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16

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No. 96, 16th NOVEMBER 1963

EVERY MONDAY—PRICE ONE SHILLING

ZULU WARRIORS CRUSH A BRITISH ARMY

see page 20

LOOK AND LEARN

No. 96. 16th November, 1963
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CONTENTS

BETWEEN OURSELVES

Whatever may be said about the new tall buildings which are springing up in our cities (and terms like "orange box architecture" are frequently used), they perform one useful function - they allow the occupants to see a little more of the place in which they are living and working; giving them more than a "worm's eye view."

At a height of five feet above ordinary ground level you can see for a distance of 2.9 miles. At twenty feet you can see over five miles. At a hundred feet the sight range is increased to over thirteen miles. But we are still a long way off the heights of many new buildings which reach up into the sky for 500 feet; and from that lofty perch the city worker can see for nearly thirty miles in all directions.

What does he see, apart from the view? In winter time he is likely to see the pall of smoke rising from the chimney pots. At all times he will see the sprawl of the shabby areas that still remain in most cities. He will see the traffic jams which still delay our daily life. Green patches will remind him of the parks and public lands which must never be covered by concrete. He might also see the open land beyond the town, to which he should escape whenever opportunity permits.

Yes, it does us good to be able to look down on daily life - and to be reminded not only of how it can be improved, but of the horizons beyond.

The Editor

Quick QUIZ

PEOPLE

1. *Until quite recently Princess Marina was known by a different title. What was it?*
2. *Who conceived the theory of Relativity?*
3. *The French revolutionary leader Jean Marat was stabbed to death in his bath by a woman. Who was she?*

NATURAL HISTORY

1. *The guanaco is the wild form of which well-known South American animal?*
2. *In winter the stoat's coat turns from brown to white. What is its fur called?*
3. *What have the following in common: Pintail, mallard, teal, merganser, tufted duck?*

GEOGRAPHY

1. *In which country would you find the towns of Sainte Maxime, Arles and Soissons?*
2. *Which of these mountain ranges is the highest: (a) the Alps, (b) the Rockies, (c) the Andes, (d) the Himalayas?*
3. *What is the capital of Cuba?*

COUNTIES

1. *In which county is Newmarket?*
2. *Which county is bordered by Bedfordshire, Cambridgeshire and Northamptonshire?*
3. *Which county is known as Thomas Hardy's county?*

SPORT

1. *In which country will the 1964 Olympic Games be held?*
2. *What was the result of the Test Match rubber when England played the West Indies last summer?*

ANSWERS ON PAGE 27

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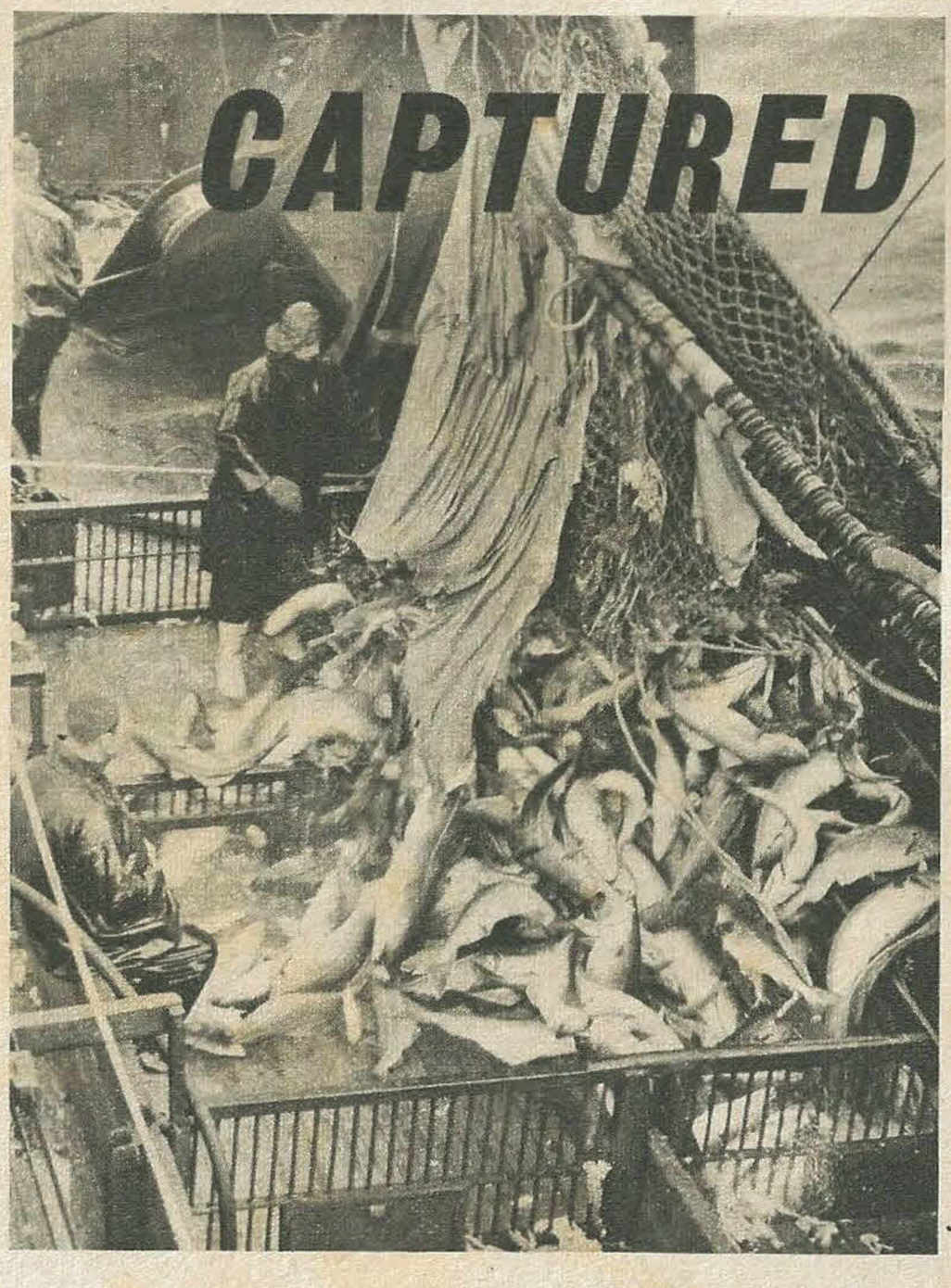

CAPTURED FROM THE DEEP

"The wind begins to rise and the sea, green beneath scowling clouds, grows impatient and restless. Trawls—as the big nets are called—are rigged, bobbins and floats inspected.

"Suddenly the tension breaks. The trawler is 'on fish.' The crew spring to action. The trawl has begun and will go on ceaselessly eighteen hours out of twenty-four for days to come until the fish-room is filled with tons of fine cod, haddock and halibut."

This is the life of the trawlerman, tough, rugged and at times so hard that you wonder why they carry on. It is vividly told in the 1964 LOOK AND LEARN BOOK.

How other people live and work is always fascinating, and the LOOK AND LEARN BOOK is full of these glimpses.

How would you control 20,000 bees? What is it like to be a Canadian Mountie? How do map makers work? What would you be doing if you were preparing for a flight to Mars? Can you imagine spending 15 years making one carpet, and putting 2,848,750 stitches into it? How do you drive a veteran car?

There are more than fifty varied features. The 1964 LOOK AND LEARN BOOK has 160 pages, many of them in wonderful colour. It would make a wonderful present to give, or to receive!

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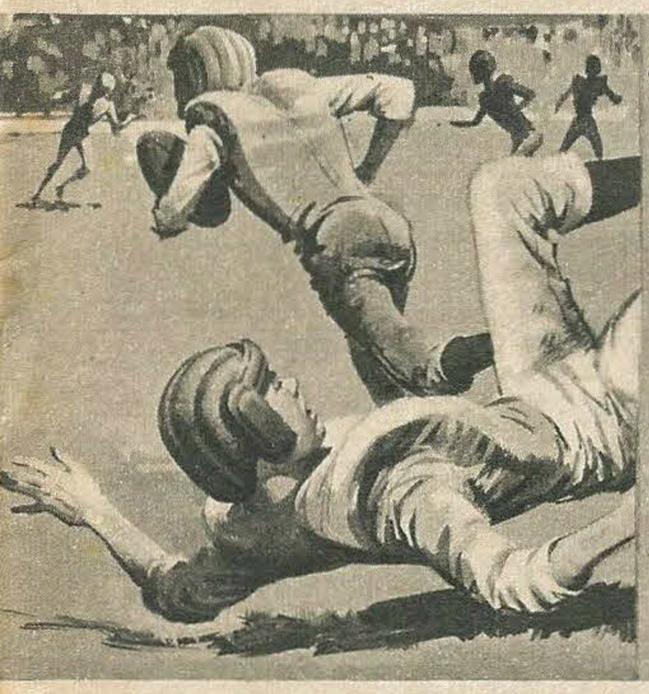
MEN OF POWER—KENNEDY: PART I

AMERICA'S DYNAMIC PRESIDENT

John Fitzgerald Kennedy became President of the United States of America in January 1961. Aged 43 years, he was the youngest-ever president to be elected, and his rise to power has been studded with adventure, including shipwreck. This determined young leader of the Democratic Party came from a large family where politics and finance were everyday subjects. The son of a multi-millionaire, he was born near Boston in May 1917. His Irish grandparents were both Democratic supporters, and his father was American Ambassador to Britain from 1937 to 1941.

As a six-year-old boy, John Kennedy often listened to his grandfather rehearsing fiery political speeches at home.

At eighteen John was sent to the London School of Economics, where he studied under Professor Harold Laski, a famous Socialist teacher.

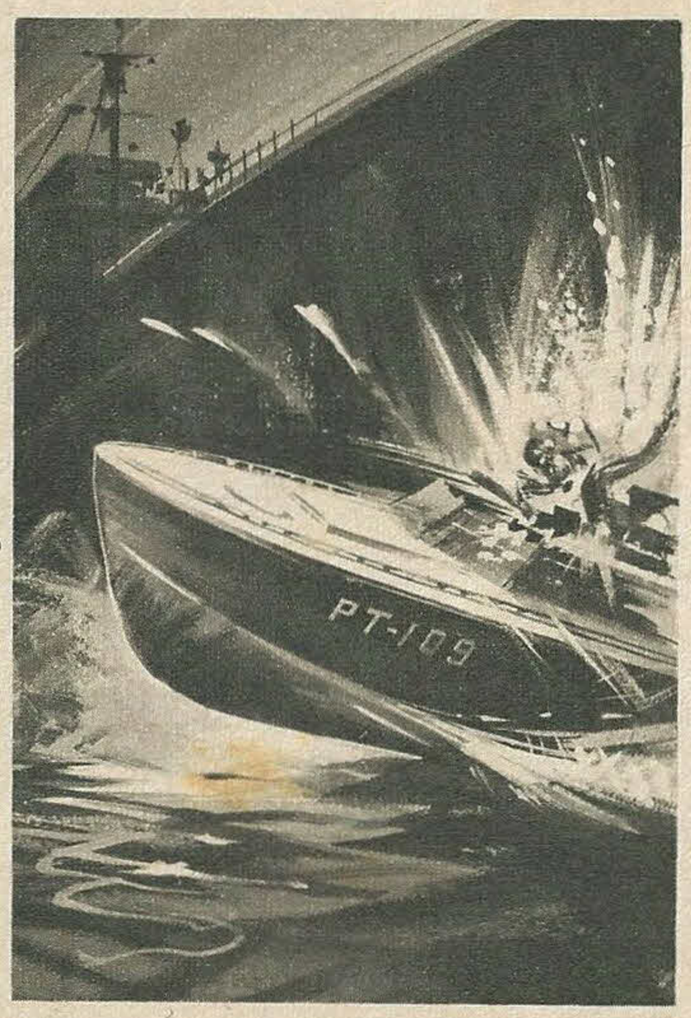


He went on to Harvard University where, in 1938, he badly injured his back in a football game. Later he won an honours degree in political science.

War was near when he toured Europe in 1939. In England he and his eight brothers and sisters were all present at a dinner given by his father to King George VI and Queen Elizabeth.

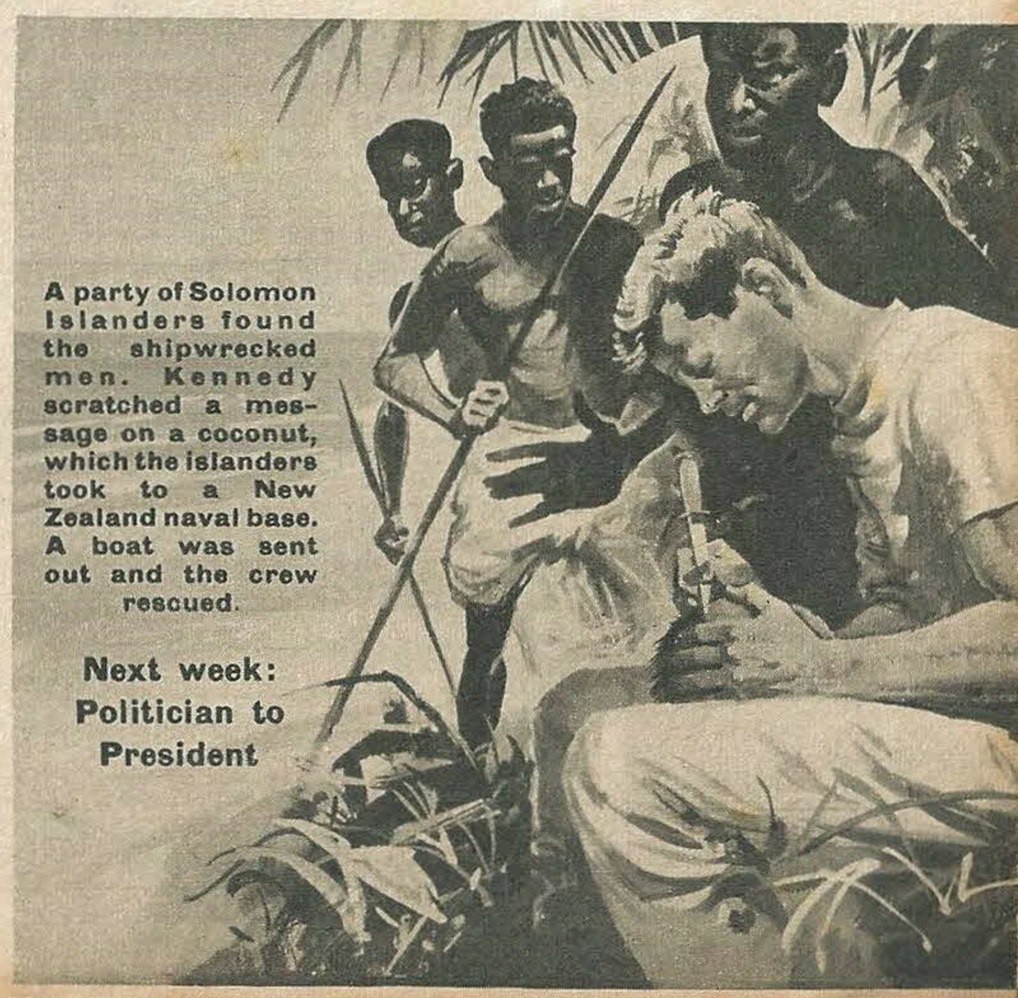
When war broke out John was sent by his father to Glasgow to help American survivors from the liner Athenia, which was sunk by enemy submarines. This was his first taste of war, for America at this time was still neutral.

America joined the Allies, but John was turned down for service because of his back injury. Determined to enlist, he took treatment and exercise until he was accepted as a Naval officer.



In 1943 the patrol boat he commanded was sliced in two by a Japanese destroyer in the Pacific. His back badly injured again, he drifted all night with eleven other survivors, clinging to wreckage.

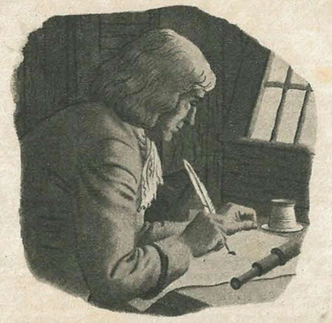
Lieutenant Kennedy decided to swim with his men to a small island three miles away. For five hours he struggled through the water, towing an injured sailor by a life-belt strap gripped between his teeth. Exhausted, they reached the shore, where their only food was coconuts and snails.



