE histories are evidently much more necessary in an advanced state of science, than in the infancy of it. At present philosophical discoveries are so many, and the accounts of them are so dispersed, that it is not in the power of any man to come at the knowledge of all that has been done, as a foundation for his own inquiries. And this circumstance appears to me to have very much retarded the progress of discoveries.

NOT that I think philosophical discoveries are now at a stand. On the other hand, as quick advances seem to have been made of late years as in any equal period of time past whatever. Nay, it appears to me, that the progress is really accelerated. But the increase of knowledge is like the increase

## THE PREFACE.

vii

crease of a city. The building of some of the first streets makes a great figure, is much talked of, and known to every body; whereas the addition of, perhaps, twice as much building, after it has been swelled to a considerable size, is not so much as taken notice of, and may be really unknown to many of the inhabitants. If the additions which have been made to the buildings of the city of London, in any single year of late, had been made two or three centuries ago, it could not have escaped the observation of historians; whereas, now, they are so scattered, and the proportion they bear to the whole city is so small, that they are hardly noticed. For the same reason, the improvements that boys make at school, or that young gentlemen make at an academy, or the university, are more taken notice of than all the knowledge they acquire afterwards, though they continue their studies with the same assiduity and success.

THE history of experimental philosophy, in the manner in which it ought to be written, to be of much use, would be an immense work; perhaps more than any one man ought to undertake; but it were much to be wished, that persons who have leisure, and sufficient abilities, would undertake it in separate parts. I have executed it, in the best manner I have been able, for that branch which has been my own favourite amusement; and I shall think myself happy, if the attempt excite other persons to do the like for theirs.

I CANNOT help thinking myself to have been peculiarly fortunate, in undertaking the history of electricity, at the most proper time for writing it, when the materials were neither too few, nor too many to make a history; and when  
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## viii THE PREFACE.

they were so scattered, as to make the undertaking highly desirable, and the work peculiarly useful to Englishmen.

I LIKEWISE think myself peculiarly happy in my subject itself. Few branches of Natural Philosophy would, I think, make so good a subject for a history. Few can boast such a number of discoveries, disposed in so fine a series, all comprised in so short a space of time, and all so recent, the principal actors in the scene being still living.

WITH several of these principal actors it has been my singular honour and happiness to be acquainted; and it was their approbation of my plan, and their generous encouragement that induced me to undertake the work. With gratitude I acknowledge my obligations to Dr. Watson, Dr. Franklin, and Mr. Canton, for the books, and other materials with which they have supplied me, and for the readiness with which they have given me any information in their power to procure. In a more especial manner am I obliged to Mr. Canton, for those original communications of his, which will be found in this work, and which cannot fail to give a value to it, in the esteem of all the lovers of electricity. My grateful acknowledgments are also due to the Rev. Mr. Price F. R. S. and to the Rev. Mr. Holt, our professor of Natural Philosophy at Warrington, for the attention they have given to the work, and for the many important services they have rendered me with respect to it.

To the gentlemen above-mentioned the public is, likewise, indebted for whatever they may think of value in the *original experiments* which I have related of my own. It was from conversing with them that I was first led to entertain the thought



## THE PREFACE.

ix

thought of attempting any thing new in this way, and it was their example, and favourable attention to my experiments, that animated me in the pursuit of them. In short, without them, neither my experiments, nor this work would have had any existence.

THE historical part of the work, the reader, I hope, will find to be full and circumstantial, and at the same time succinct. Every new fact, or important circumstance, I have noted as it arose; but I have abridged all long details, and have carefully avoided all digressions and repetitions. For this purpose, I have carefully perused every original author, to which I could have recourse; and every quotation in the margin points to the authority that I myself consulted, and from which the account in the text was actually taken. Where I could not procure the original authors, I was obliged to quote them at second hand, but the reference will always show where that has been done. That I might not misrepresent any writer, I have generally given the reader his own words, or the plainest translation I could make of them; and this I have done, not only in direct quotations, but where, by a change of person, I have made the language my own.

