

WHAT THE MOON WEIGHS AND HOW WE KNOW The Marvellous Things that Mathematicians Can Do SPEED OF THINGS THAT FALL

We recently mentioned in the C.N. that the weight of the moon was about 78 million million million tons, and many readers have asked us to explain how the moon is weighed.

Strictly speaking, the moon is not weighed at all. When we speak of the weight of anything we mean its tendency to fall to the ground, as when a pound of sugar pushes down the scale-pan; and the greater this tendency the heavier we say the object is. For convenience we use this tendency to fall, or weight, as a measure of mass—that is, the quantity of matter in a body; and when we speak of the weight of the moon we simply mean its mass, or the amount of stuff in it.

Now, the strange fact is that though the moon is so near to us it is far more difficult to find its actual mass than that of the sun or the most distant planet. Let us see why.

Experiment on a Mountain

Mathematicians have found that any body falling freely to the ground near the earth's surface passes through rather more than 16 feet in one second, and at the end of the second has a speed of 32 feet a second; at the end of the second second its speed would be 64 feet a second; and every second it would increase its speed 32 feet. This increase is called its acceleration.

If the experiment were made on a mountain top the acceleration acquired in the first second, and so on, would be less, for the acceleration of the force with which a body falls is diminished as the distance from the earth's surface or centre is increased. If we go twice the distance the force of gravity is not one half but one quarter; if three times the distance it is one ninth. As Newton taught us, it diminishes "in inverse proportion to the square of the distance."

Travelling in a Curve

This being the case we can find the mass of the sun. The earth in moving through space would go forward in a straight line but for the sun's attraction, which pulls it round so that it travels in a curve. In other words, the earth cannot go straight because it is continually falling a little out of the straight toward the sun.

Knowing the distance of the sun from the earth and the time the earth takes to travel right round the sun, scientists can work out how far the earth falls toward the sun in a given time.

The earth is 93,000,000 miles from the sun, and the distance the earth falls toward the sun in a second is found to be 0.116 of an inch. A body at the earth's surface is 4,000 miles from its centre, and it falls 16 feet in a second.

Falling of the Moons

If it were removed 93,000,000 miles away we can work out that it would fall in a second 0.000,000,349 of an inch. This is only one-332,000th of the fall due to the sun's attraction, and so we know that the mass of the sun is 332,000 times that of the earth, or, as we should say, it weighs 332,000 times as much as the earth.

The mass of any planet that has moons is similarly worked out by studying the fall of the moons toward their particular planet.

But when we come to our own moon, which has no satellite of its own, we cannot use this comparatively simple method. We have to follow a more difficult process. There are various methods of discovering the mass of the moon, and the most common is that of studying what is known as the monthly oscillation, or inequality, in the sun's apparent movement.

Continued in the next column

WASHINGTON IN ENGLAND

To Take His Stand in Trafalgar Square

The American people are specially proud of the statue of George Washington by Houdon, a French sculptor, which stands in the precincts of the State Parliament of Virginia.

Now an association of American people, who value highly the kinship and friendship between the two great branches of the English-speaking race, are offering two replicas in bronze of the statue, which is in white marble.

One replica is to be placed in Trafalgar Square, by the entrance to the National Gallery, and the other has been offered to, and accepted by, Liverpool.

George Washington was an honourable man who commanded the admiration of a majority of the people of this country even when he was opposing them in war, and his fame has grown.

Great Britain will be very glad to welcome the statue of one of the most successful of her old-time enemies.

TIGERS THAT LAUGHED

And a Bear that Searched a Boy's Pocket

A schoolboy up in London from the Isle of Wight tells us what he saw at the Zoo.

I was conducted round by a friend, who is a member of the Zoological Society and knows the personal names of many of the larger animals.

The most homely animals of the cat tribe are the two tigers Rajah and Rancee, and we tickled them till they laughed.

But the most affectionate animal is Winnie, the black bear. She will hug you without doing the slightest harm. Also, she will search your pockets for food.

We had an interesting time in the Reptile House. The keeper annoyed the rattlesnake so that we might hear the loud rattle. He also gave us a young alligator and a snake to hold. My friend put the snake round his neck, it being quite harmless. I also held the snake.

PHOTOGRAPHS FROM THE AIR

Making Navigation Safe

Objects that lie forty-five feet below the surface of the sea have been clearly photographed from aeroplanes, and aeroplane photography will make it possible to make maps of the greatest value, showing sand bars, shoals, terraces, and channels beneath the water.

These photographs have to be taken under suitable conditions of the atmosphere, as submarine objects are not always visible; but the new method enables geographers to take a further step toward making navigation safe.

Continued from the previous column

In everyday language we speak of the moon travelling round the earth in a month, but what really happens is that the earth and the moon move together as one body round a common centre of gravity, as if they were joined by a great bar of steel.

It is not, as a matter of fact, therefore, the earth that moves in an ellipse round the sun, but this common centre of gravity of the earth and moon reckoned as one body, and the result is an oscillation of the sun's apparent movement which enables us to find out just where the centre of gravity of the earth and moon, taken together, is.

Careful calculations have proved that this centre is situated within the earth's body, about 2900 miles from the earth's own centre.

That is found to be about one-81st part of the moon's distance from the earth, and so it is reckoned that the earth's mass must be about 81 times that of the moon. As the earth weighs about 6000 million million million tons, this figure divided by 81 gives the approximate weight, or mass, of the moon.