A party of Solomon Islanders found the shipwrecked men. Kennedy scratched a message on a coconut, which the islanders took to a New Zealand naval base. A boat was sent out and the crew rescued.

Next week: Politician to President

RIDDLE of the LAND of LONG EARS



Two hundred and forty years ago a Dutchman landed on a new island—an island filled with strange statues. Why were they there? That is just one of the many questions that the natives cannot—or will not—answer

"LAND HO!" The look-out's cry from the crow's nest of the Dutch sailing ship sent the crew scurrying across to the starboard rail. Admiral Roggeveen looked, too. Then he excitedly consulted his charts. No land was marked at this point in the Pacific Ocean.

As the ship approached and circled the island, the Admiral noted that it was thirty to forty miles in circumference and roughly triangular, with a mountain at each corner.

Admiral Roggeveen inked on his map the triangular blob of land, and wrote beside it "Easter Island." For it was Easter Day, 1722.

Little did he know as he brought his ship in to the coast that he had named the world's most mysterious island.

Roggeveen's own report sets the scene: "This island contains about six thousand souls. And all over the island stand huge idols of stone, the figure of a man with big ears and the head covered with a red crown."

Unusual Carving

ONE can imagine how that report intrigued other adventurers. Many made landings. They tramped the island and counted the statues. There were 230 standing all over the place. And apart from size—varying from fifteen to thirty-five feet high—the statues were all identical.

Legless, they rose from the earth at hip level. The faces were expressionless, with receding foreheads, tight lips, prominent chins and a curious tilt at the end of the nose.

But more curious still were the ears. Long and thin, they hung down to the jaw. On each statue was a hat-like crown of red stone.

About a hundred of the statues stood on and around the slopes of a dead volcano. The rest adorned either side of a five-mile long avenue—the sacred road to the island's burial ground.

They had been carved in an unusual manner. Instead of first hacking out a block of stone and then shaping it, as any of our sculptors would have done, the Easter Island sculptor had chiselled his statues into the living rock. Only when it was complete was it separated from the rock behind and below.

Stone Tablets

THEN it was dragged to its chosen position and slipped into a hole already prepared for it. This in itself was a Herculean task, for each statue weighed between 20 and 40 tons.

Whom do they represent? Why are they there? Why are there so many? Who made them? Questions like these were expected to be answered when explorers discovered that the natives of Easter Island had 67 stone tablets covered with writing. The only trouble was that none of the natives could read them. Nor could the language experts of the civilized world.

So for answers to those baffling questions, scientists studied the islanders' legends, which had been handed down by word of mouth for centuries. This is how their story goes:

"Many years ago there was a fair country called the Kingdom of Maraerenga. The king had two sons named Ko and Hotu Matua. When the old king died, Ko became king of Maraerenga and Hotu Matua was forced to flee and find a kingdom of his own.

"He set out with a fleet of canoes carrying his wife, his followers, servants, seeds and tools. At last he came to this fertile island which he named Rapa Nui. The people prospered and multiplied and Hotu Matua wore the crimson cloak and crown of kingship.

"His followers, all aristocratic long-eared people, and his servants and workers who were short-eared like us, were happy. But when Hotu Matua died the long-eared rulers used the people cruelly and made them slaves.

"So the people rose up and killed the long-eared ones. All of them. But they remembered Hotu Matua with love, and a sculptor named Rapu was inspired to make a statue of him. When they saw it the people were so overjoyed they asked for more statues of their beloved former king, to keep their island safe in case other long-eared people should take revenge."

But if this legend is true, Rapu must have lived about three hundred years! For quite apart from the 230 standing statues, there are 157 more in the quarries in stages of construction.

They are even bigger than the standing statues, but of course, identical in appearance. All the 157 were being worked on at the same time when, for some unknown reason, the project was so suddenly abandoned that tools were left lying all over the quarries.

No one man could have done the job. There must have been a small army of sculptors and a large army of labourers, the experts now believe.

Again, in the burial ground are the bones of many more people than the island could have supported, even allowing for the tombs having been used for many centuries.

Both these facts point to the conclusion that Easter Island must at one time have been near to a much larger island, or series of islands. Some scientists believe that Easter Island was the holy land and cemetery for its bigger neighbour.

In 1576 a navigator named Fernandez reported the existence of a large land area not far from where Easter Island was later discovered. A ship's captain named Davis also saw this extensive land mass a hundred years later. He did not delay his voyage to land, but named the place Davis Land.

Where is Davis Land today?

There is no doubt that it has vanished. Some natural calamity—an undersea volcanic eruption, a tidal wave, an earthquake—destroyed it.

Some scientists believe that the Easter Islanders came originally from Peru in about the year 500 A.D., where the ruling aristocracy were called Long Ears.

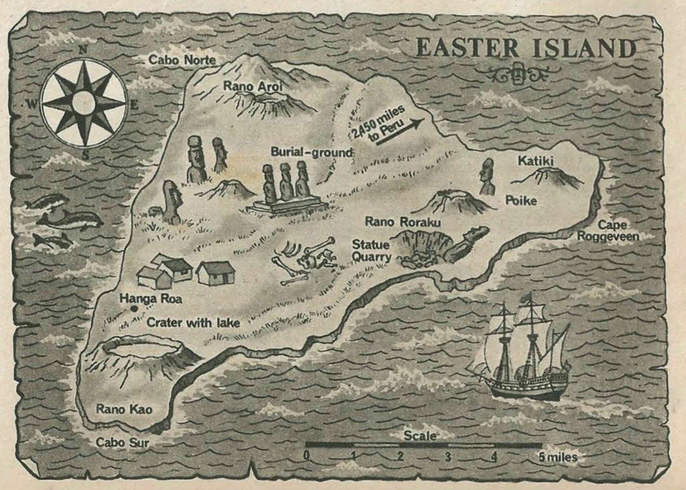
The many expeditions that followed the great Routledge Expedition of 1919 have found an increasing number of the statues overthrown and mutilated by the natives.

Why they do it they will not say. They just repeat the legend of Hotu Matua. Why, believing such a legend, do they hate the statues?

If only those 67 stone tablets could talk!

But even that would not be much use now, for the natives have hidden them all. And so well that years of digging has failed to find them.

All that scientists can work on are the copies that were made of a few of the tablets before they vanished. So far their message has been a complete blank. As blank as the stares on the identical faces of those hundreds of Long Ears that watch over Easter Island.



This is what an earthquake did to Skopje in Yugoslavia last July. Within seconds a large part of this town of 120,000 people was in ruins. More than 2,000 lives were lost.

A city can be destroyed and thousands of people killed in seconds . . .

WHEN THE EARTH TREMBLES

WITHOUT any warning, the ground begins to heave and sway, and in a few moments buildings collapse in heaps of dust and rubble. Then follow the screams and groans of people trapped in the wreckage of an earthquake.

It is not surprising that our superstitious ancestors thought that earthquakes were caused by huge monsters that lived under the ground, heaving about as they struggled to come to the surface.

Today we have stopped believing in these fairy tales. Scientists have discovered that earthquakes are just nature's way of letting us know that the earth is settling down.

According to geologists, as the scientists are called who study the history of our earth, the world was once a mass of soft and very hot material. Then during millions and millions of years, the outer cover of the earth cooled into a hard crust.

Below its hard outer crust, the earth is comparatively soft and is liable to sudden "bubbling" movements, rather like those in a pan of porridge boiling on a stove.

The bubbling of the hot and soft material of the earth set up all sorts of stresses and strains. Most of the stresses and strains are not strong enough for us to notice them.

But sometimes there will be a tremendous strain and heave. When that happens near a fault or flaw in one of the underground ridges of rock, the rock slips. This sets up vibrations which reach the surface of the ground.

It is the very strong vibrations that result in an earthquake so violent that it can shake down every building in a city.

An earthquake can also be caused by the squeezing together of the material in the outer layers of the earth's surface. The outer layers become folded, just as a carpet does when laid flat on a floor and the opposite ends pushed towards each other.

When one of these folds cracks, or the lower part slips, and this can happen very suddenly, the surface of the ground shifts.

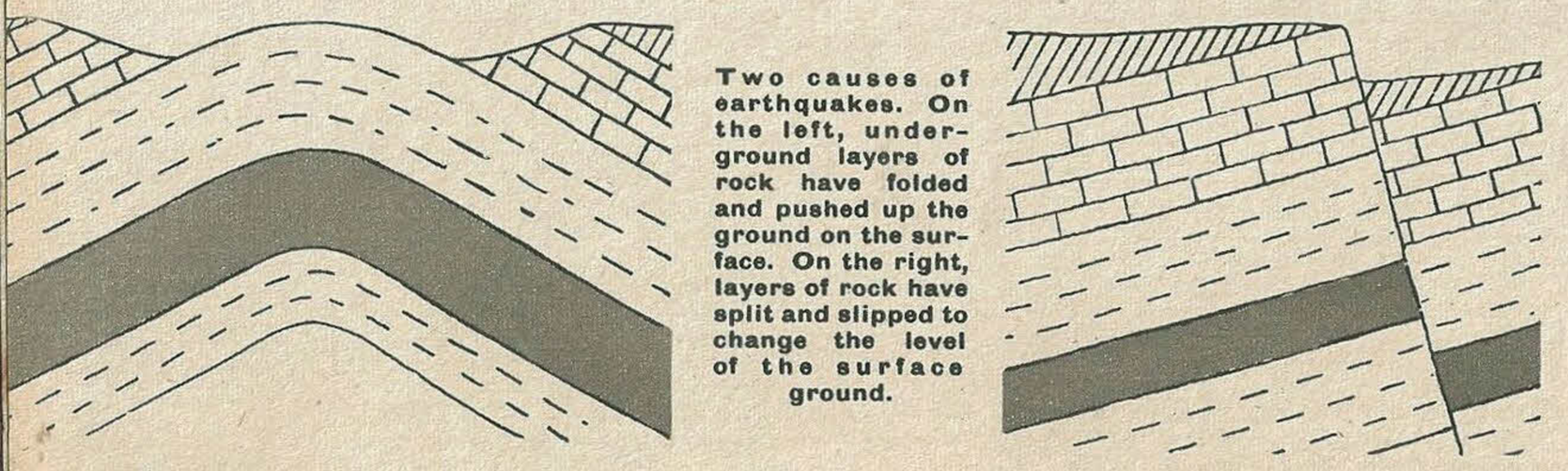
Besides the vertical or up-and-down movement of the ground during an earthquake, there is also a horizontal or backwards and forwards movement. It is the horizontal movement that does the greatest damage, though the movement may not be much more than an inch.

Every earthquake, no matter at what depth below the ground it begins, consists of one or more severe shocks, followed by a number of smaller shocks. It is the first shocks that weaken buildings and the smaller shocks that finally bring them crashing to the ground.

Fortunately, the British Isles are not liable to experience earthquakes. Throughout the whole of our history only two people are known to have been killed by earthquakes in Britain.

Earthquakes and the strength of their shocks are registered on delicate balancing instruments called seismographs.

Every year seismographs record about thirty thousand earthquakes throughout the world. But only about a hundred are serious.



Two causes of earthquakes. On the left, underground layers of rock have folded and pushed up the ground on the surface. On the right, layers of rock have split and slipped to change the level of the surface ground.

ANCIENT PEOPLES OF THE WORLD—NEW GUINEA MOUNTAIN TRIBES

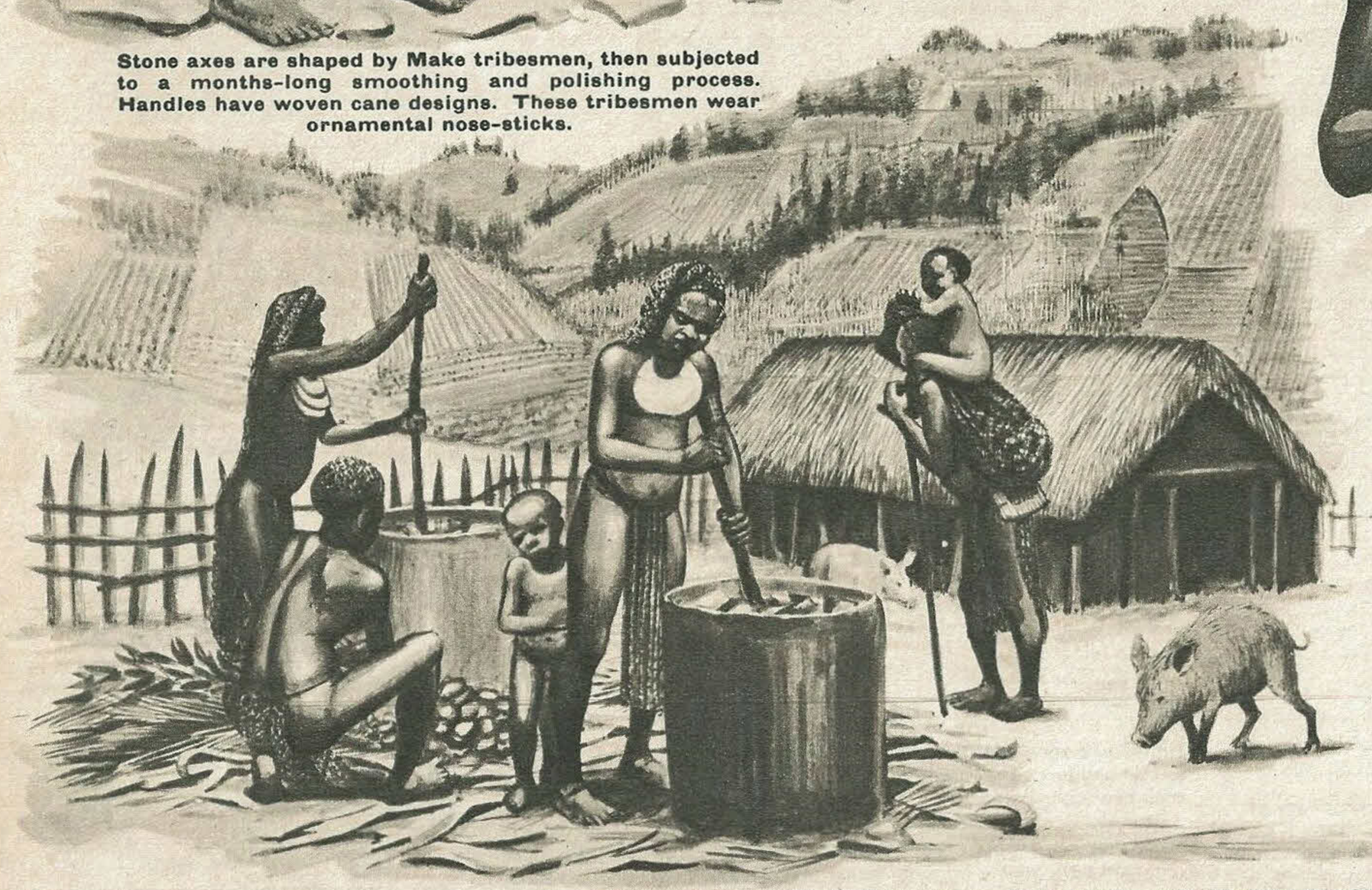
BIRD PLUMES ARE THEIR WEALTH

Stone axes are shaped by Make tribesmen, then subjected to a months-long smoothing and polishing process. Handles have woven cane designs. These tribesmen wear ornamental nose-sticks.

UNTIL about twenty years ago the mountain people of New Guinea were completely unknown to us, and even today the interior of this Pacific Island has not been fully explored.

