

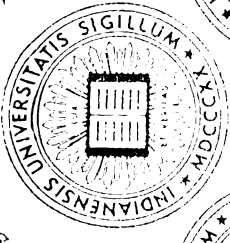


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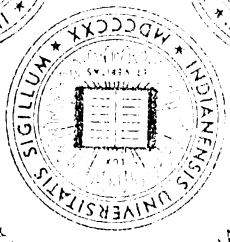
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# INTRODUCTION

TO THE

## Doctrines of *Fluxions*,

And DEFENCE of the

### MATHEMATICIANS

AGAINST THE

OBJECTIONS of the Author of the  
*ANALYST*, so far as they are designed to  
affect their general Methods of Reasoning.

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Thomas Bayes




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# P R E F A C E.

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*HAVE* long ago thought that the first principles and rules of the method of Fluxions stood in need of a more full and distinct explanation and proof, than what they had received either from their first incomparable author, or any of his followers; and therefore was not at all displeas'd to find the method itself oppos'd with so much warmth by the ingenious author of the Analyst; and had it been his only design to bring this point to a fair issue, whether a demonstration by the method of Fluxions be truly scientific or not, I should have heartily applauded his conduct, and have thought he deserved the thanks even of the Mathematicians themselves. But the invidious light in which he has put this debate, by representing it as of consequence to the interests of religion, is, I think, truly unjustifiable, as well as highly imprudent. Among all wise and fair inquirers, 'tis beyond all contradiction plain, that religion can be no ways affected by the truth or falshood of the doctrine of Fluxions. And tho' prejudic'd minds may be variously affected by it, yet it is not easy to be conceived what advantage this debate is likely to give to the cause of religion and virtue in general even among them. Whereas it is easy to guess of what disservice our author's representation of a controversy in which

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religion





religion has no manner of concern, may be towards raising and inflaming the passions of weak men on both sides of the question: And I wish he had been pleased coolly to consider beforehand of what consequence the result of this dispute is likely to be to the cause of religion, among those for whose conviction his Analyst is chiefly designed. If he should not be able to make out his point, will not the blind followers of the Infidel Mathematicians be more confirmed in their errors than they were before? Will they not be more prejudiced against religion, and established in their esteem and veneration of their masters by a weak and fruitless attempt to depress their characters; and by finding that a zeal for it has occasioned so strong an attempt to wound the reputation of Sir Isaac Newton as a cautious and fair reasoner? And on the other hand, if our author should carry his point, and his proofs should be allowed, that the doctrine of Fluxions is an incomprehensible mystery, and that the most accurate Mathematicians have, one after another, imposed upon themselves in the most egregious manner, by false and inconclusive reasonings, what consequences can we suppose that such persons will draw from these premises? Our Author indeed would have them only from hence make this one conclusion, That their masters, the Mathematicians, are not to be depended upon when they speak against religion. But I believe it can't in reason be expected that they should stop here.

If such men as Dr. Barrow, Dr. Clarke, &c. and the incomparable Sir Isaac Newton, were capable of imagining that they saw with the greatest clearness and perspicuity, where they had nothing but absolute and incomprehensible darkness before them, what conclusion will persons, used to take their opinions from authority, be likely to make  
from

from these premises, but that all pretences to knowledge in religion, and every thing else, are only confidence and presumption?

If they are taught that it is inconsistent for a person to reject the mysteries of religion, and yet believe the mystery of Fluxions, will they not know how to draw the opposite conclusion themselves, that it is inconsistent to reject the doctrine of Fluxions because mysterious, and yet receive the mysteries of religion? And \* when they are taught to think that a person may be justly said to have faith, because they give into what they can neither demonstrate nor conceive; if this give them a mean opinion of the Mathematicians, 'tis odds if it don't give them a mean opinion of faith itself. I am sure 'tis a very strange account of that which may justly be called faith: For without clear notions no man can believe any more than demonstrate.

Considering these things, I can't help thinking it was highly wrong to bring religion at all into this controversy, which may inflame the dispute, but can hardly do any real service: Of which, to me, it is a very strong presumption, that every thing urged by the author of the Analyst against Infidels in general, would have sounded full as well in the mouth of a Papist, if urged against those Mathematicians that don't believe the doctrine of Transubstantiation, as it would have been peculiarly in character for such a one to have made his chief attack upon a great enemy of all superstition and tyranny, and an hearty friend to the reasonable religion of Christians and Protestants. But enough of this. I shall now consider my subject as stript of all relation it has to religion, and merely as a matter of human science, and endeavour to shew that the method of Fluxions is founded upon clear and substantial principles.

S E C T.

† Defence of Freethinking, p. 62.

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## S E C T. I.



IT cannot be doubted but that Sir *Isaac Newton* well understood the doctrine of which he was the original inventor ; and his proofs of it are very far from being fallacious and deceitful, or their force hard to be understood by those that are used to these kinds of subjects.