I MADE it a rule to myself, and I think I have constantly adhered to it, to take no notice of the mistakes, misapprehensions, and altercations of electricians; except so far as, I apprehended, a knowledge of them might be useful to their successors. All the disputes which have no way contributed to the discovery of truth, I would gladly consign to eternal oblivion. Did it depend upon me, it should never be known

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to

to posterity, that there had ever been any such thing as envy, jealousy, or cavilling among the admirers of my favourite study. I have, as far as my best judgment could direct me, been just to the merits of all persons concerned. If any have made unjust claims, by arrogating to themselves the discoveries of others, I have silently restored them to the right owner, and generally without so much as giving a hint that any injustice had ever been committed. If I have, in any case, given a hint, I hope it will be thought, by the offending parties themselves, to be a very gentle one; and that it will be a *memento*, which will not be without its use.

I THINK I have kept clear of any mean partiality towards my own countrymen, and even my own acquaintance. If English authors are oftner quoted than foreign, it is because they were more easily procured: and I have found a difficulty I could not have expected, in procuring foreign publications upon this subject.

I FIND it impossible to write a preface to this work, without discovering a little of the enthusiasm which I have contracted from an attention to it, by expressing my wishes, that more persons of a studious and retired life would admit this part of experimental philosophy into their studies. They would find it agreeably to diversify a course of study, by mixing something of action with speculation, and giving some employment to the hands and arms, as well as to the head. Electrical experiments are, of all others, the cleanest, and the most elegant, that the compass of philosophy exhibits. They are performed with the least trouble, there is an amazing variety in them, they furnish the most pleasing and surprising

## THE PREFACE.

xi

prising appearances for the entertainment of one's friends, and the expence of instruments may well be supplied, by a proportionable deduction from the purchase of books, which are generally read and laid aside, without yielding half the entertainment.

THE instruction we are able to get from books is, comparatively, soon exhausted; but philosophical instruments are an endless fund of knowledge. By philosophical instruments, however, I do not here mean the globes, the orrery, and others, which are only the means that ingenious men have hit upon to explain their own conceptions of things to others; and which, therefore, like books, have no uses more extensive than the views of human ingenuity; but such as the air pump, condensing engine, pyrometer, &c. (with which electrical machines are to be ranked) and which exhibit the operations of nature, that is of the God of nature himself, which are infinitely various. By the help of these machines, we are able to put an endless variety of things into an endless variety of situations, while nature herself is the agent that shows the result. Hereby the laws of her action are observed, and the most important discoveries may be made; such as those who first contrived the instrument could have no idea of.

IN electricity, in particular, there is the greatest room to make new discoveries. It is a field but just opened, and requires no great stock of particular preparatory knowledge: so that any person who is tolerably well versed in experimental philosophy, may presently be upon a level with the most experienced electricians. Nay, this history shows, that several raw adventurers have made themselves as considerable, as some who

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have

have been, in other respects, the greatest philosophers. I need not tell my reader of how great weight this consideration is, to induce him to provide himself with an electrical apparatus. The pleasure arising from the most trifling discoveries of one's own far exceeds what we receive from understanding the much more important discoveries of others; and a mere reader has no chance of finding new truths, in comparison of him who now and then amuses himself with philosophical experiments.

Human happiness depends chiefly upon having some object to pursue, and upon the vigour with which our faculties are exerted in the pursuit. And, certainly, we must be much more interested in pursuits wholly our own, than when we are merely following the track of others. Besides, this pleasure has reinforcements from a variety of sources, which I shall not here undertake to trace; but which contribute to heighten the sensation, far beyond any thing else of this kind that can be experienced by a person of a speculative turn of mind.

It is a great recommendation of the study of electricity, that it now appears to be, by no means, a small object. The electric fluid is no local, or occasional agent in the theatre of the world. Late discoveries show that its presence and effects are every where, and that it acts a principal part in the grandest and most interesting scenes of nature. It is not, like magnetism, confined to one kind of bodies, but every thing we know is a conductor or non-conductor of electricity. These are properties as essential and important as any they are possessed of, and can hardly fail to show themselves wherever the bodies are concerned.