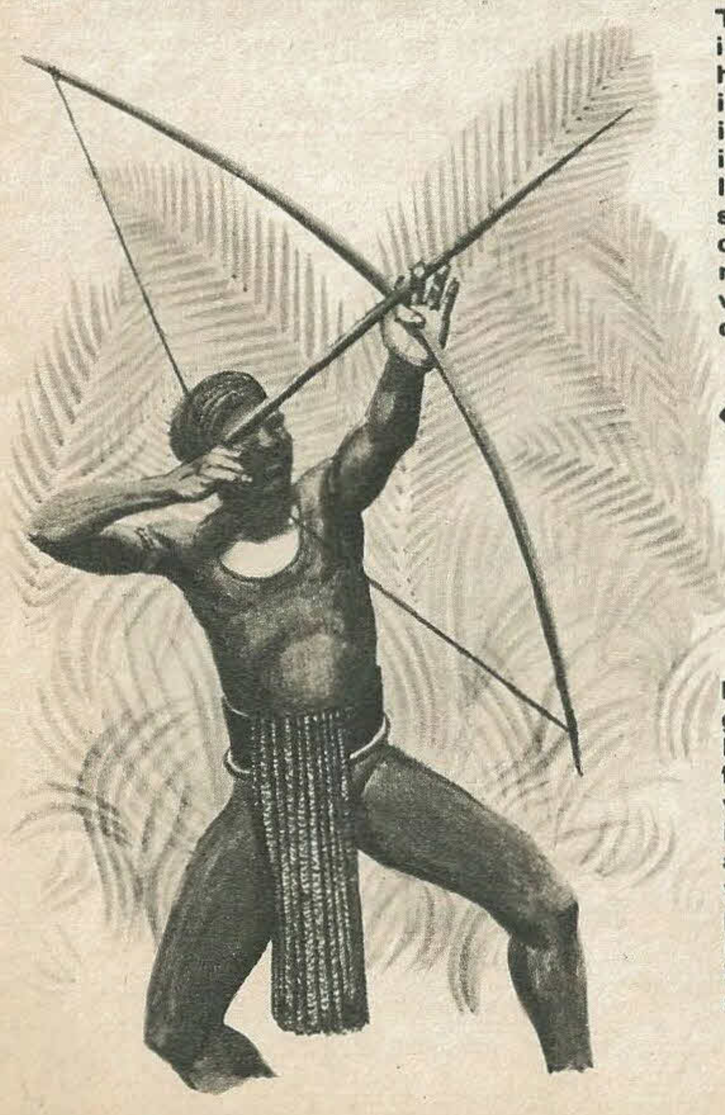
Numerous tribes of mixed Polynesian and Malay stock live in the interior, where jungle-covered mountain chains conceal gentle slopes and valleys. These tribes, differing in customs and language, make up half the island's population.

They are an agricultural people, living mainly on yams (sweet potatoes) and using only simple stone axes as tools. Most of the axes are made by the *Make* people, who are renowned for their fine workmanship. Their neighbours are the *Chimbus*, who live on slopes behind the Bismarck Mountains. They can grow crops all the year because of the mild climate.



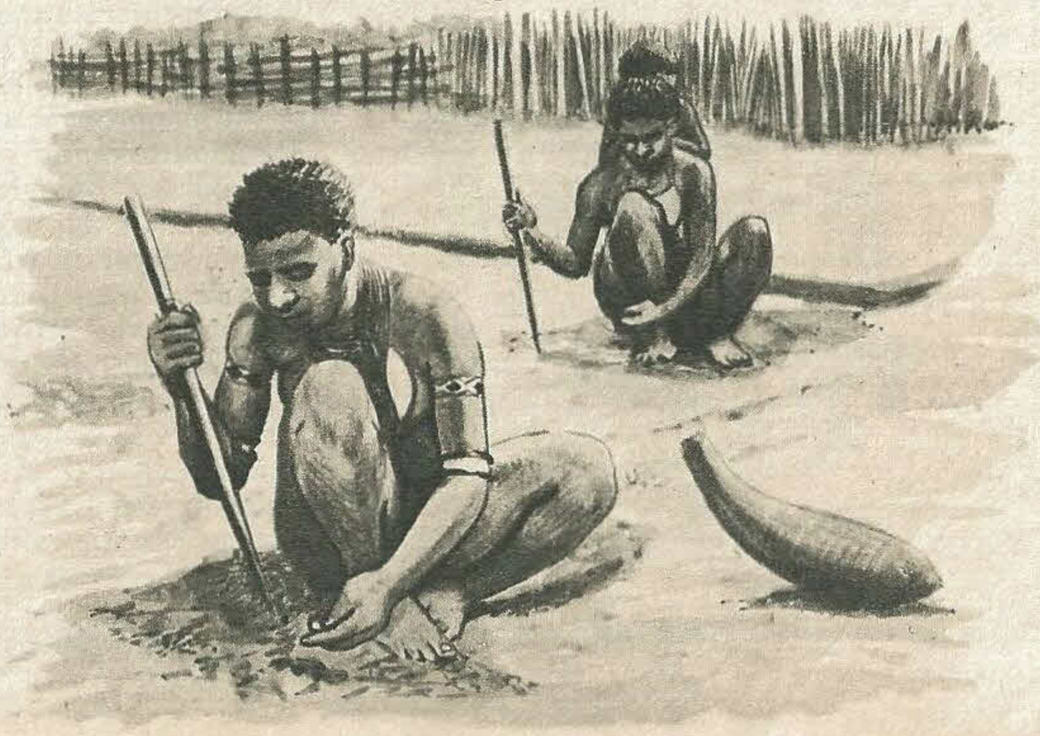
The Chimbus live in individual houses instead of villages. These low, dark huts are used only for sleeping. Food is cooked in the open on hot stones or in a kind of pressure cooker, which is a hollowed-out wood cylinder lined with grass and filled with hot stones. Food wrapped in leaves is put on the top, water poured over it and more grass used to cover it. Pigs, which provide protein in the Chimbus' diet, are reared like pets by women.

Every three or four years the Chimbus hold a festival and "pig" feast, a ritual dedicated to their ancestors, but a typical ceremony takes place more often, when local clans give presents and dance to drums. The men deck themselves with shiny green, blue and scarlet plumes of the bird of paradise (right). At evening parties in long huts, young men and women take partners and, instead of dancing, face one another in seated rows and sing.

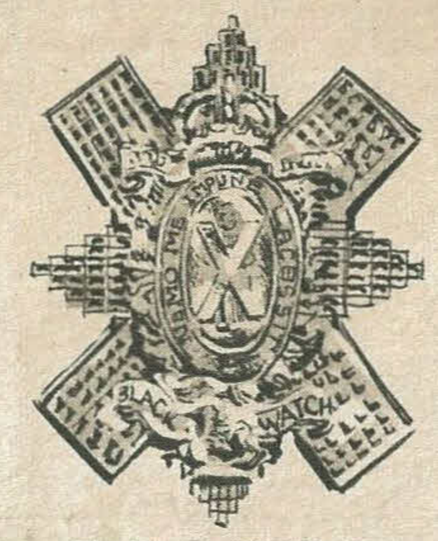


◀ Bows and arrows are used only for hunting birds of paradise. The plumes of these rare and beautiful birds are much coveted, as are the shell discs which the mountain people wear round their necks as a sign of wealth. Axes are often bartered for the plumes.

Every family owns a group of gardens, rather like allotments. Heavy work, like clearing ground, fencing and draining, is done by men while planting, weeding and harvesting is left to the women. The climate allows planting at any time of the year, the chief crops being sweet potatoes, bananas, beans, sugar and maize grown in neat lines. During World War II the friendly people supplied vegetables to Allied Forces. ▶



A NEW SERIES— BADGES OF COURAGE



The Regimental Badge

THE BLACK WATCH

Scotland's Famous Regiment

IN 1725 a local police force, or "watch," was raised in the Highlands of Scotland to prevent cattle stealing. Four years later it was decided to make this force into four army companies (not yet a whole regiment), and in order to distinguish them from regular troops, who were known as "red soldiers" because of their uniforms, these four companies, with their dark tartan kilts, were called "The Black Watch." In 1739 more troops were raised, and the Black Watch became a regiment.

They have kept their name to this day, and with that name goes a formidable fighting record. For two centuries, across five continents, the "Forty Twas" (so-called because the original regiment was the 42nd Highland Regiment of Foot) have struck terror into the enemies of Britain.

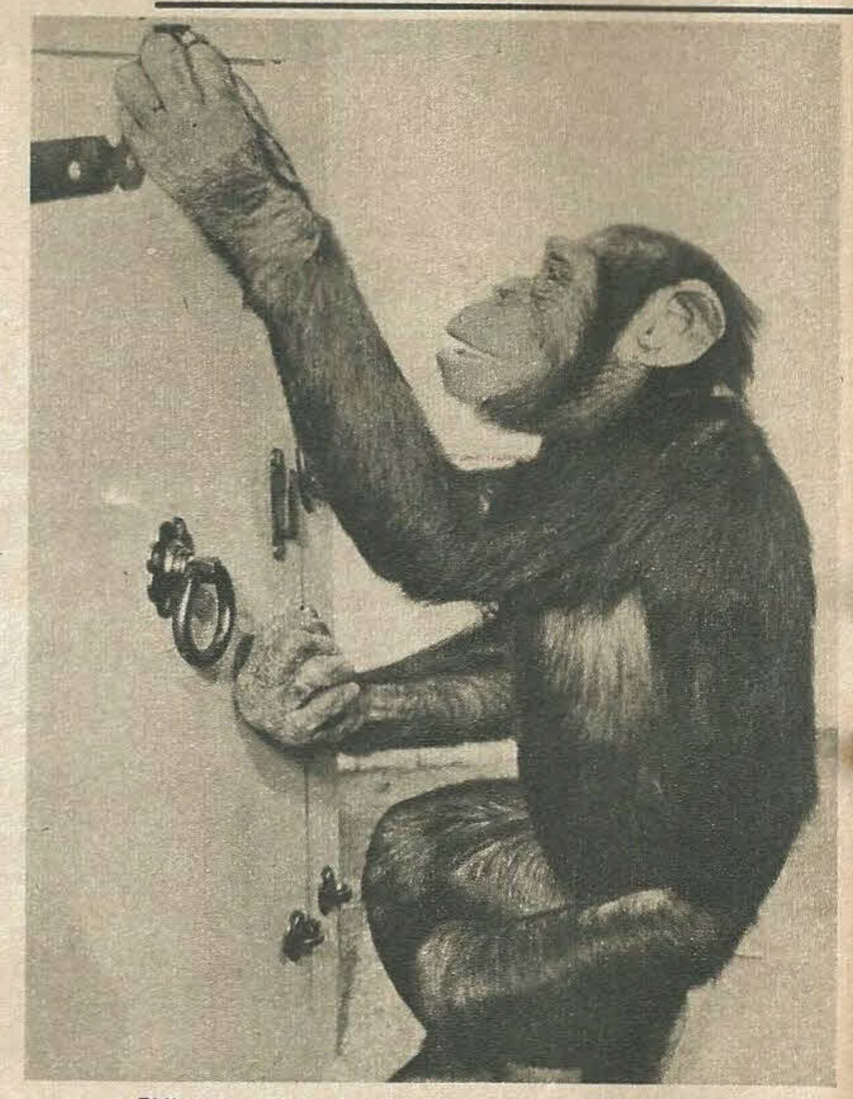
At the Battle of Fontenoy, in 1745, the Black Watch waited until the French were about to fire at them, then fell flat so that the musket balls passed harmlessly overhead. Then they rose, threw away their muskets and charged the French with dirk and sword before they had time to reload.

In 1881 The Black Watch (42nd) amalgamated with the 73rd Regiment, and the regiment is known today as The Black Watch (Royal Highland Regiment) (42 and 73). Their badge is the badge of the Order of the Thistle, and their headquarters are at Perth.

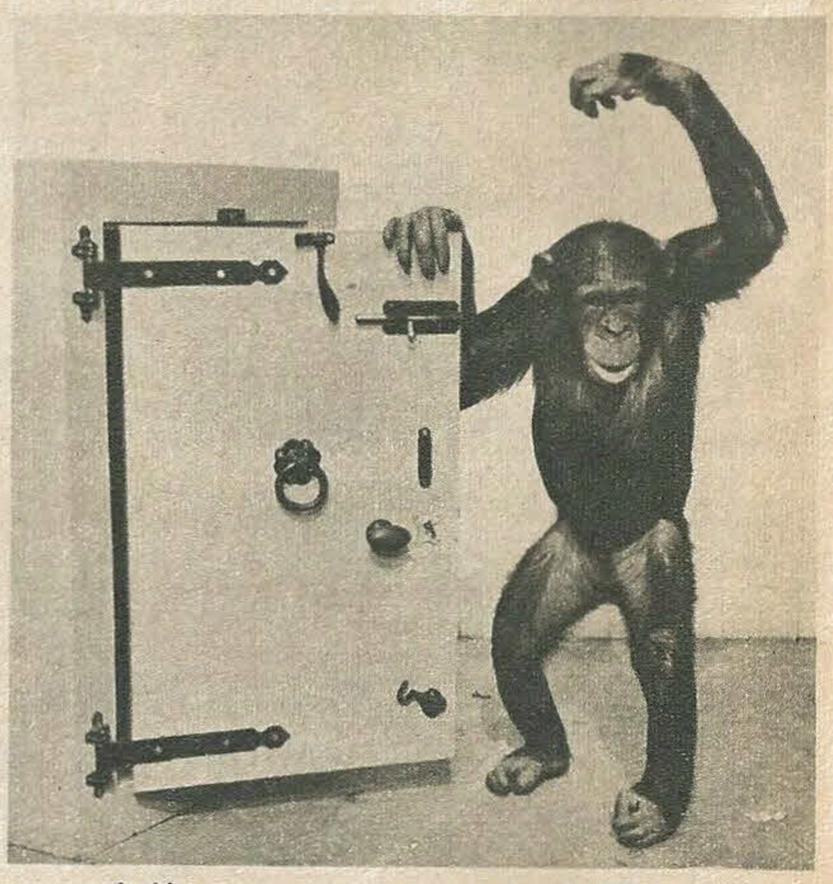
The regimental motto is apt, for it reflects the spirit that has brought fame to a fine fighting regiment—*Nemo me impune lacessit*: Let no one touch me and go unharmed.

This is the uniform of the 43rd (later 42nd) Highland Regiment, as worn in 1745. The plaid and kilt are in the Black Watch tartan, and as this man is a corporal he wears a white shoulder-knot.

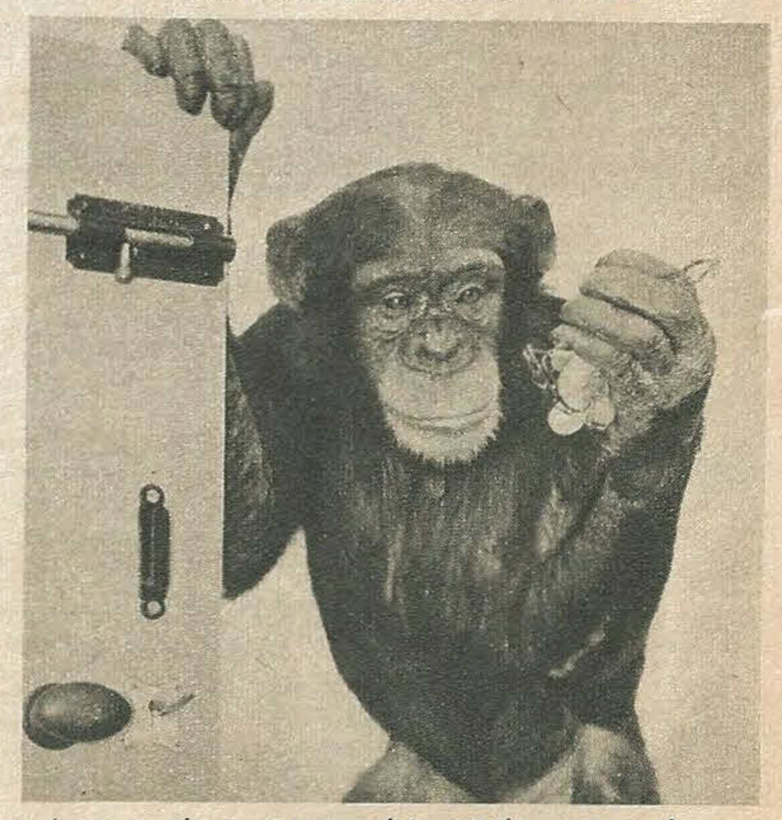
WONDERS OF NATURE:



Fifi, one of the London Zoo's brightest chimps, demonstrates the art of breaking into a safe.



Inside were some grapes and though Fifi had never tackled the bolts before . . .



. . . she soon managed to get them open and seize the reward.

COLLECTORS' CORNER

A LAUGH WITH THE MAIL!

TO commemorate the 100th anniversary of the City Mail Delivery Service, the United States Post Office issued on October 26 the first humorous stamp in its history.

