CHAPTER I.

PROPERTIES OF BODIES.

Extension, impenetrability, divisibility, porosity, com-
ssibility, elasticity, inertia, and gravity are general proper-
common to all bodies, whether solid, liquid, or gaseous,
le some bodies possess specific properties, such as solidity,
dity, tenacity, malleability, color, hardness.

EXTENSION AND IMPENETRABILITY.

To all matter must be attributed two essential qualities:
, that in virtue of which it occupies space, and which is

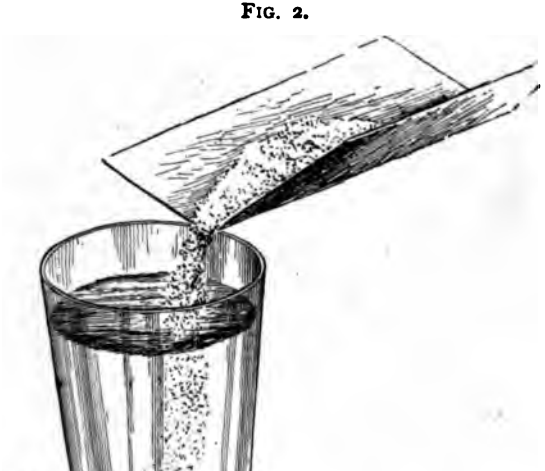
FIG. 1.

A Hatful of Cotton in a Tumblerful of Alcohol.

wn as extension, and, second, that which allows only one

of loose cotton without causing the alcohol to overflow.*
e success of the experiment depends upon the slow intro-

FIG. 2.



Solution of Sugar in Water.

tion of the cotton, allowing the alcohol to invest the
rs, before they are fairly plunged beneath the surface
ne alcohol.

In this experiment the penetration of the alcohol is only
arent; the fibers displace some of the alcohol, but the
ntity is so small as not to be observable. If the cotton
e compressed to the smallest possible volume, it would
ound to occupy but very little space. So small a body

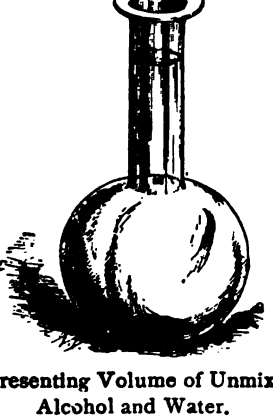
* See also chapter on projection.

nout increasing its bulk.

Here the physicist is forced to acknowledge that either water is penetrated or its atoms are so disposed as to eive the sugar between them, possibly in the same way scuttle filled with coal might contain also a bucketful of d. This latter view is adhered to. The atom or ultimate ticle is held to be impenetrable.

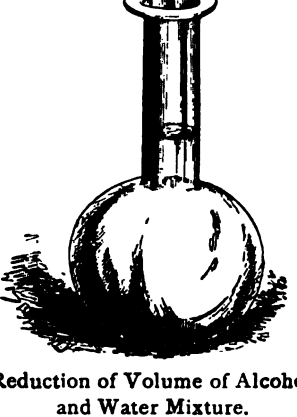
In the case of the mixture of water and alcohol, or water

FIG. 3.



resenting Volume of Unmixed Alcohol and Water.

FIG. 4.



Reduction of Volume of Alcohol and Water Mixture.

sulphuric acid, a curious phenomenon is presented. e alcohol and water for example. Equal volumes of hol and water, when mixed, occupy less space than when arate. If the sum of the volumes of the two separate ids is 100, the volume of the mixture will be only 94. In case of the mixture of sulphuric acid and water, the dif- nce is greater.

An easy way to perform this experiment is to fill a narrow- ked flask up to a line which may conveniently be marked

that the molecules of the two liquids accommodate the
selves to each other in such a manner as to reduce the por
and thus diminish the volume of the mixture.

DIVISIBILITY.

The property of a body which admits of separating
into distinct parts, and which is known as divisibility, is p
sessed by all matter. An example of extreme divisibility
found in the coloring of a pail of water with a minute parti
of aniline.