BUT it is also very plain, that the question, which is the main dispute between our author and his adversaries, whether Mathematicians take the notion and certainty of the method of Fluxions implicitly from him or not, does not depend upon our being able to defend the exact accuracy of the demonstrations he has made use of, and the propriety of every phrase by which he has explained his notions upon this head. He always seems to have studied conciseness of expression, and to depend on the good sense and judgment of his reader. And on this account some of his demonstrations are not the most full and compleat that might be given, and must remain obscure to those who have no genius for the mathematical science, and can't find out those steps in a demonstration, which a writer often omits in confidence of the sagacity of his reader. In my opinion this is in some measure the case with respect to his proofs of the

the first principles of Fluxions, and therefore I don't wonder persons differ in their sentiments about them. But it is truly provoking to find that the greatest genius that ever appeared in the philosophical world, and one whom the lovers of knowledge must always think of with respect and gratitude, should be represented contrary to his known character, as craftily imposing on the world, in confidence of his own authority, and the obscurity of his subject. And therefore I would hope that the author of the *Analyst* did not design that severe reflection his words seem to carry with them, when he says, "Such reasoning as this, nothing but the  
 " obscurity of the subject could have *encouraged*  
 " *or induced* the great author of the fluxionary method *to have put upon* his followers ;  
 " and nothing but an *implicit* deference to his  
 " authority could have moved them to admit." To suspect Sir *Isaac Newton* of the mean design of seeking reputation among the ignorant, by venting unintelligible notions, and defending them by artful and cunning sophistry, is what I think no man is capable of doing. And therefore if the author of the *Analyst* does not think fit, for his own reputation, to revoke or explain the sentence just mentioned, it needs not a particular confutation. Nor do I propose particularly to follow him in all the objections he has made against Sir *Isaac's* notions and demonstrations, being of opinion that the best way of answering him is to assist persons in understanding the subject itself ; for if any one can do this, he will easily see there is little weight in what he has said against it. However, as I go along, I shall endeavour to obviate any thing that I think may create a difficulty ; but my main  
 view

view is to settle the first principles on which the doctrine of Fluxions depends, and then to shew that, by just reasoning from them, the rules for finding the Fluxions of equations, as delivered by Sir *Isaac*, do truly follow.

THE notion of Fluxions was originally gained by the observation of quantities being described by a continual motion; and the method of Fluxions was designed to do these two things. *1st*, From the magnitude of a quantity continually changing being given, to find out the rate or velocity according to which the quantity itself continually increases or decreases. And, *2dly*, From this latter continually given, to find the former.

WHERE you see the main thing taken for granted is this

POSTULATE.

*Quantities may be supposed as continually changing, so as every distinct instant of time to be different from what they were before.*

ILLUSTRATION.

SUCH quantities are the following, Time from a given hour, the distance of a body from a plane to or from which it moves, the amount of money lent out at interest, &c. However, it is not the business of the Mathematician to dispute whether quantities do in fact ever vary in the manner that is supposed, but only whether the notion of their so doing be intelligible; which being allowed, he has a right to take it for granted, and then to see what deductions he can make from that supposition. It is not the  
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business

business of a Mathematician to show that a strait line or circle can be drawn, but he tells you what he means by these; and if you understand him, you may proceed farther with him; and it wou'd not be to the purpose to object that there is no such thing in nature as a true strait line or perfect circle, for this is none of his concern: he is not inquiring how things are in matter of fact, but supposing things to be in a certain way, what are the consequences to be deduced from them; and all that is to be demanded of him is, that his suppositions are intelligible, and his inferences just from the suppositions he makes. In the case before us, Whether quantities in fact do ever vary in the manner before explained, or not, is nothing to the purpose, but whether the notion of their so doing be intelligible; and that it is so is plain, because tho' this should not be fact in any case, yet in a great many it seems to us so to be. When a stone falls to the ground, the line it describes seems continually to increase; nor can I avoid the same sentiment when I describe a circle or any other line upon a paper. And it may as well be pretended that the letters I now write consist of a number of distinct and separate dots, and no continued lines, as that each of them does not seem to be formed by a continued motion. Now if I really think I see quantities formed by a continued motion, it is plain that this sort of increase is not unintelligible, and therefore may be supposed by the Mathematician. The reader perhaps may here think that I intend to obviate an objection that even the author of the *Analyst* himself would never make; but I must own my suspicion of the contrary, because I think he can't allow of such sort of increase,



## Doctrīne of FLUXIONS. II

increase, without giving up his cause, and allowing me a right to make this farther

### POSTULATE II.

*The notion of FLUXIONS is intelligible.*

FOR if quantities may increase or decrease so as to be different every distinct instant of time from what they were before, it will follow that they must change at a certain rate either fixed or variable, it being impossible that a man shou'd conceive of a quantity continually changing, without knowing that it must either alter at the same rate always, or else sometimes faster, and at other times slower; *i. e.* he can't do this without knowing what Sir *Isaac Newton* means when he defines the Fluxion of a quantity to be the velocity or swiftness with which the quantity changes its magnitude: And the Fluxion of a quantity cannot be an unintelligible notion, when it necessarily arises from a plain and easy supposition. Nay, I am very well satisfied that our author himself must have a notion both of a first and second Fluxion, if he at all understands himself, when he supposes *a line described by the motion of a point continually accelerated.* At least I am sure 'tis as hard for me to conceive of the motion of a point, and the acceleration of that motion, as to form an idea of a first and second Fluxion.