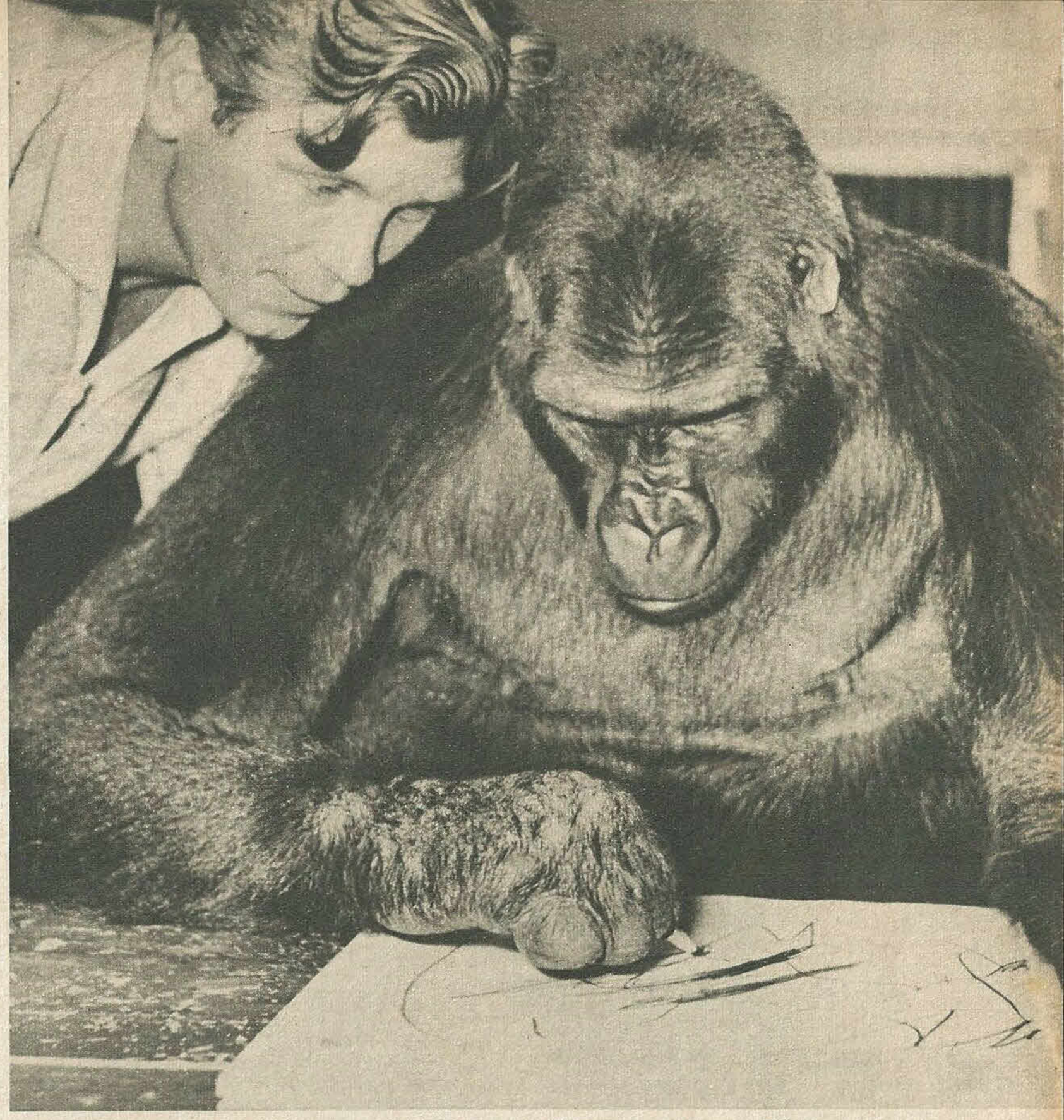
The multicoloured stamp is recess-printed by the Bureau of Engraving and Printing and is Perforation 11. The designer is the American magazine artist Norman Rockwell.

In 1825, the United States Congress provided for the delivery of mail by private carrier, but this service was not free and only operated in the larger cities. In July, 1863, the Postmaster-General, Montgomery Blair, introduced another act into Congress which provided free delivery of city mail. In 49 cities 499 letter carriers—or postmen as we would call them—began service as a result.

Do Animals Think? Part 3

WHEN APES PLAY MONKEY TRICKS ...

"Why, they are almost human!" we cannot help saying. But one thing will forever stop them being exactly like humans—the ability to master speech.



What goes on in a gorilla's head when she draws a picture, no one knows. But there is something uncannily human about this one's air of concentration as she produces a remarkable "abstract" picture.

HAVE you ever seen an ape drag a bun through the bars of his cage with a stick? Or have a tea-party? Or paint? Or push pennies in a machine to get a sweet? If you have, you can hardly stop yourself from saying, "He is almost human!"

Apes are the only animals that begin to approach a human level of intelligence, and this should not surprise us if we remember that biologists put apes and man in the same family of animals—the family of Primates.

One scientifically-minded couple brought up an ape in their own house to see how it compared with an ordinary baby. They were amazed at what it could learn. It could feed and dress itself, and it once even started the car! In its first two years it was even ahead of a human baby in doing things with its hands and solving puzzles.

But of course by the time an ordinary human child was two years old it was beginning to talk, so that it soon leapt ahead of the ape which never mastered speech.

Apes are, if you like, part way between having in-born instincts and having intelligent behaviour.

Automatic Language

THEY appear very bright when they are young, as instincts play an important part in the lives of babies. But they appear much less bright later on, when a child's basic brain power comes into full force. In many ways an adult ape is like a bright two-year-old child.

In fact the one thing that really stops an ape, or any other animal, from being human is that it cannot talk. Animals can make sounds, every variety of them. But they can never have a language in which a spoken word stands for an idea, and in which the spoken word can be written down and read from a piece of paper.

The language of animals is quite unlike our own in that the "words" of their language are really nothing more than automatic sounds that arise in certain situations. Birds cry out when they see an enemy, or a dog whimpers if it is in pain. But the gull can never cry a warning cry when there is no enemy in sight; and it can never poke fun at the other birds by *pretending* to see an enemy, so making them fly away in fright. To poke fun, you really need a much better brain than most animals possess.

The automatic language of animals is also found in young human babies—they cry when they are hungry, and laugh when they feel warm and happy.

Parrots, by the way, never learn to speak, they merely learn to imitate sounds. You can teach a parrot to say "water", but you can never teach a parrot to say "water" *when it is thirsty*. It is incapable of making the sound for "water" stand for the idea of satisfying its thirst.

There is a quite simple explanation of why animals cannot talk: they lack the brain for it. Not only do humans have bigger brains than animals (not bigger in weight but bigger in terms of surface area), but they also have a "speech centre" (called Broca's area) that is responsible for the ability to talk. If this centre is destroyed accidentally in a young child, he will never learn to talk.

It is because man is able to speak that he is far superior to all other animals. Speech allows him to pass on his knowledge of the world in writing to future generations.

Although animals have no language, that does not mean that they have no human qualities. They are perfectly capable of suffering acutely, for instance. The tragedy is that they are incapable of telling us about it.

A baby monkey that is taken from its mother and given a "teddy bear" to hug instead, will cling to it as though it were its mother. But when it grows up and then has children of its own it usually neglects them badly, because it itself had no experience as a baby of what it was like to be loved by a mother.

Animals can also become addicted to alcohol, and show all the symptoms of anxiety and worry when they are denied it.

Many animals are capable of pining, of being lonely, of affection, and of great loyalty. But the real danger is not for us to forget their almost human qualities, but for us to think that they are more human than they really are.

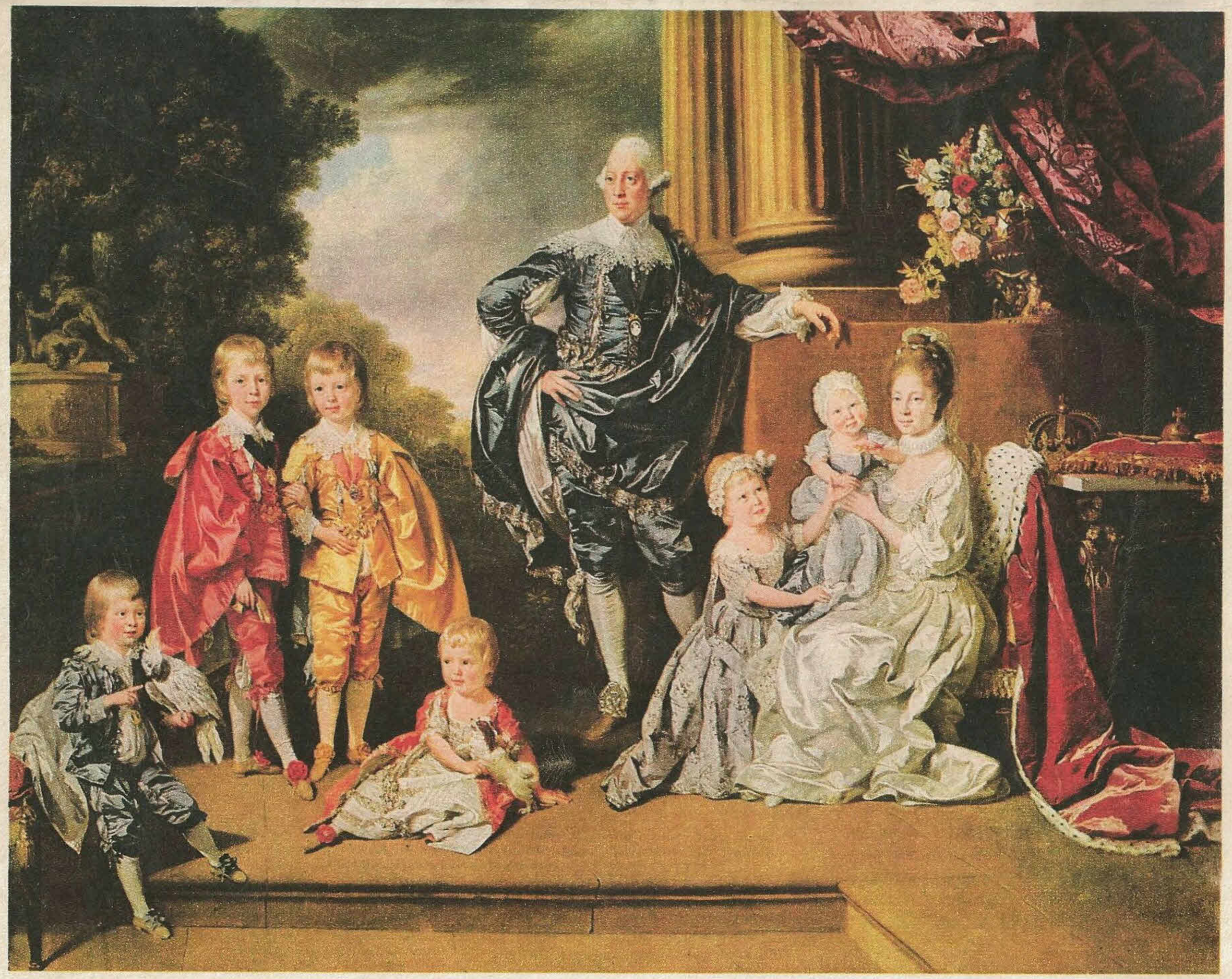
Limited Understanding

WE always have to remember that animals are animals, not humans, and that we have only a limited understanding of their world and they of ours.

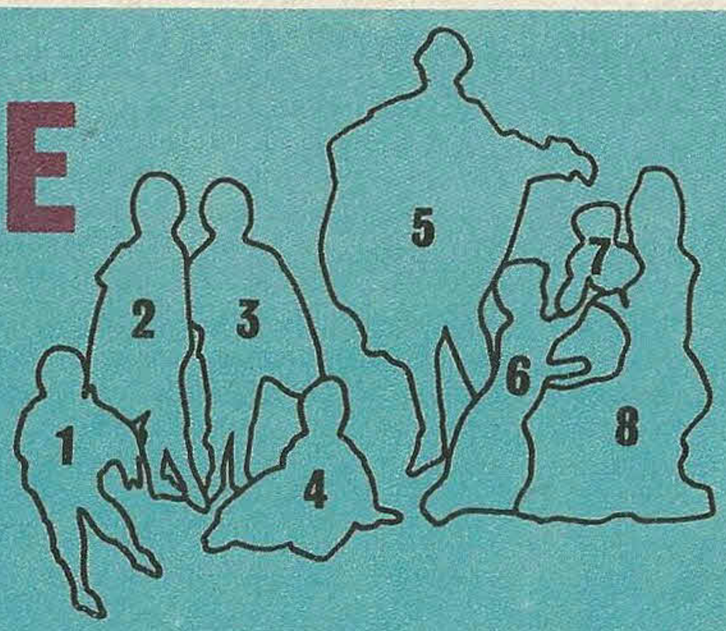
A dog's idea of a room, for example, is probably quite different from ours. They probably see a room as a wide space full of different smaller spaces—some smelling nice and others having a warm, cosy look that makes them good to sleep in.

It is so easy to misinterpret animals' behaviour if we forget that they are animals. There was a chimpanzee at the London Zoo, for example, called Congo. Congo was very charming, and always delighted visitors with his antics. They were even more delighted when he took hold of their hands and smiled at them. But they were given a great shock when he suddenly leaned forward and bit them.

Congo, far from being friendly, was in fact baring his teeth (what the visitors thought was smiling), and was drawing the "enemy" towards him for a good bite. This is what chimpanzees do when they are frightened, and it only goes to show that we must never treat animals as human beings, however "human" they may appear to us.



FARMER GEORGE AND HIS FAMILY



KEY TO THE PAINTING

From left to right: 1. Prince William. 2. George, Prince of Wales. 3. Frederick, Duke of York. 4. Edward, Duke of Kent. 5. King George III. 6. Charlotte, Princess Royal. 7. Princess Augusta. 8. Queen Charlotte.

KING GEORGE III—known as "Farmer George" because of his simple manners—was one of the best-loved men to occupy the English throne. He was also one of the most artistic. George loved painting, and his favourite court artist was a German called John Zoffany, who emigrated from Germany in 1758.

Zoffany had a remarkable talent for painting fine likenesses, and this, combined with his painstaking craftsmanship, made him a very successful painter. From the moment of their meeting, King George liked and admired Zoffany's work.

He commissioned not one, but many portraits of himself and his family, and the one reproduced above is famous. It shows the King with Queen Charlotte and their children, and was painted about 1770. Of George's children, two became Kings, and one the Commander-in-Chief of the Army.

The kings were George IV, the eldest son, and William IV, the third son. George, Prince of Wales was, of course, the famous Prince Regent who built the Brighton Pavilion. Famous for his lavish manner of life, he became Regent when his father was declared insane in 1811, although he did not become King until 1820.

William, "The Sailor King," was devoted to the navy, and became king on the death of his brother George in 1830. His was only a short reign—seven years—but in that time he made himself immensely popular with the common people.

Frederick, Duke of York, would have become king when George IV died, for he was the second eldest son of George III. But he died in 1827, although he was not forgotten. His name has been immortalized in the old nursery rhyme:

"The brave old Duke of York,
He had ten thousand men . . ."

From 1798 to 1809 he was Commander-in-Chief of the Army. But his talents were limited, and he was incapable of coping with the explosive situation created in Europe by Napoleon Bonaparte. Forced to resign in 1809, he became Commander-in-Chief again in 1811, and held the office until his death in 1827.

Edward, Duke of Kent, the fourth son, was the father of Queen Victoria—a great honour for the shortest-lived of George's sons.

LOOK AND LEARN

FOCUS on AUTOMATION

OUR ROBOT AGE AT WORK

Children talk to Sabor, a German robot which can actually tell the time and answer questions in several languages. Sabor can also walk.

HOW HUMPHREY
(The Boy Who Liked Fishing)
THOUGHT UP AUTOMATION

When he needed an afternoon off, Humphrey made a machine do his job for him. Today thousands of machines in Britain are at work for us—taking the tedium out of our lives and giving more leisure time to everyone.

WHEN we talk about automation we are using a term that comes from the Greek word *automatos*, meaning something that acts by itself.

That is exactly what automation is: an electrical or mechanical device that will do the work of human hands and, sometimes, human brains. And once the device has been started, it will continue doing its job accurately and tirelessly until someone stops it.

The opening of factories and the invention of the internal combustion engine began the Industrial Revolution of the late eighteenth and early nineteenth centuries. Today we have a second Industrial Revolution led by robots and controlled by electronic brains.