POROSITY.

There are two kinds of pores, viz., physical or int
molecular pores and sensible pores. In the case of t
former, the interspaces are so small that the molecules
within each other's influence and may attract or repel ea
other. Expansion by heat, contraction by reduction of te
perature, and reduction of volume by compression are amo
examples of phenomena rendered possible by the existen
of physical pores.

Sensible pores are small cavities or spaces, across whi
molecular forces are unable to act.

The experiment illustrated by Fig. 5 shows the existen
of sensible pores. In the neck of an Argand chimney is
serted a plug of Malacca wood, which is sealed around t
periphery with wax or paraffine. In the top of the chimn
is inserted a stopper, through which projects a short gl
tube, having its upper end bent over or capped with a sm
test tube. To the outer end of the glass tube is applied
rubber tube. When the chimney is in an inverted positi
as shown in the engraving, a quantity of mercury is plac
in the larger part of the chimney, and the air is partly
hausted from the chimney, by applying the mouth to t

direction of these pieces of wood.

Wood, vegetable, and animal tissues, sponge, pumice ne, and many other substances have sensible pores that

FIG. 5.

Mercurial Shower.

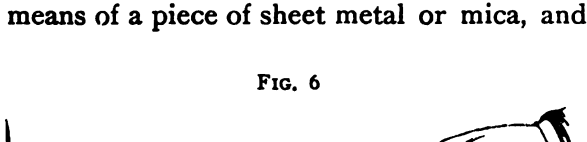
y readily be seen. Physical pores cannot be seen even the aid of the most powerful microscope; but their tence is proved by the fact that all bodies may be com- ssed or diminished in volume.

Sensible pores play an important part in the operations ature, especially in the vegetable and animal kingdoms.

ed in volume, by pressure, without losing weight, is
wn as compressibility. This property is possessed in the
ıtest degree by gases, which may be reduced by com-
ssion to from one-tenth to one-hundredth their original
ıme.

The simplest piece of apparatus for showing the com-
ssion of a gas is a well-made toy popgun, such for ex-
ple as that shown in Fig. 6. By closing the mouth of this
by means of a piece of sheet metal or mica, and oiling

FIG. 6



The Popgun used as a Pneumatic Syringe.

piston well with a heavy oil, to prevent the escape of air
n the barrel, it may readily be shown that the air con-
ed by the barrel may be greatly reduced in volume by
ply pushing in the piston.

ELASTICITY.*

When a body resumes its original form or volume after
ortion or compression, it possesses the property of elas-
y, and is therefore known as an elastic body. Elasticity
be shown by pressure, by bending, by torsion or twist-
or by tension or stretching. Gases and liquids are per-
ly elastic. When compressed and afterward allowed to

* See also chapter on projectiles.

tested for any permanent set, was found to have re-
ed to exactly its original shape. Elasticity by flexure
ending is seen in various springs, such as carriage
gs, gun-lock springs, etc.
he elasticity of torsion is exhibited by door springs of
in forms, spiral springs, and by twisted threads of cot-
linen, and other material. The elasticity of tension is
n in the strings of all stringed musical instruments, and
ly in soft rubber in its various forms.

A body is said to be at rest when its position is not being nged, but this statement needs some qualification, since rest known to us is only relative. All bodies with which are acquainted are continually changing their position er in relation to adjacent objects or along with adjacent ects relatively to distant objects. For example: a bowl- is said to be at rest when it maintains its position relative he earth's surface, but since the earth itself is not at rest, evident that whatever is fixed on the face of the earth not be at rest.

On the other hand, if the bowlder were rolling down a livity, it would be changing its position relative to the h's surface as well as to all other objects, and would refore be said to be in motion; but a body may be arently in motion while in reality absolutely at rest. If we e to suppose a body projected from the earth into space n a velocity equal to that of the earth, but in a direction osite that of tne earth's motion and uninfluenced by venly bodies, the body, although having apparently a n velocity relative to the earth, would be absolutely at .