HITHERTO

## THE PREFACE.

xiii

HITHERTO philosophy has been chiefly conversant about the more sensible properties of bodies; electricity, together with chymistry, and the doctrine of light and colours, seems to be giving us an inlet into their internal structure, on which all their sensible properties depend. By pursuing this new light, therefore, the bounds of natural science may possibly be extended, beyond what we can now form an idea of. New worlds may open to our view, and the glory of the great Sir Isaac Newton himself, and all his contemporaries, be eclipsed, by a new set of philosophers, in quite a new field of speculation. Could that great man revisit the earth, and view the experiments of the present race of electricians, he would be no less amazed than Roger Bacon, or Sir Francis would have been at his. The electric shock itself, if it be considered attentively, will appear almost as surprising, as any discovery that he made; and the man who could have made that discovery, by any reasoning *a priori*, would have been reckoned a very great genius: but electrical discoveries have been made so much by accident, that it is more the powers of nature, than of human genius, that excite our wonder with respect to them. But if the simple electric shock would have appeared so extraordinary to Sir Isaac Newton, what would he have said upon seeing the effects of a modern electrical battery, and an apparatus for drawing lightning from the clouds! What inexpressible pleasure would it give a modern electrician, were the thing possible, to entertain such a man as Sir Isaac for a few hours with his principal experiments!

To return from this excursion to the business of a preface: Besides relating the history of electrical discoveries, in the order

der in which they were made, I thought it necessary, in order to make the work more useful, especially to young electricians, to subjoin a methodical treatise on the subject, containing the substance of the history in another form, with observations and instructions of my own. The particular uses of these parts of the work are expressed at large in the introductions to them. And, in the last place, I have given an account of such original experiments as I have been so fortunate as to hit upon myself.

I INTITLED the work the *history and present state of electricity*; and whether there be any new editions of the whole work or not, care will be taken to preserve the propriety of the title, by occasionally printing ADDITIONS, in the same size, as new discoveries are made; which will always be sold at a reasonable price to the purchasers of the book; or given *gratis*, if the bulk be inconsiderable.

CONSIDERING what respectable persons have already honoured this work with their valuable communications, I hope it will not be deemed arrogance in me, if I here advertise, that if any person shall make discoveries in electricity, which he would chuse to see recorded in this history, he will oblige me by a communication of them; and if they be really original, a proper place shall certainly be assigned to them in the next edition, or paper of additions. And I hope that, if electricians in general would fall into this method, and make either a periodical, or occasional, but joint communication of their discoveries to the public, the greatest advantage would thence accrue to the science.

THE business of philosophy is so multiplied, that all the  
books

## THE PREFACE.

xv

books of general philosophical transactions cannot be purchased by private persons, or read by any person. It is high time to *subdivide* the business, that every man may have an opportunity of seeing every thing that relates to his own favourite pursuit: and all the various branches of philosophy would find their account in this amicable separation. Thus the numerous branches of a large overgrown family, in the patriarchal ages, found it necessary to separate; and the convenience of the whole, and the strength, and increase of each branch were promoted by the separation. Let the youngest daughter of the sciences set the example to the rest, and show that she thinks herself considerable enough to make her appearance in the world without the company of her sisters.

BUT before this general separation, let each collect together every thing that belongs to her, and march off with her whole stock. To drop the allusion: let histories be written of all that has been done in every particular branch of science, and let the whole be seen at one view. And when once the entire progress, and present state of every science shall be fully and fairly exhibited, I doubt not but we shall see a new and capital *era* commence in the history of all the sciences. Such an easy, full, and comprehensive view of what has been done hitherto could not fail to give new life to philosophical inquiries. It would suggest an infinity of new experiments, and would undoubtedly greatly accelerate the progress of knowledge; which is at present retarded, as it were, by its own weight, and the mutual entanglement of its several parts.

I WILL just throw out a further hint, of what, I think, might be favourable to the increase of philosophical knowledge. At present there are, in different countries in Europe, large incor-

incorporated societies, with funds for promoting philosophical knowledge in general. Let philosophers now begin to subdivide themselves, and enter into smaller combinations. Let the several companies make small funds, and appoint a director of experiments. Let every member have a right to appoint the trial of experiments in some proportion to the sum he subscribes, and let a periodical account be published of the result of them all, successful or unsuccessful. In this manner, the powers of all the members would be united, and increased. Nothing would be left untried which could be compassed at a moderate expence, and it being *one person's business* to attend to these experiments, they would be made, and reported without loss of time. Moreover, as all incorporations in these smaller societies should be avoided, they would be encouraged only in proportion as they were found to be useful; and success in smaller things would excite them to attempt greater.