Yet it all began as long ago as the seventeenth century—because a boy wanted to go fishing.

His name was Humphrey Potter and he had the tedious job of opening and shutting valves on a Newcomen steam engine used for pumping water out of a coal mine in Warwickshire.

The Newcomen steam engine was one of the first attempts to do useful mechanical work, and was a very primitive affair indeed.

It had what was called a "walking" beam which was pivoted at its centre on top of a tower. This enabled the beam to move up and down like a sea-saw. To keep the engine working, a valve had to be opened to let water into the boiler and another valve opened to let steam into the cylinder which turned the crank driving the pump.

Humphrey Potter's job was to open and shut

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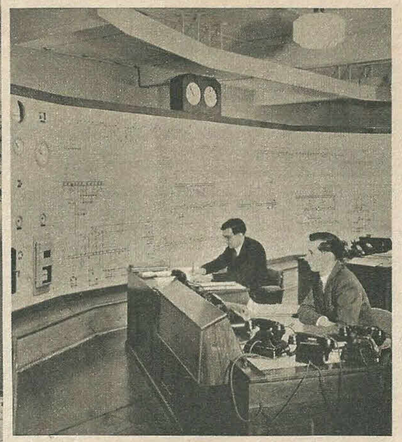


Left: By pressing switches on the right of his cabinet, called a console, the supervisor at an oil depot automatically loads a fleet of road tankers. When each tanker is full, a lamp lights. Robots hidden by the great wall diagram in the top photograph tell controllers at an electricity distribution centre how power is being used.

HOW HUMPHREY THOUGHT UP AUTOMATION

continued from page one

these valves scores of times every day by pulling on cords. Humphrey had not been doing this job for very long before he hit on the ingenious idea of fixing the valve cords to various parts of the walking beam.

The see-saw motion of the beam then automatically did Humphrey's work for him, and he was able to go away and fish, safe in the knowledge that the engine would get on with its work without his help.

Nearly a century after young Potter had his bright idea, James Watt, who was famous for his improvements to steam engines, designed and put into operation a device that automatically controlled the speed of steam engines.

Neither Humphrey Potter nor James Watt had ever heard of the word "automation." And if they had they would not have known what it meant. But they had both hit on the idea of making a machine do a man's work—and do it much better and cheaper than the man.

Modern automation uses electronic, electrical, magnetic, temperature-reading and mechanical devices unheard of in the days of Potter and Watt. Yet all the gadgets used in automation have the same purpose—to use mechanical or electrical controls and operations instead of human labour.

There are now very few industrial activities and processes that cannot at some stage be automatically carried out by automation devices.

Oil refining, for example, depends upon the temperature of the oil, the pressure at which it is kept in the refinery tanks and pipelines, and upon the length of time that the oil spends in each refining process.

Automatic Refineries

At an oil refinery all this is done automatically. The speed of the pumps that force the oil through the various pipes and stills is controlled by pressure gauges. The temperature of the oil is automatically governed by thermometers which turn the heaters up or down according to the temperature needed for any particular process. Time switches open valves so that the oil is emptied at the exact moment a process is finished.

All these automatic devices are operated from a central switchboard so that a handful of technicians can run a refinery producing thousands of gallons of oil and oil products every hour of the day.

Inventors are even working on a super-automatic system which would do away with men at a switchboard. Calculating machines called computers would operate electrical relays which would move the switches at the times required.

Modern gasworks use automatic devices very similar to those employed at refineries. At one of the biggest gasworks in Britain, a team of twenty men now operates automation equipment which does the work which forty years ago needed the labour of 400 men.

One of the most fantastic automation systems is that controlled by the electronic brain.

The necessary information about what has to be done is "written" as a code of dots which are punched on to a tape. The tape is then fed into an instrument rather like a gigantic radio receiver with thousands of valves.

This sets in operation a mass of electrical switches which can be made to perform all manner of tasks.

Making Space Safe

Besides their many industrial uses, computers are used to give details necessary to send a space satellite into orbit. Without computers, pioneers like Glenn and Gagarin would never have become spacemen; they could not have got off the ground with any certainty of returning to it.

Computers used for space flights work out in advance the future course of the satellite and the speed at which it must leave the earth to go into its specified orbit. They tell the scientists what will happen to the astronaut during his journey.

One of the largest chains of teashops in Britain uses computers to work out the pay of their thousands of employees; the amount of income tax that must be paid by each; give information as to where any one employee works and his or her hours of duty; and calculate the amount of overtime earned or the time lost by sickness and holidays.

This electronic brain will even tell its masters the number of cups of tea, buns, or other foods served in any of the firm's teashops or restaurants at any hour of the day.

At one time it would have taken hundreds of clerks and typists several days to produce all that information. Now the computer does it in a few minutes—and without making mistakes.

Coded tape passing through a computer is also used on a large scale for the automation control of factories and workshops. The tape sends out impulses according to its coded instructions, and these in turn send out impulses which control electric motors on the machines.

In many factories automation has taken over the task of inspecting and passing as correct, or rejecting as faulty, finished products. Automation devices do this much more quickly than human inspectors, and unlike them does not make mistakes.

A MAGIC EYE THAT MAKES LIGHT OF WORK

The heart and brain of many of the devices that have made automation possible is the photo-electric cell. Not without reason has the photo-electric cell been called the magic eye that makes light of the world's work.

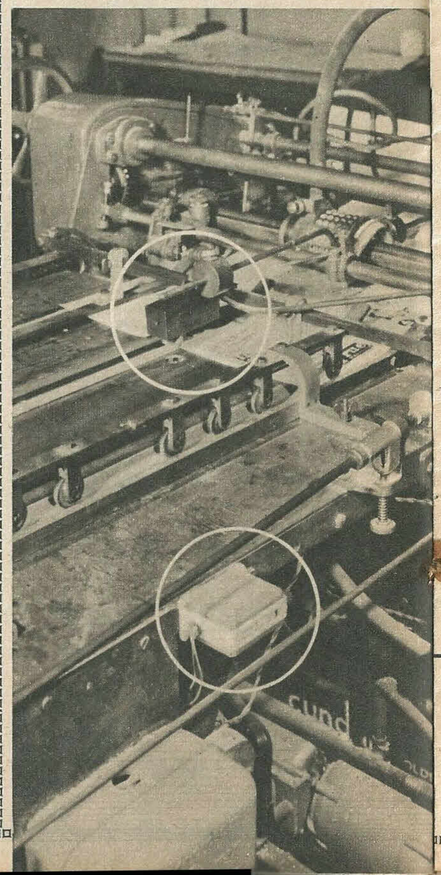
A photo-electric cell looks rather like a radio valve. One type has inside it a strip of metal with the curious property of allowing an electric current to pass through it when light falls on it. One of these metals is called selenium.

If a photo-electric cell is placed in such a way that light from an electric lamp is shining on the selenium, current from a battery connected to the cell will pass through the selenium and operate any electrical or mechanical machine. But if the light shining on the cell is interrupted by anything coming in front of it, the current is cut off and the machine stops.

By interrupting the light shining on the cell, electrical and mechanical devices can be made to do hundreds of tasks that once had to be done by hand. Besides "manual" labour the cell can be used to do tedious jobs such as counting, and it does its sums much more quickly than a human being—and without making mistakes.

Factories use photo-electric cells to count articles passing from one part of the building to another on conveyor belts.

This is done by mounting a photo-electric cell on one side of the conveyor belt and an electric lamp on the other side so that the light shines on the selenium strip.



With its magic eye this folding machine counts the pages of a magazine as it comes off the printing press. As the folded sheet moves through the machine it interrupts a beam of light shining on the photo-electric cell (upper circle). Electric impulses then operate the numbers on the counting machine (lower circle).

Whenever an article on the conveyor moves forward, it interrupts the light to the photo-electric cell. The current passing through the selenium is then interrupted. This operates a mechanical counter which steadily adds up the articles.

Other types of conveyors are controlled by photo-electric cells in such a way that articles can be pushed by mechanical arms off the main conveyor on to others leading to a different part of the factory. The mechanism controlled by the cell can be so arranged that the arms will push off only articles of a certain shape, or even just a few articles of the hundreds passing before the cell.

Automatic machines that fill bottles, tins or packets at the rate of hundreds an hour must do so very accurately to prevent the material being bottled, tinned or packaged from being wasted. No human eyes or hands could work fast enough or accurately enough to turn on or off the caps or levers controlling the filling nozzles.

With a photo-electric cell, however, the job is done efficiently without human hands or eyes.

A photo-electric cell is placed on one side of the filling nozzles and an electric light on the other. As the bottles, cans or packets move forward on a conveyor belt and come directly under the filling nozzles, the beam of light to the cell is cut off. This automatically turns the tap or nozzle and allows the exact amount of whatever is being filled to come through. As the container moves away from the nozzle, light again falls on the cell and the tap or lever is automatically turned off.

Cutting To Size

Where wood, steel or other material has to be cut to exact lengths, a photo-electric cell is mounted on a frame so that light from a lamp underneath shines up on it. While the light is shining on the cell, an electro-magnet is holding up the cutting tool, called a guillotine.

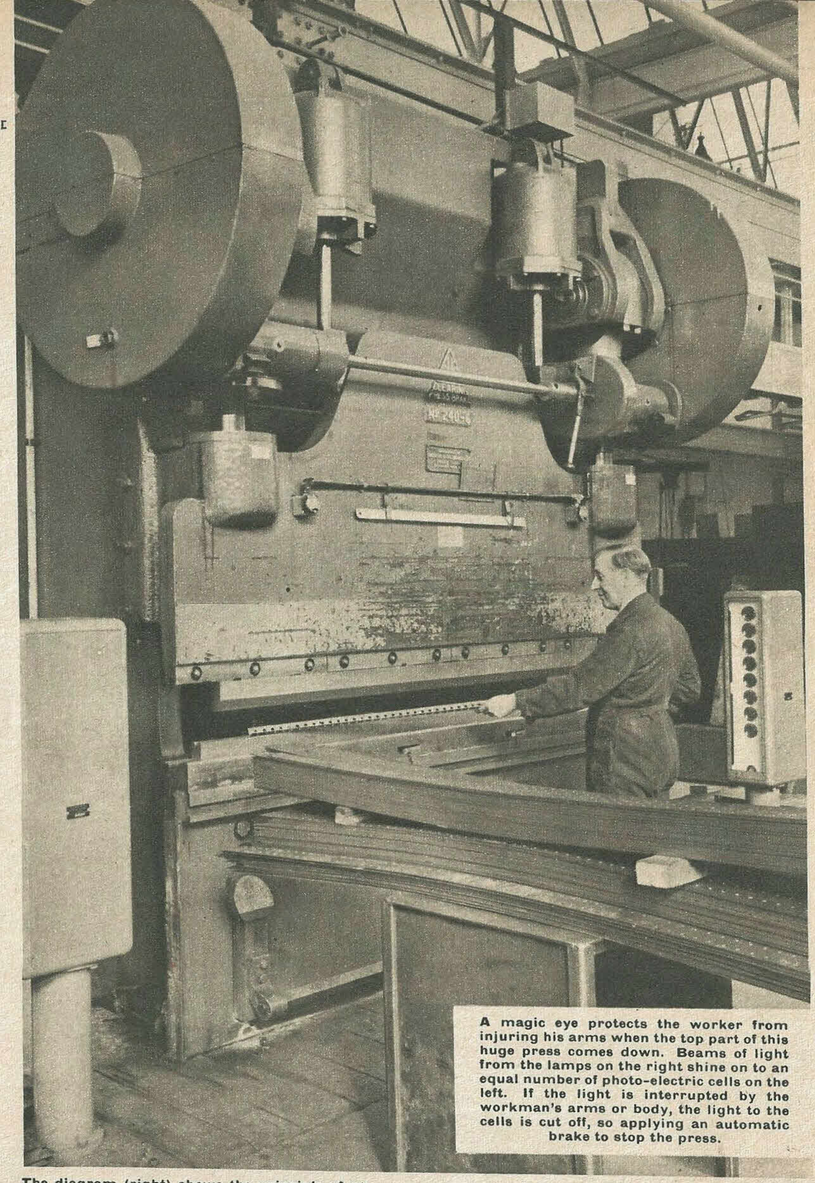
The material that has to be cut into lengths is fed into the machine in a continuous strip.

Immediately the front edge of the strip of material moves forward it interrupts the light between the cell and the lamp. The current passing through the cell to the electro-magnet is then cut off. The electro-magnet loses its magnetism and this at once releases the guillotine which falls and slices off the correct length of material.

The cut-off lengths are carried forward on the machine and the light again falls on the cell. Current goes to the electro-magnet and the guillotine is pulled up ready to make its next cut.

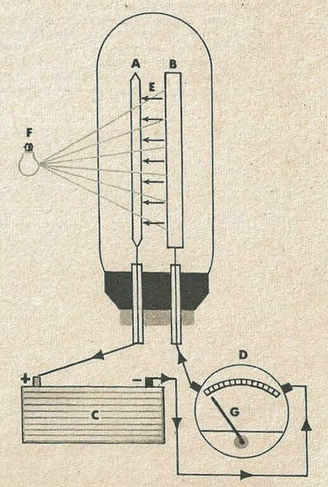
In some of the heavy stamping machines used for pressing sheets of steel into shape, the steel sheets for shaping are pushed into the machine by hand. Unless the operator is very quick and careful, the moving part of the press may come down and injure his hands before he has time to move back.

The photo-electric cell prevents this from happening.



A magic eye protects the worker from injuring his arms when the top part of this huge press comes down. Beams of light from the lamps on the right shine on to an equal number of photo-electric cells on the left. If the light is interrupted by the workman's arms or body, the light to the cells is cut off, so applying an automatic brake to stop the press.

The diagram (right) shows the principle of a photo-electric cell; instead of using selenium, this one uses the metal caesium. When light from a bulb (F) falls on the caesium strip (B) it releases electrons (little particles of electricity). These provide a path for the electric current to jump the gap (E) between the caesium and a nickel strip (A). The current then flows through the battery (C) in the direction of the arrows, and is registered in the meter (D) by the needle (G). If an object blocks the light, then no current flows.

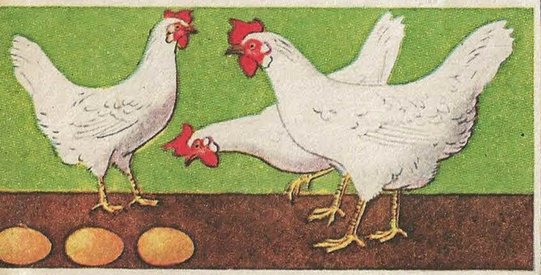


On one side of the press is a row of lamps, each shining on one of a row of photo-electric cells mounted on the other side of the machine. If the beams of light are broken by something passing through them, an electro-magnet immediately prevents the moving part of the machine from coming down.

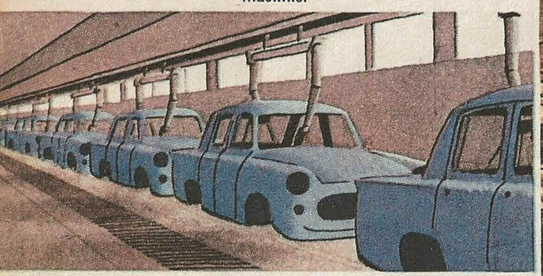
The reason for having several lamps each shining on its own cell is to have a number of separate beams of light, so that a thin object passed to the machine moves between the beams. Therefore no light is interrupted and the brake on the machine does not act.

But if one or more beams of light are interrupted by an object wider than the steel sheet, such as the operator's arm, enough light beams to the cells are broken to apply the electro-magnetic brake and so stop the press.

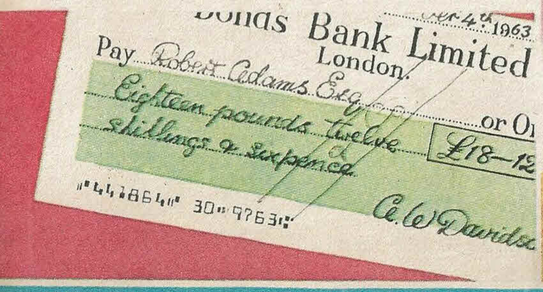
Rockets and satellites travelling in space send back to earth detailed information about the conditions through which they are passing, while their own movements can be controlled from the ground. The messages from space to earth consist of instrument readings of temperature, cosmic radiation, etc., which are converted into electrical impulses by a system called telemetering and then radioed to the ground by the satellite's transmitter.