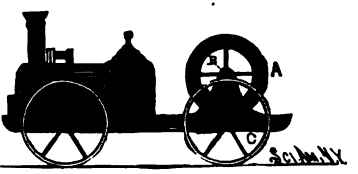
INERTIA.

No body is of itself able to change from a state of rest to ate of motion, neither can a body in motion change its ction or pass unaided to a state of rest. That which ses or tends to cause a body to pass from a state of rest one of motion, or accelerates or retards the motion of a y, or changes its direction, is known as Force. The apability of matter to change from rest to motion, or the erse, is a negative property known as Inertia.

ne top is an example of persistent rotation due to
a. To inertia is due the action of projectiles, hammers,
presses, also the hydraulic ram.

ne property of inertia, the storage of power, the trans-
power by friction, and the conversion of rotary into
inear motion are illustrated by the toy locomotive shown
annexed engraving. The flywheel, A, is mounted on
haft, B, which rests
e supporting and driv-
heels, C. The wheel,
spun by means of a
in the same manner
op. By virtue of its
a, the wheel, A, tends
ntinue its rotary mo-
If unaffected by out-
nfluences, it would run on forever; but the friction
bearings and of the air and other causes combine to
it to rest.

FIG. 7



Inertia Locomotive.

ne power imparted to and stored in the wheel, A, is
out in turning the wheels, C, overcoming friction, and
lling the machine forward.

FRICTION.

ne resistance caused by the moving of one body in
ct with another is known as friction. No perfectly
h surface can be produced, all surfaces having minute
ctions or roughnesses, so that when the surfaces of any
odies are moved in contact with each other, the pro-
ns of one body engage the projections of the other
thus offering resistance to the free motion of the
s. When the surfaces are covered witn a lubricant,
inequalities are filled and smoothed over and the fric-

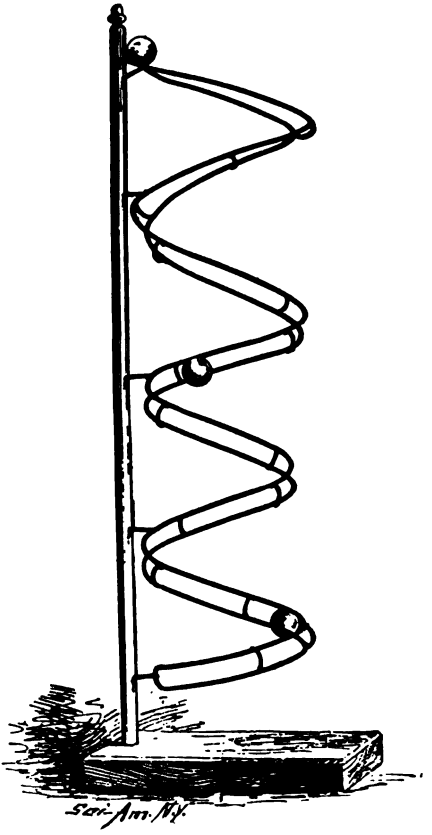
FIG. 8.

Centrifugal Railway.

nany kinds of machinery are provided with roller or ball
rings, thus substituting rolling for rubbing surfaces. An
nple of bearings of this kind is found in the pedals and
ts of bicycles and tricycles, which are provided with
bearings.

alled centrifugal force. When a body moving in a ular path is released, oes not fly off radial- out on a line tangent he circular path. The that a body travel- in a circular path, en released from all raint, will move in a ight line, proves that normal path of a mov- body is a straight . The centrifugal rail- represented in Fig. ows with what force estrained body tends fly from a circular .

FIG. 9.



Spiral Railway.

This railway is made he same manner as swiftest descent ap- atus described on an- er page. Two wires bent into spiral loops nd a cylinder, and extremities are curv- upwardly as shown. two curved wires are nected together by ved wire cross pieces fastened by soldering, and two wire are attached to complete the apparatus. No particular is required for the construction of the centrifugal