I BY no means disapprove of large, general and incorporated societies. They have their peculiar uses too; but we see by experience, that they are apt to grow too large, and their forms are too slow for the dispatch of the *minutiæ* of business, in the present multifarious state of philosophy. Let recourse be had to rich incorporated societies, to defray the expence of experiments, to which the funds of smaller societies shall be unequal. Let their transactions contain a summary of the more important discoveries, collected from the smaller periodical publications. Let them, by rewards, and other methods, encourage those who distinguish themselves in the inferior societies; and thus give a general attention to the whole business of philosophy.

I WISH



## THE PREFACE.

xvii

I WISH all the incorporated philosophical societies in Europe would join their funds (and I wish they were sufficient for the purpose) to fit out ships for the complete discovery of the face of the earth, and for many capital experiments which can only be made in such extensive voyages.

PRINCES will never do this great business to any purpose. The spirit of adventure seems to be totally extinct in the present race of merchants. This discovery is a grand desideratum in science; and where may this pure and noble enthusiasm for such discoveries be expected but among philosophers, men uninfluenced by motives either of policy or gain? Let us think ourselves happy if princes give no obstruction to such designs. Let them fight for the countries when they are discovered, and let merchants scramble for the advantage that may be made of them. It will be an acquisition to philosophers if the seat of war be removed so far from the seat of science; and fresh room will be given to the exertion of genius in trade, when the old beaten track is deserted, when the old system of traffick is unhinged, and when new and more extensive plans of commerce take place. I congratulate the present race of philosophers on what is doing by the English court in this way; for with whatever view expeditions into the South seas are made, they cannot but be favourable to philosophy.

NATURAL Philosophy is a science which more especially requires the aid of wealth. Many others require nothing but what a man's own reflection may furnish him with. They who cultivate them find within themselves every thing they want. But experimental philosophy is not so independent.

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Nature

Nature will not be put out of her way, and suffer her materials to be put into all that variety of situations which philosophy requires, in order to discover her wonderful powers, without trouble and expence. Hence the patronage of the great is essential to the flourishing state of this science. Others may project great improvements, but they only have the power of carrying them into execution.

BESIDES, they are the higher classes of men which are most interested in the extension of all kinds of natural knowledge; as they are most able to avail themselves of any discoveries, which lead to the felicity and embellishment of human life. Almost all the elegancies of life are the produce of those polite arts, which could have had no existence without natural science, and which receive daily improvements from the same source. From the great and the opulent, therefore, these sciences have a natural claim for protection; and it is evidently their interest not to suffer promising inquiries to be suspended, for want of the means of prosecuting them.

BUT other motives, besides this selfish one, may reasonably be supposed to attach persons in the higher ranks of life to the sciences; motives more exalted, and flowing from the most extensive benevolence. From Natural Philosophy have flowed all those great inventions, by means of which mankind in general are able to subsist with more ease, and in greater numbers upon the face of the earth. Hence arise the capital advantages of men above brutes, and of civilization above barbarity. And by these sciences also it is, that the views of the human mind itself are enlarged, and our common nature improved and enobled. It is for the honour  
of

## THE PREFACE.

xix

of the species, therefore, that these sciences should be cultivated with the utmost attention.

AND of whom may these enlarged views, comprehensive of such great objects, be expected, but of those whom divine providence has raised above the rest of mankind. Being free from most of the cares peculiar to individuals, they may embrace the interests of the whole species, feel for the wants of mankind, and be concerned to support the dignity of human nature.

GLADLY would I indulge the hope, that we shall soon see these motives operating in a more extensive manner than they have hitherto done; that by the illustrious example of a few, a taste for natural science will be excited in many; in whom it will operate the most effectually to the advantage of science and of the world; and that all kinds of philosophical inquiries will, henceforward, be conducted with more spirit, and with more success than ever.