INVENTIONS & IDEAS

Things Just Patented

By Our Patent Office Expert

These inventions have been only just patented, and the Editor has no further information

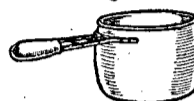
A GRAMMAR TEACHER

A box has compartments corresponding to the parts of speech, each of a distinguishing colour. Cards bearing words enable sentences to be made up, and each card is coloured according to its part of speech.



A HANDLE FOR A SAUCEPAN

This handle, instead of being welded to the saucepan, is separate from it. The curved part fits round and grips the saucepan, and is riveted in position. It can be adapted to other receptacles, such as glue-pots.



A COLLAPSIBLE BAG

A bag of flexible material, such as cloth or leather, is attached all round to a circular lazy-tongs arrangement, fitted with a handle. The bag can then be opened to various degrees, making bags of different sizes according to the need of the moment.



NOVEL CURLING TONGS

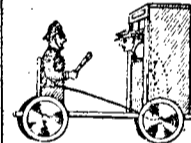
This apparatus consists of a metal tube adapted to receive a heating rod. The



hair is wound round and secured by a tape, a large tube is placed over the whole, and a heating rod inserted.

A WATCHFUL POLICEMAN

This is a mechanical toy in which one figure—a robber—puts his head in and out of a window, while a policeman, waiting outside, alternately raises and lowers his truncheon. The movement is obtained by levers attached to the wheels.



TO PREVENT LADDERS FROM SLIPPING

A socket, or shoe, is so made that the end of the ladder can be placed inside. Screws hold the ladder firmly in the socket; and a hinged cup, which acts as a sucker, grips the ground and enables the ladder to be placed at any angle, thus preventing it from slipping.



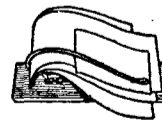
A FOLD-UP TROUSER-STRETCHER

This is on the principle of the lazy tongs, and closes into a small space. When in use clamps hold the trousers at each end, and the stretcher can be opened to any length, being locked in position by a rack.



A SPRING PAPER-HOLDER

A curved spring is attached at one end to a back plate, the other end being loose and fitting tight to the plate. This can be pulled away and paper placed in position, the spring closing with a snap and pressing the papers.



A BOTTLE EMPTIER

This device for emptying bottles easily consists of a bent tube, or spout, fitted into the cork-stopper. It has a plug-cock operated by a wire, one end of which is attached to a lever on the cock, and the other end to a crank lever secured to the bottle neck by means of a spring clip.



THE WEEK IN HISTORY

THE UNLUCKY ADMIRAL

Parliament that Lasted Nearly Twenty Years

HEROINE OF THE FRENCH REVOLUTION

March 13. Joseph Priestley born near Leeds. 1733
14. Admiral Byng shot at Portsmouth. . . . 1757
15. Julius Caesar assassinated in Rome. . . . 44 B.C.
16. Long Parliament dissolved. 1660
17. Madame Roland born in Paris. 1754
18. London-to-Paris telephone first used. . . 1891
19. Six Englishmen founded Massachusetts. . 1623

Admiral John Byng

THOUSANDS of soldiers have been shot for failure in their duty, but only one admiral. That admiral was John Byng, the son of a fighting admiral, George Byng.

John Byng was shot on the quarter-deck of a British man-of-war in a British naval port, by sentence of a court-martial.

A law had been passed to ensure that naval commanders did their duty. The penalty under this law for any one of three offences was death. These offences were cowardice, treason, and negligence, and Admiral Byng was found guilty of negligence, but was recommended to mercy. King George II declined to show mercy, and Admiral Byng faced the firing party with unshaken bravery.

As commander-in-chief in the Mediterranean he had been ordered to relieve Minorca, which the French were besieging. Byng bungled the control of his fleet badly, and sailed away, leaving the French victorious.

Byng was not a fighting admiral, but a muddler. But to shoot him was monstrous, for he should not have been chosen for the work.

The Long Parliament

THE Long Parliament was the longest that ever sat, and it made the most history.

It met on November 3, 1640, and was dissolved on March 16, 1660, so it lived 19 years and 4 months, though its life was not a full life, as many of its members were, for a time, kept out forcibly.

As soon as this Parliament was elected it insisted on reforming gross abuses established by King Charles I. Then came the great Civil War.

One of the laws passed was that the Parliament should only be dissolved by its own vote. When the army became master the Presbyterian members of the Parliament were turned out by Colonel Pride's cavalry, and the members left were called the Rump Parliament. This Parliament would not dissolve itself, but Cromwell turned them out.

After Cromwell's death the army recalled the members of the Rump Parliament; but when General Monk arrived in London he used his influence to call up all the members of the Long Parliament, and it then dissolved itself according to its own law.

Madame Roland

MADAME ROLAND was the greatest heroine of the French Revolution. A brilliantly clever woman, she early became an enthusiastic Republican, and when her husband, a hard-working but rather commonplace man, was made Minister of the Interior, she wrote for him the suggestions he made to the Parliament or to the country.

As the Revolution grew more violent and bloodthirsty she and her husband drew back toward the more moderate party. Then both were seized and flung into prison. M. Roland escaped. His wife was sent to the guillotine, a martyr to her moderation in a cause she sincerely upheld. Her exclamation as she went calmly to her death will live as long as the French Revolution is remembered: "O Liberty, what crimes are committed in thy name!"

On hearing of her death her husband took his own life, leaving the message that he "wished not to remain longer on an earth polluted with crimes."