On a modern poultry farm, thousands of hens can be looked after by two or three people assisted by a number of ingenious machines. Each hen has its own pen before which passes a conveyor belt carrying the exact amount of food it needs. When a hen lays an egg, the egg rolls down a chute and is automatically stamped with the date and the hen's number. Another machine sorts the eggs according to size and passes them to a packing machine.



Without automatic machinery, a motor car would cost many times more than it does. Where once bodies were put together by hand, giant presses turn them out in single units. Cylinder blocks are drilled in one operation by one machine. Other machines turn out thousands of road wheels a day; there are machines that automatically cast in single pieces of metal complicated engine blocks; and precision machines make the pistons.



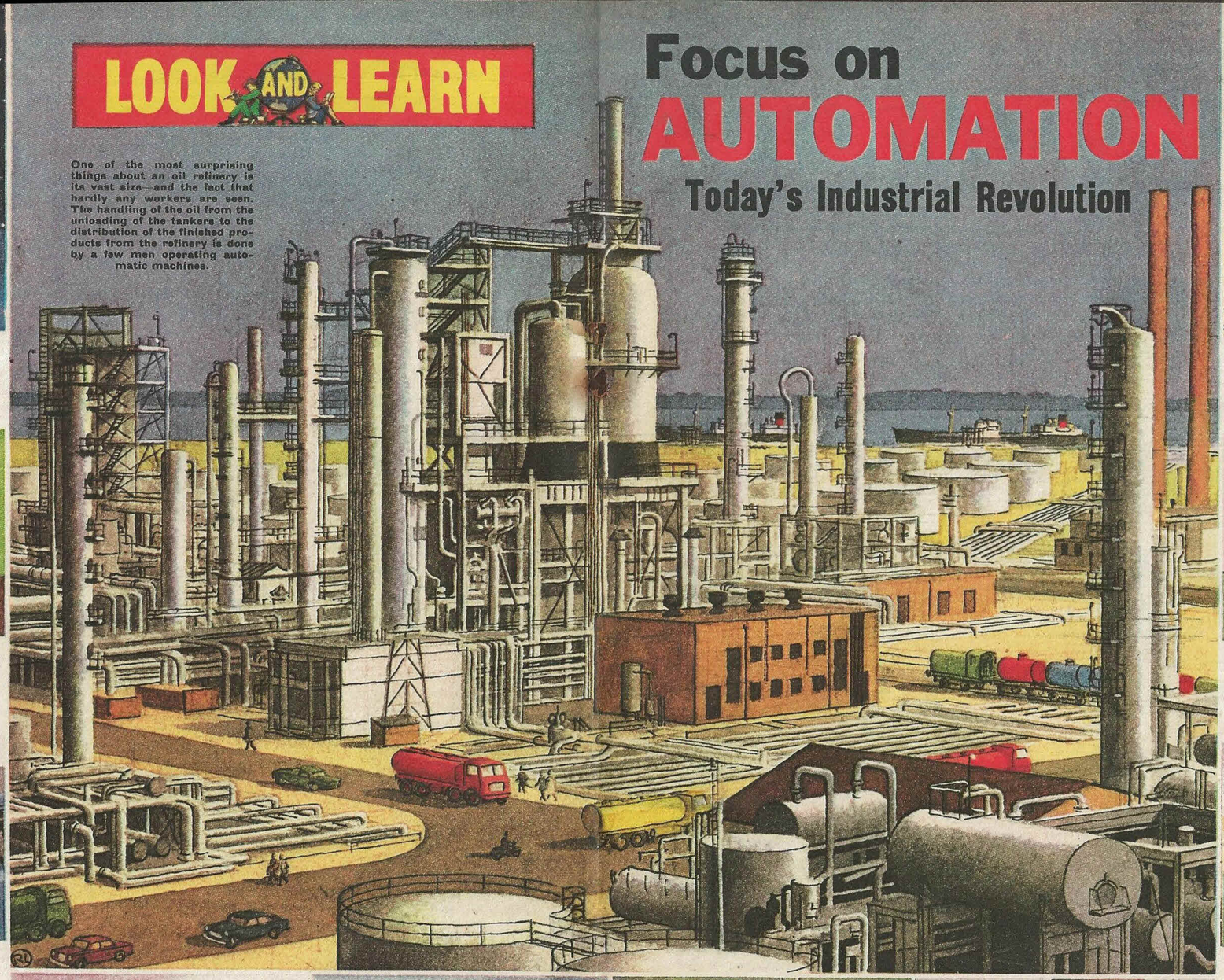
Not so very long ago every cheque passing through a bank had to be sorted by hand. Now there are robot clerks to do that job. At the bottom of the cheque are a number of figures and symbols printed in magnetic ink. When the cheques are passed through a machine the magnetic ink operates relays which set the sorting equipment into action.

LOOK AND LEARN

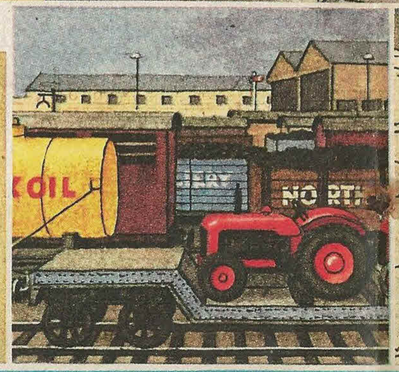
Focus on AUTOMATION

Today's Industrial Revolution

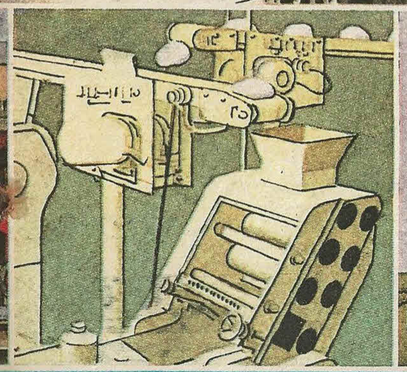
One of the most surprising things about an oil refinery is its vast size—and the fact that hardly any workers are seen. The handling of the oil from the unloading of the tankers to the distribution of the finished products from the refinery is done by a few men operating automatic machines.



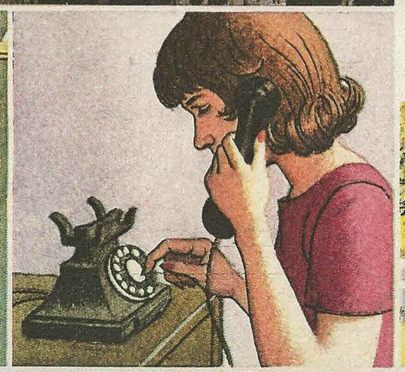
When a shoe factory decides on a new style of shoe, machines are set which automatically cut out the uppers and soles to the required sizes and shapes. Sometimes the shoes are made from plastic materials which machines automatically mould to size and shape.



Freight wagons from all parts of the country are uncoupled from incoming trains, sorted according to their destinations and made up into new trains at marshalling yards. The whole process is operated by switches in a control tower which overlooks the yards.

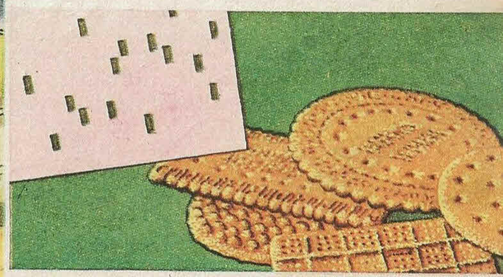


Most of the bread you eat is made and baked in automatic machines and ovens. The quantity and quality of the flour and other ingredients are fixed by machines; machines mix the dough, and the heat in the ovens is automatically controlled. Other machines slice and wrap the loaves.

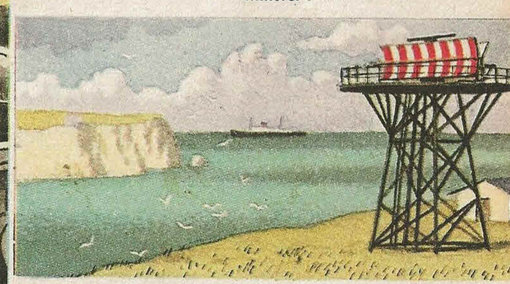


The automatic telephone is the most amazing machine of the Robot Age. Simply by turning a dial according to the number required, one person can speak to another hundreds of miles away without being connected by a human operator. And the robot fixes the charge!

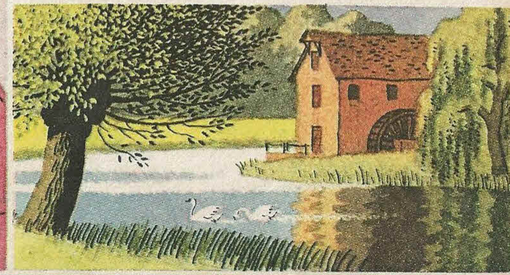
When an airliner is approaching an airport its position, height, and speed are shown by a spot of light, called a "blip," moving across a radar screen. There may be several aircraft flying near to the airport and each has its own "blip" on the screen. By carefully watching the positions of the "blips," the airport control officer can warn pilots if they are in danger of colliding.



In large biscuit factories, the recipe for any particular biscuit is "written" as a series of round or square holes punched in long strips of paper. The perforated paper is then passed through a machine which by means of various switches and valves turns the holes into electrical impulses. These impulses open the containers of ingredients and send the exact quantities to the mixers.



By watching a spot of light, called a "blip," moving across the face of a radar screen, a radar operator at a coastal station can follow the course of ship which he may not be able to see because of dense fog. If the "blip" shows him that the ship is moving dangerously close to rocks or sandbanks, he can radio a message to the ship's navigator directing him to a safe course.



Once upon a time our water came from any pond or river and was often dirty and unhealthy. Today, water is automatically analysed and any impurities removed by automatic filtering machines. The same process is used to purify waste water from factories, before it is returned to rivers, so protecting fish from harmful factory effluent.

HAPPY LANDING FOR AN INVISIBLE AIRCRAFT

THICK fog suddenly smothers an airport in a swirling blanket of invisibility. And coming in to land is an airliner whose pilot has no chance of seeing the runways.

Not so very long ago, that was the most terrifying problem that the pilot of an aircraft had to face—landing on a fog-bound airport he could not see.

Peering through the cockpit window, he had only a few minutes to make a quick decision. He could fly about until the fog lifted, or he could try to reach an airfield where the weather was clear.

Either choice had its own risk. If he flew around waiting for the fog to disappear, he might collide with other aircraft. If he decided to use another airfield he might not have enough fuel for the extra journey: then he would have to land somehow—even at the risk of crashing.

Today all that has changed. Thanks to a form of radar automation called Ground Control Approach, aircraft can now be landed on airfields which the pilots cannot see.

Ground Control Approach is so called because a radar operator on the ground controls all the movements of the aircraft approaching the airfield and brings it safely down on the runway. Even more astonishing is the fact that the ground operator does not actually see the aircraft any more than the pilot sees the airport.

On the edge of the airfield is a van carrying a radar transmitter and receiver. The radar crew are always on duty and the van is kept ready to move to any runway.

Immediately the weather becomes foggy, the operator in the van starts transmitting radar impulses. These are broadcast from a constantly revolving aerial.

As the transmitter has a range of thirty miles, the radar broadcast covers an area of thirty miles all around the airport.

When the sweeping beam of radar impulses makes contact with an aircraft approaching through the fog, the impulses are reflected back by the aircraft's fuselage and wings and are picked up by the radar aerial on the van.

These reflected or "echoed" impulses then cause a spot of light called a "blip" to appear on screens rather like those of television receivers.

One of the screens has marks across its face representing thousands of feet. From the position of the "blip" against any particular mark, the operator knows at once the height at which the aircraft is flying.

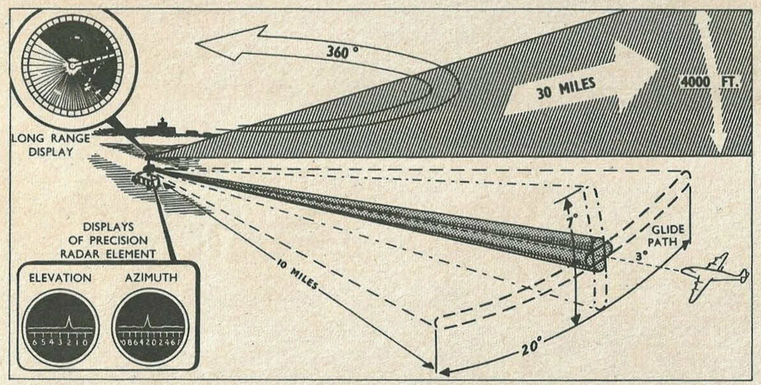
Another of the screens is marked around its edge with the points of the compass. It also has across it a number of concentric rings; that is, rings one inside the other and all having the same centre.

The space between each pair of rings represents a distance of five miles. From the position of the "blip" on this screen, the operator knows from which direction of the compass the aircraft is flying—and how far away it is.

After he has "read" the information given by his screens, the radar operator then speaks to the aircraft pilot by radio and instructs him about the course he must fly to reach the airport.

When the pilot has brought his aircraft within a certain distance of the airport, he is told the direction of the runway on which he is to land. He is also signalled by radio the exact moment when he must begin gliding in.

By watching an illuminated map of the airport's runways and noting the positions of the moving "blips" on the radar screens, the operator knows at once if the aircraft is flying on the right course.



This diagram shows width, depth and range of Ground Control Approach Radar. Long Range Display Beam (screen, top left) has range of thirty miles. Lower beams form a radar "Channel" for aircraft. Ground Controller can see if aircraft stray from channel on screens, bottom left.

The Moving 'Blip'

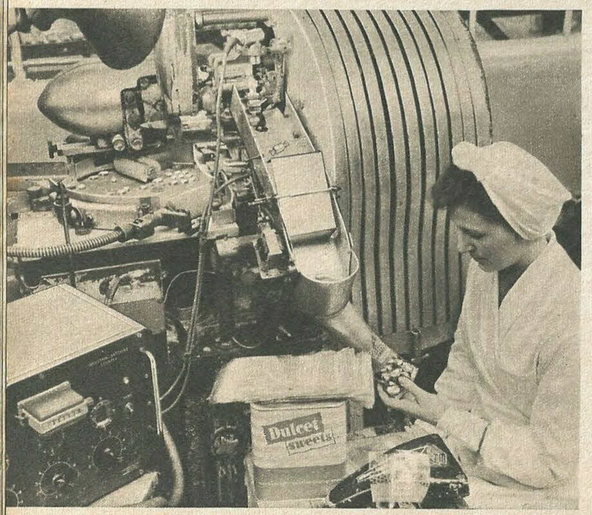
IF the pilot is not flying on the course that will bring him to a safe landing he receives radio orders to change direction until the "blips" are again moving in such a way as to show that the aircraft is flying directly towards the runway. If the "moving blip" shows that the aircraft is not gliding at the correct angle, the pilot is told by radio what to do.

In this way the radar operator can keep the aircraft in constant "view" on his screens until the pilot has the wheels of the aircraft safely taxi-ing on a runway which he may have been unable to see before he actually touched down.

At very busy airports there may be several aircraft flying about and all of them will appear as "blips" on the radar screen. The controller on the ground then has to identify each aircraft.

This he does by sending a radio signal to the pilot asking him to turn his aircraft. The particular "blip" that then moves on the screen is made by the aircraft wishing to land. This type of radar has now been greatly improved for use at large centres such as London Airport, although it is still used on smaller airfields.

What the radar operator sees on the long-range screen. The white spot on the right indicates an aircraft approaching from the north-east at a distance of twenty-five miles. The spot on the left is made by an aircraft flying from the south-west fifteen miles away. The white mark in the centre is the position of the ground radar.



A photo-electric cell operating a trap door from the wrapping machine counts the exact number of sweets to go into each packet. This robot saves the trouble of having to weigh them.

ROBOTS THAT FILL YOUR LARDER

YOU only need to look in the larder or refrigerator to see how automation is affecting our way of living. There are very few tinned, packaged or bottled foods that have not been handled by robots at some stage.

Bottled milk is handled automatically from the time it leaves the cow until it is delivered on our doorstep.