WERE I to pursue this subject, it would carry me far beyond the reasonable bounds of a preface. I shall therefore conclude with mentioning that sentiment, which ought to be uppermost in the mind of every philosopher, whatever be the immediate object of his pursuit; that speculation is only of use as it leads to *practice*, that the immediate use of natural science is the power it gives us over nature, by means of the knowledge we acquire of its laws; whereby human life is, in its present state, made more comfortable and happy; but that the greatest, and noblest use of philosophical speculation is the discipline of the heart, and the opportunity it affords of inculcating benevolent and pious sentiments upon the mind.

A PHILOSOPHER ought to be something greater, and better than another man. The contemplation of the works of God should give a sublimity to his virtue, should expand his benevolence, extinguish every thing mean, base, and selfish in his nature, give a dignity to all his sentiments, and teach him to aspire to the moral perfections of the great author of all things. What great and exalted beings would philosophers be, would they but let the objects about which they are conversant have their proper moral effect upon their minds! A life spent in the contemplation of the productions of divine power, wisdom, and goodness, would be a life of devotion. The more we see of the wonderful structure of the world, and of the laws of nature, the more clearly do we comprehend their admirable uses, to make all the percipient creation happy: a sentiment, which cannot but fill the heart with unbounded love, gratitude, and joy.

EVEN every thing painful and disagreeable in the world appears to a philosopher, upon a more attentive examination, to be excellently provided, as a remedy of some greater inconvenience, or a necessary means of a much greater happiness; so that, from this elevated point of view, he sees all temporary evils and inconveniences to vanish, in the glorious prospect of the greater good to which they are subservient. Hence he is able to venerate and rejoice in God, not only in the bright sun shine, but also in the darkest shades of nature, whereas vulgar minds are apt to be disconcerted with the appearance of evil.

NOR

## THE PREFACE.

xxi

NOR is the cultivation of piety useful to us only as *men*, it is even useful to us as *philosophers*: and as true philosophy tends to promote piety, so a generous and manly piety is, reciprocally, subservient to the purposes of philosophy; and this both in a direct, and an indirect manner. While we keep in view the great final cause of all the parts and the laws of nature, we have some clue, by which to trace the efficient cause. This is most of all obvious in that part of philosophy which respects the animal creation. As the great and excellent Dr. Hartley observes. “ Since this world is a system of benevolence, and consequently its author the object of unbounded love and adoration, benevolence and piety are our only true guides in our inquiries into it; the only keys which will unlock the mysteries of nature, and clues which lead through her labyrinths. Of this all branches of natural history, and natural philosophy afford abundant instances. In all these inquiries, let the inquirer take it for granted previously, that every thing is right, and the best that can be *ceteris manentibus*; that is, let him, with a pious confidence, seek for benevolent purposes, and he will be always directed to the right road; and after a due continuance in it, attain to some new and valuable truth: whereas every other principle and motive of examination, being foreign to the great plan on which the universe is constructed, must lead into endless mazes, errors, and perplexities. \*

WITH respect to the indirect use of piety, it must be observed, that the tranquility, and cheerfulness of mind, which

\* Hartley's Observations on Man, Vol. 2. p. 245.

results

results from devotion forms an excellent temper for conducting philosophical inquiries; tending to make them both more pleasant, and more successful. The sentiments of religion and piety tend to cure the mind of envy, jealousy, conceit, and every other mean passion, which both disgrace the lovers of science, and retard the progress of it, by laying an undue bias upon the mind, and diverting it from the calm pursuit of truth,

LASTLY, let it be remembered, that a taste for science, pleasing, and even honourable as it is, is not one of the highest passions of our nature, and the pleasures it furnishes are even but one degree, above those of sense; and therefore that temperance is requisite in all scientific pursuits. Besides the duties of every man's proper station in life, which ought ever to be held sacred and inviolate, the calls of piety, common friendship, and many other avocations ought generally to be heard before that of study. It is therefore only a small share of their leisure that most men can be justified in giving to the pursuit of science; though this share is more or less, in proportion to a man's situation in life, his natural abilities, and the opportunity he has for conducting his inquiries.

I SHALL conclude with another passage from Dr. Hartley to this purpose. “ Though the pursuit of truth be an entertainment and employment suitable to our rational natures, and a duty to him who is the fountain of all knowledge and truth, yet we must make frequent intervals and interruptions; else the study of science, without a view to God and our duty, and from a vain desire of applause, will get possession of our hearts, engross them wholly, and  
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