THE AUTHOR S PREFACE

SINCE the ancients (as we are told by Pappus), made great account oi

the science of mechanics in the investigation of natural things : and the

moderns, laying aside substantial forms and occult qualities, have endeav

oured to subject the phenomena of nature to the laws of mathematics, I

have in this treatise cultivated mathematics so far as it regards philosophy.

The ancients considered mechanics in a twofold respect ; as rational, which

proceeds accurately by demonstration ; and practical. To practical me

chanics all the manual arts belong, from which mechanics took its name.

Rut as artificers do not work with perfect accuracy, it comes to pass that

mechanics is so distinguished from geometry, that what is perfectly accu

rate is called geometrical , what is less so, is called mechanical. But the

errors are not in the art, but in the artificers. He that works with less

accuracy is an imperfect mechanic ; and if any could work with perfect

accuracy, he would be the most perfect mechanic of all ; for the description

if right lines and circles, upon which geometry is founded, belongs to me

chanics. Geometry does not teach us to draw these lines, but requires

them to be drawn ; for it requires that the learner should f.rst be taught

to describe these accurately, before he enters upon geometry ; then it shows

how by these operations problems may be solved. To describe right lines

and circles are problems, but not geometrical problems. The solution of

these problems is required from mechanics ; and by geometry the use of

them, when so solved, is shown ; and it is the glory of geometry that from

those few principles, brought from without, it is able to produce so many

things. Therefore geometry is founded in mechanical practice, and is

nothing but that part of universal mechanics which accurately proposes

and demonstrates the art of measuring. But since the manual arts are

chiefly conversant in the moving of bodies, it comes to pass that geometry

is commonly referred to their magnitudes, and mechanics to their motion.

In this sense rational mechanics will be the science of motions resulting

from any forces whatsoever, and of the forces required to produce any mo

tions, accurately proposed and demonstrated. This part of mechanics was

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cultivated by the ancients in the five powers which relate to manual arts,

who considered gravity (it not being a manual power), ho Otherwise than

as it moved weights by those powers. Our design not respecting arts, but

philosophy, and our subject not manual but natural powers, we consider

chiefly those things which relate to gravity, levity, elastic force, the resist

ance of fluids, and the like forces, whether attractive or impulsive ; and

therefore we offer this work as the mathematical principles :f philosophy ; for

all the difficulty of philosophy seems to consist in this from the phenom

ena of motions to investigate the forces of nature, and then from these

forces to demonstrate the other phenomena ; and to this end the general

propositions in the first and second book are directed. In the third book

we give an example of this in the explication of the System of the World :

for by the propositions mathematically demonstrated in the former books,

we in the third derive from the celestial phenomena the forces of gravity

with which bodies tend to the sun and the several planets. Then from these

forces, by other propositions which are also mathematical, we deduce the mo

tions of the planets, the comets, the moon, and the sea. **I wish we could do-**

**rive the rest of the phenomena of nature by the same kind of reasoning from**

**mechanical principles; for I am induced by many reasons to suspect that**

**they may all depend upon certain forces by which the particles of bodies.**

**by some causes hitherto unknown, are either mutually impelled towards**

**each other, and cohere in regular figures, or are repelled and recede from**

**each other; which forces being unknown, philosophers have hitherto at**

**tempted the search of nature in vain ; but I hope the principles here laid**

**down will afford some light either to this or some truer method of philosophy.**

In the publication of this work the most acute and universally learned

Mr. Edmund H alley not only assisted me with his pains in correcting the

press and taking care of the schemes, but it was to his solicitations that its

becoming public is owing ; for when he had obtained of me my demonstra

tions of the figure of the celestial orbits, he continually pressed me to com

municate the same to the Royal Societ //, who afterwards, by their kind en

couragement and entreaties, engaged me to think of publishing them. But

after I had begun to consider the inequalities of the lunar motions, and

had entered upon some other things relating to the laws and measures oi

gravity, and other forces : and the figures that would be described by bodies

attracted according to given laws ; and the motion of several bodies moving

among themselves; the motion of bodies in resisting mediums; the forces,

densities, and motions, of rn( Hums ; the orbits of the comets, and such like ;

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deferred that publication till I had made a searcli into those matters, and

could put forth the whole together. What relates to the lunar motions (be

ing imperfect), I have put all together in the corollaries of Prop. 66, to

avoid being obliged to propose and distinctly demonstrate the several things

there contained in a method more prolix than the subject deserved, and in

terrupt the series of the several propositions. Some things, found out after

the rest, I chose to insert in places less suitable, rather than change the

number of the propositions and the citations. I heartily beg that what 1

have here done may be read with candour; and that the defects in a

subject so difficult be not so much reprehended as kindly supplied, and in

vestigated by new endeavours of mv readers.

ISAAC NEWTON.

Cambridge, Trinity Coupge May 8, liHB.