The cow is milked by a milking machine and its quantity and quality measured automatically before it is pumped to the machine that fills the milk churns.

When the churns arrive at the dairy they are emptied by machinery into tanks ready for pumping into the great vats in which it is pasteurized to destroy harmful bacteria. From the pasteurization plant, the milk is delivered by pumps to almost human machines which fill it into bottles and close the bottle tops with aluminium caps.

Mechanical Loading

CONVEYOR belts carry the bottles of milk to another machine which packs them into crates, and yet another machine loads the crates on to the delivery floats. Practically the only time the bottles of milk are touched by hand is when the roundsman puts them on your doorstep.

The preparing and packing of tinned, frozen or packeted foods is almost completely mechanized.

Tinned peas, for example, are handled by mechanical robots from the moment they arrive at the packing factory until they are delivered to the grocery store.

The sacks of freshly picked peas from the farms must first be graded according to quality and any which are below standard are rejected. The first process is to separate the bad peas from the good ones.

This is done by passing the peas through a long, revolving cylinder lined with thousands of needles. As the cylinder revolves, the needles pick out any peas with holes or other kinds of damage and reject them as unfit.

Peas that pass the first testing machine move by conveyor belt to another machine which has the job of testing them for good colour. The peas pass in front of a photo-electric cell. This is an electric device used a great deal in automation, and how it works is explained on page six of this supplement.

The photo-electric cell is able to "see" the colour of the peas, and immediately a badly-coloured one passes in front of it, an electrically operated metal finger comes into action and flicks the unwanted pea into a waste-bin.

By using this amazing machine, peas can be examined at the rate of six millions an hour. Imagine how long it would take human eyes and hands to do that.

As the peas successfully pass their examination they are carried by conveyor belts to the packing machine.

If they are to be frozen, they go to great refrigerators. There they are quickly frozen and passed to a machine that automatically fills them into bags, and another set of mechanical fingers closes the tops of the bags.

If the peas are to be canned, the conveyor belts take them to huge hoppers from which they fall into the cans moving on a conveyor belt. Another machine puts the tops on the cans and closes them down. The filled cans then roll along to the machine that prints the labels and wraps them round the tin.

Finally, the filled and labelled cans of peas move to machines that pack them into cartons ready for delivery to the shops.

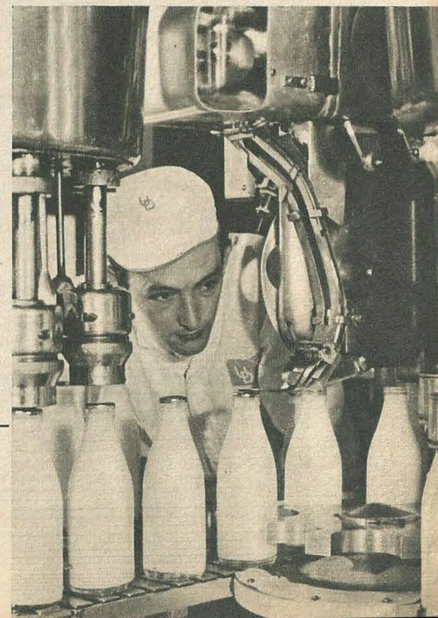
Equally ingenious machines are used for preparing and trimming fruit. There are machines that peel the fruit and extract the pips and stones, cut fruit such as peaches or pineapples into slices and then pack them in the tins.

Purer Food

COOKED food such as meat or fish is prepared by robot chefs before being sealed in tins or bottles.

Next time you buy a bar of chocolate or any other kind of wrapped sweet, notice how neatly the silver paper or other wrapping has been folded round it. That is another job that was done by automatic machines.

Automation in food factories means that most of the things we eat are much more pure and wholesome than in the days when everything had to be done by hand. The less handling of food by human beings, the less chance it has of collecting disease-carrying bacteria.



Robot fingers of steel close the aluminium tops on bottles of milk as they are carried on conveyors from the filling machines. Thousands of bottles an hour are capped like this.

FOCUS on AUTOMATION-Our Robot Age at Work

Cars growing up on the production line. As each car moves forward on the travelling platform, mechanics at the sides and underneath add more bits and pieces. At the end of its journey through the factory it rolls off the line ready for the road.

CARS BY THE THOUSAND

WITHOUT automation, the cheapest motor car on the road would cost several thousands of pounds instead of a few hundreds. Every part, down to the smallest screw and nut and bolt would have to be made by hand.

Instead of one big factory turning out thousands of cars a day, the motor "industry" would consist of scores of little workshops each producing a couple of cars a week.

By making machines do the work of craftsmen, all the parts of a car, from the engine to its many fittings, are turned out by automatic machines.

The parts are then brought to what is called the production line. This is an elaborate kind of conveyor belt on which the cars are built up piece by piece as they pass the mechanics who each add one particular part to the growing car.

The car starts its journey on the belt simply as a flat frame, called the chassis. Then as it moves through the factory, sometimes from one floor level to another, it "grows" into a complete car ready to be driven off the production line.

The first production line was built as long ago as 1784 for a flour mill in Philadelphia, U.S.A. A series of small trucks attached to an endless rope passing over pulleys and driven by a steam engine, carried the wheat from its storage hoppers to the steam-driven grinding wheels or millstones. The flour from the millstones was then taken by conveyor belts to a machine that filled it into bags.

A similar system, but greatly improved and using many more automatic devices, is used in modern biscuit factories and bakeries.

The first really modern assembly line was built in 1869 by a meat-packing company in Chicago. At the beginning of the line, the cattle were slaughtered and their carcases carried on conveyor belts past hundreds of butchers who quickly cut them up into convenient pieces and removed the bones and other unwanted pieces.

The meat was then carried by the belts to automatic cookers, after which it rolled along on belting to canning machines. After that, the cans were labelled and packed into wooden cases by machinery.

It was this automatic meat factory that in 1913 gave Henry Ford the idea of the assembly lines that made possible the production of cheap motor cars.

Today, automation has made such strides in the car industry that the whole process of manufacture from the raw material to the finished car takes place under one roof. There is a car factory in Britain where iron ore to be made into steel is unloaded from ships at one end of the plant, and cars gleaming in fresh paint and chromium come off the last of the conveyor belts to be loaded on to ships for export overseas.

All the parts arriving at a production line to be assembled into cars are made by machines that turn them out by the thousand. The machine that makes a car's cylinder block, for example, is a miracle of mechanical ingenuity.

The cylinder block needs nearly 600 separate operations with scores of different tools. Yet every one of these operations is carried out automatically, and where any of the drills or other tools begin to show signs of wear signal lights warn the operator in charge that a replacement is needed, and experiments have been made with a machine that replaces worn tools by itself.

AUTOMATION—WHAT IT MEANS

THE word "automation" is often wrongly used to describe comparatively simple mechanical devices such as conveyor belts, lifting, transferring and sorting machines. Strictly speaking, these are merely mechanical operations and should be described as mechanization.

Mechanization is just a series of mechanical but separate processes. In many works and factories you will find a number of machines each controlled by its own operator or team of operators.

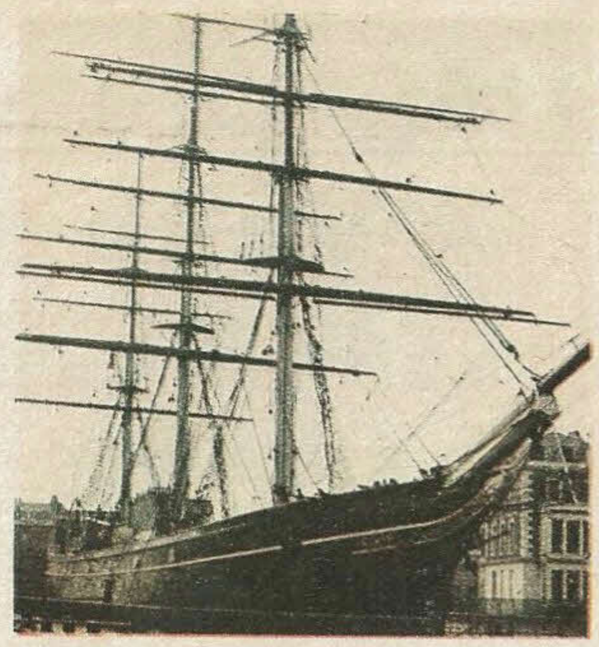
On the other hand the term "automation" really means the electrical and mechanical control of a complete unit of machines producing a finished article from the raw material from which it is made.

In other words, mechanization replaces muscles, but automation replaces brains and muscle. When a machine produces an article every time the operator pulls a lever, we have mechanization. But when a machine is controlled by a computer or similar device to pull the lever, we have automation.

Complete automation, that is an automatic factory with robots controlling every machine and process, is not yet with us. But it may soon come about in certain industries.

Every technical improvement in automatic machines and electronic brains that makes it possible for a machine or instrument to do away with the work of human hands and brains is a step towards full automation.

OUR COLOUR CAMERA VISITS A MUSEUM OF...



Left: The Cutty Sark is preserved as a memorial to merchant seamen and is open to visitors. Her figurehead is modelled on a witch in "Tam O' Shanter," a poem by Robert Burns.

Right: Omar Pasha, a figurehead with glass eyes, was found in Malta. It was taken from a brig built in 1854.

SAILORS' LUCKY CHARMS

IN the days of the oared war-galley, the fierce-looking figurehead on the prow of the ship gave the warriors a feeling of confidence. It was also used as a battering ram. With the coming of sail the figurehead served no practical purpose, but remained as a "good luck charm" until the late nineteenth century. Many famous ships of this period were wrecked or went to the scrap yard, but their figureheads were saved. They now form part of the world's largest museum of figureheads, in the famous tea-clipper Cutty Sark, in dry dock at Greenwich.

The Golden Cherubs is said to be the oldest merchant ship figurehead in existence. It was originally on a vessel built in 1660 for a Cornish smuggler and wrecked off Tintagel in 1703.

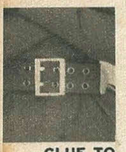
This figurehead is believed to represent Florence Nightingale as a young girl. It came from a schooner which used to trade in the Mediterranean, and it was found in Malta.

Old Goody, as she is called, was found at Faversham and was the figurehead from a barquentine (small ship) of 174 tons which was built at Sandwich, Kent, in 1865.

Tantivy belonged to a ship built in 1848, which was one of the "Straitsmen" carrying herrings through the Straits of Gibraltar to Italy. She was wrecked during a gale in the 1880s.

CROSSWORD

CLUE TO 12 ACROSS



CLUE TO 22 ACROSS

CLUE TO 1 DOWN

CLUE TO 16 DOWN

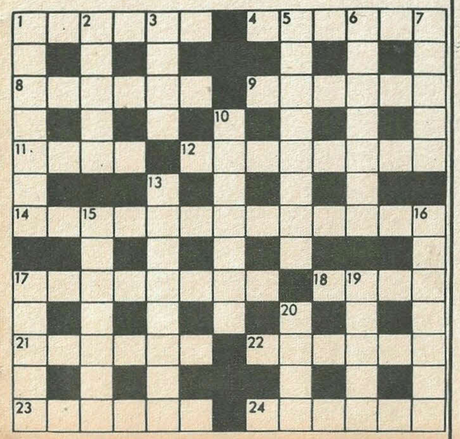
CLUES ACROSS

1. Part of a zoo where birds are to be found. (6)
4. Very poor handwriting. (6)
8. One of the three divisions of Yorkshire. (6)
9. The Rialto —— in Venice crosses the Grand Canal. (6)
11. This kind of frost is made of particles of frozen dew. (4)
12. In fourteen hundred ninety-two "—— sailed the ocean blue." (8)
14. Kitchen implements used in preparing an everyday vegetable. (6, 7)
17. Cleansed of all impurities. (8)
18. The sun is really the nearest one to the earth. (4)
21. Another word for the beginning of something. (6)
22. Belts and sandals usually have one for the strap to pass through. (6)
23. Glucose is taken by runners to give them this. (6)
24. Broadstairs, Margate and Ramsgate are on this isle. (6)

CLUES DOWN

1. No longer a form of air transport, it was filled with hydrogen. (7)
2. In this country over two hundred different dialects are spoken. (5)
3. In 2 down the word for a queen, or the wife of a prince. (4)
5. This used to mean a tilting-match; in America, now, a merry-go-round. (8)
6. Very faint sounds are scarcely this. (7)
7. City of Yorkshire with its own University. (5)
10. These are sold for Remembrance Day. (7)
13. Taxidermy means —— birds and animals. (8)
15. Though not a true ant, this destructive —— is called the white ant. (7)
16. This creature tempted Eve in the Garden of Eden. (7)
17. Shortened word used for "telephone." (5)
19. With this birthday present one can get a book, or a record. (5)
20. Girl's name, and the name of a book in the Old Testament. (4)

SOLUTION ON PAGE 27



INTO BATTLE: Part One of the Story of the Zulu War

WHEN SAVAGES SMASHED A BRITISH ARMY

Wearing feathers and oxtails and armed only with spears, thousands of yelling Zulus descended on the army camp. The Britons fought gallantly—but the odds were impossible . . .

AT the height of its greatness the British Empire had many enemies to face. The big ones are well recorded in the pages of history. The little ones are not so well known, but in the acts of heroism they provoked and in the intensity of their wrath against Britain they are often fascinatingly interesting.

This is the story of a little enemy who twisted the tail of the mighty British lion when the lion was in its prime. The year was 1879, and the tail-twister's name was Cetewayo, the King of the Zulus.

In the time of Victorian Britain, Zululand lay to the north of the English colony of Natal (which is now part of South Africa), split from it by the Buffalo River, and causing it continual discomfort with border raids on the settlers.

The Zulu warriors' one quest in life was to obey. Each man took an oath to die without question for the King, and the hallmark of the warrior was to bathe his assegai (spear) in the enemy's blood.

If any of these men committed the slightest military error he was immediately put to death.

When in 1878 the English Governor and High Commissioner in South Africa, Sir Bartle Frere, issued an ultimatum that war would be the result unless this fiery nation of savages was prepared to come to peaceful terms by January 11, 1879, the Zulus happily prepared themselves for war.

Divided Troops

BY the time the ultimatum had expired Britain had massed 6,639 troops and 9,035 loyal African native soldiers along the Natal frontier, under the command of Lieutenant-General Lord Chelmsford. And so began this strange Empire war; a war fought by our great-grandfathers against a savage enemy far removed from the Africans we know today, only 84 years later.

Lord Chelmsford had divided his army into five columns, each of which was to invade Zululand at a different point to converge upon Ulundi, the Zulu capital. It is the 2nd and 3rd columns that we need to follow now, to a place called Isandhlwana, about ten miles from the Buffalo River frontier.

Isandhlwana was simply a rocky hill, and its name means "the place of the little hand," so called because it resembles an outstretched hand.

The strongest of the two columns, the 3rd, was under the immediate command of Colonel Glyn, and to this column Lord Chelmsford attached himself. The 2nd column, consisting almost entirely of native African troops, was commanded by Colonel Durnford of the Royal Engineers.

By January 20, the 3rd column were camped below Isandhlwana Hill.

Lord Chelmsford presently learned that in a range of hills, called the Inhlazatye, about a dozen miles distant, was the camp of an important Zulu chief. First he sent two parties of men to attack the camp, but when the officers in charge saw the enemy they decided that their force was not strong enough to attack.

When he heard this Chelmsford decided to lead a large reinforcement contingent himself. Only one thing was wrong with this plan—the one thing that was to prove fatal. It would, of course, considerably weaken the camp.

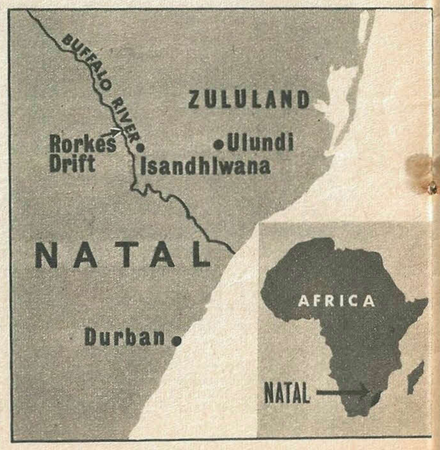
Camp Defence

TO counteract this at least partly, Chelmsford sent a messenger to the 2nd column asking them to come up to Isandhlwana to fill the gap.

Meanwhile, Lieutenant-Colonel Pulleine was to be in charge of the camp. For a few hours after Chelmsford's departure with the bulk of the men, nothing happened at Isandhlwana. Then, in the early evening, a scout reported to Colonel Pulleine that he had seen small bodies of Zulus approaching. Quickly the few men left at Isandhlwana busied themselves for the defence of their camp.

A couple of hours later Colonel Durnford arrived with the 2nd Column and took over command of the camp. Now the scouts' reports came in with ever-increasing haste: the enemy, it seemed, was gathering strength out in the low hills beyond the camp. Colonel Durnford decided that the best thing to do was to ride out at the head of some of his men and meet the enemy.

What happened next was as sudden as it was unexpected. Durnford, having ridden out, was still less than a mile from Isandhlwana when



Isandhlwana, 1879. The Zulu warriors had often captured British rifles, but were poor shots with them, and they preferred to use their deadly assegais, or spears, when fighting at close quarters.

the Zulus appeared on all sides in fantastic numbers. Ten, eleven, twelve deep they rushed upon his tiny force.

Immediately Durnford fell back, seeking desperately for cover in the great cracks in the sun-baked plain. He well knew what the Zulu battle tactics would be—they never changed. Cetewayo's men always advanced in a crescent shape, with the centre hanging back and the flanks thrust forward in a sort of "pincer movement." This they now proceeded to do, half encircling the camp at Isandhlwana and Durnford's force just outside it.

Though surprised, Durnford's gunners quickly prepared their guns and poured shells into the thick Zulu ranks. Thousands of the natives fell under their scorching fire. But always there were thousands more of the Zulus.

As they came on so they were withered by the British guns. For one brief moment then they wavered and it seemed as if they would take no more, but even in that moment disaster came to the defenders of Isandhlwana. For despite the hammering they were taking, the Zulu crescent-shape had almost completely encircled the British camp, and when the native troops of the British army saw this situation they threw down their rifles and fled. At that moment, too, the British ammunition supply failed. The Zulus, never ones to miss an opportunity, pounced, and with a terrible war-cry of triumph they burst upon the British defenders.

Few of those gallant men ever reached the road to retreat, which stretched back to the Natal frontier. Even the escape of the cavalry was hampered by the dreadful ground conditions left by the rainy season, for Zulus running, fleet of foot, with spears poised, soon proved that they were quicker than their enemies on horseback.

For ten miles back to the Buffalo River the slaughter continued. There was scant relief even for the handful of Britons who reached the river, for the past few days had seen it come into flood, and now it ran swiftly and deeply, and was practically uncrossable. So most of the survivors of the horror of Isandhlwana who were not speared as they tried desperately to cross the frothing river were drowned instead.

Hollow Success

ONE survivor, Private Wassall, braved volleys of searing spears as he jumped into the boiling Buffalo River to save a wounded comrade. The attempt was in vain, though, for Wassall just could not hold on to his man. Exhausted, he reached the bank again, then dived in a second time after his friend under another avalanche of assegais. For this Wassall was awarded the Victoria Cross.

Two cavalry captains, named Melville and Coghill, also reached the river. Captain Coghill managed to get to the far side, but Melville's horse was speared from under him. At once Coghill turned back to save his comrade, but his horse, too, was speared. Coghill then helped Melville to reach the friendly Natal shore, but alas for them the bloodthirsty Zulus charged across the river and speared both officers as they struggled exhausted up the bank.

What of Lord Chelmsford's reinforcements, who had gone out to join the force in front of the Inhlazatye hills? They engaged the enemy and pushed them back. But this was a hollow success, for it was thought afterwards that the cunning Zulus had deliberately provoked Chelmsford to come after a relatively small force of Zulus in a relatively unimportant position while their main army wreaked the terrible slaughter at Isandhlwana.

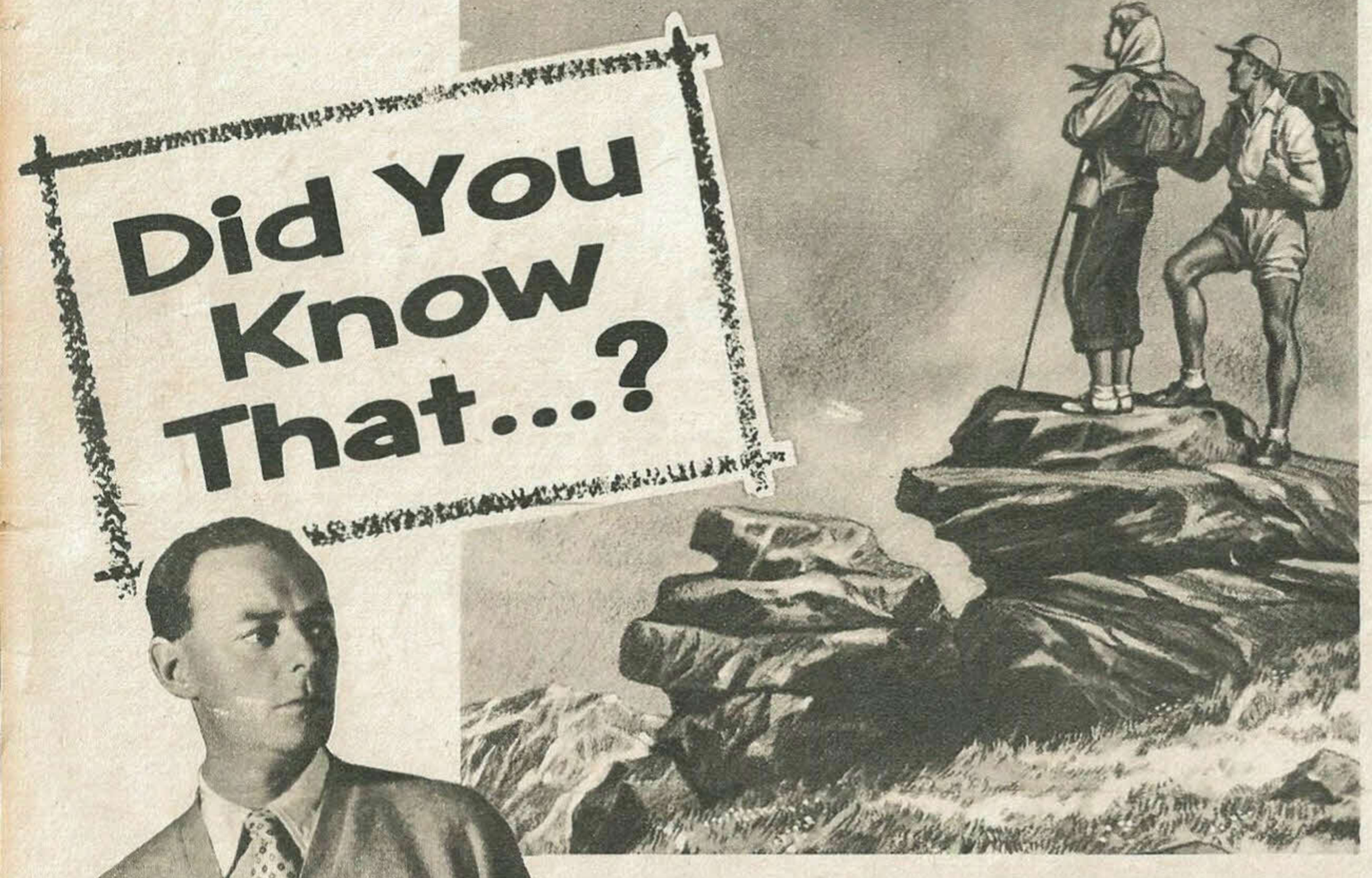
When Lord Chelmsford did decide to return towards the camp he had left he very nearly rode into another trap. For the Zulus had put on the dead British soldiers' red uniforms, and but for the vigilance of a scout the whole of Chelmsford's force might have ridden up to them completely unprepared.

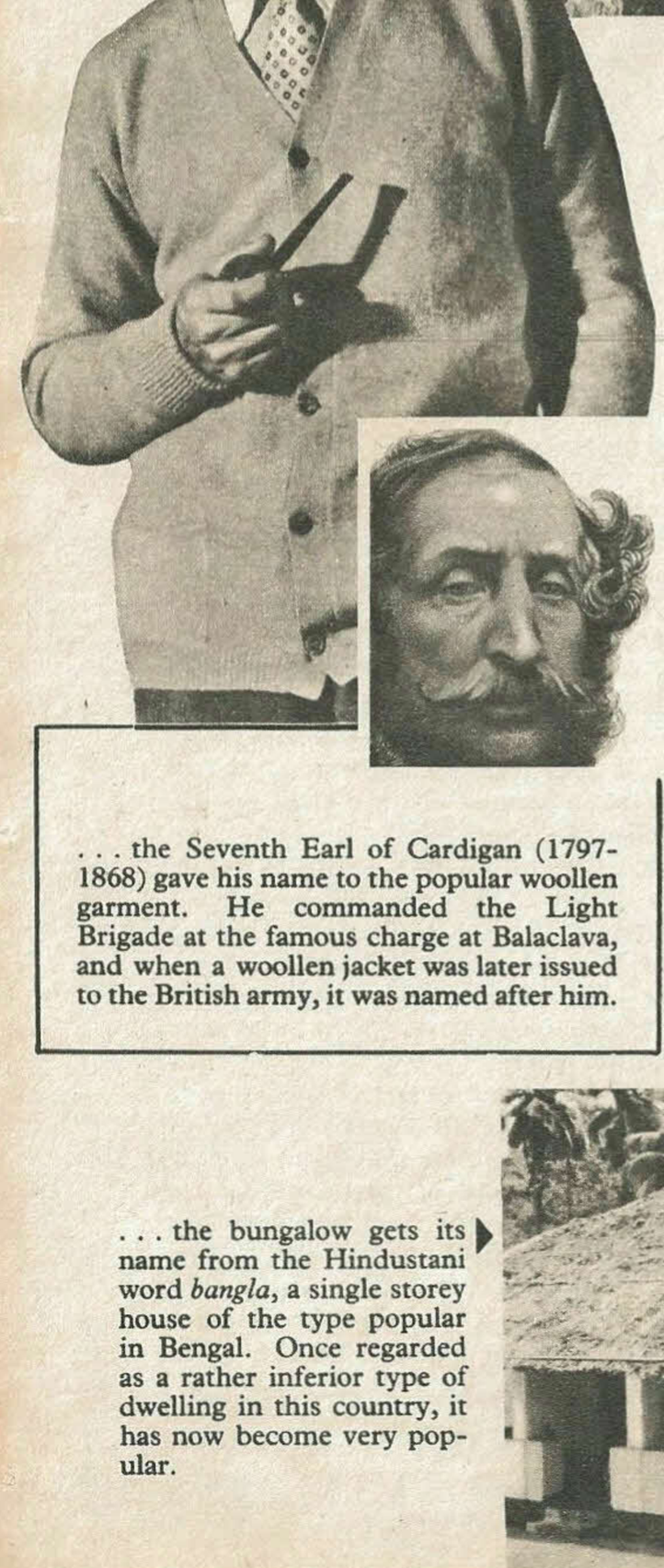
Fortunately the scout reported to his commander in time, and Lord Chelmsford's army quickly retired. By the time they came back to Isandhlwana in a state of preparedness the Zulus had gone, leaving the dead scattered over the plain. Sorrowfully Lord Chelmsford's soldiers camped for the night in that terrible place. Next morning they continued the retreat to Rorke's Drift, a British army camp on the Natal frontier.

NEXT WEEK: RORKE'S DRIFT—WHERE NINE V.C.s WERE WON

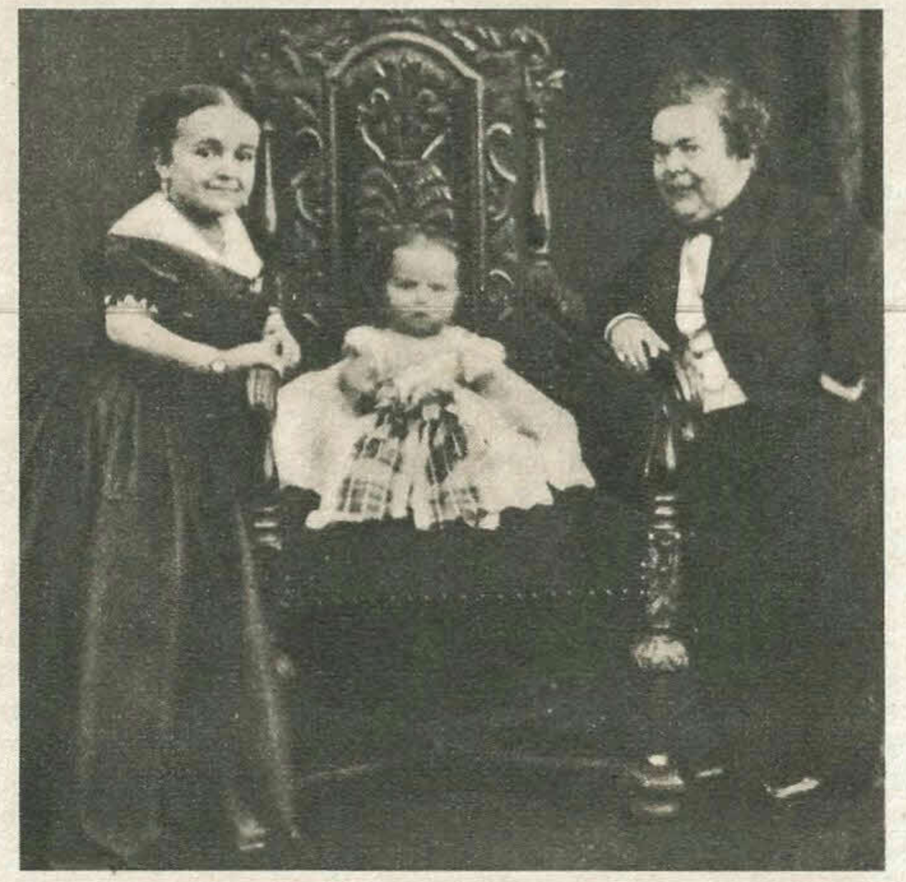
. . . on the Brocken, the highest point of the Hartz mountains in Germany, a "spectre" can often be seen. When the sun is in one direction, a mist in the other, with the summit quite clear, enormous shadows of anyone standing there are cast on the mist.

Did You Know That...?





. . . the Seventh Earl of Cardigan (1797-1868) gave his name to the popular woollen garment. He commanded the Light Brigade at the famous charge at Balaclava, and when a woollen jacket was later issued to the British army, it was named after him.



. . . "General "Tom Thumb was only 40 inches high. His real name was Charles Stratton and he was born in 1838. He was twice exhibited by Barnum, the circus proprietor, in England and appeared by command before Queen Victoria. In 1863 he married another dwarf, Lavinia Warren, and this picture shows them with their child.

. . . the bungalow gets its name from the Hindustani word *bangla*, a single storey house of the type popular in Bengal. Once regarded as a rather inferior type of dwelling in this country, it has now become very popular.

JIGSAW THAT MAKES THE BRITISH ISLES—

DUMFRIESSHIRE

THROUGH the shadowy cloisters of the Franciscan church in Dumfries the voices of two men echoed in fierce argument. Aghast, the grey-robed monks paused in their calm walk as the incredible sounds of quarrelling grew louder. Then, before their outraged gaze, one of the antagonists lunged forward and stabbed viciously at the other, who crumpled dying on the flagstones.

The murderer was Robert the Bruce, soon to be crowned King of Scotland. At his feet lay his old enemy "Red Comyn," a rival claimant to the Scottish throne and friend of King Edward I of England.

Horrified at his own hot-tempered deed, Bruce fled from the cloisters. "I must be gone, for I have slain Comyn," he told his followers breathlessly.

Six weeks later, in March, 1306, Bruce was crowned King of Scotland at Scone. When Edward I of England heard of the murder of Comyn he swore vengeance, and by Whitsun the Bruce and all his followers had been excommunicated by the Church. Comyn's only son was taken away by King Edward and brought up with his own children.

There are many versions of the events that led up to this dark incident in the history of the Scottish county of Dumfriesshire.

Several chroniclers relate that Comyn had warned King Edward, self-appointed overlord of Scotland, of Bruce's plan to seize the throne and throw out the English. But Bruce had intercepted Comyn's messenger to England and then, in revenge, had lured Comyn to the church in Dumfries where he would suspect no danger. Outside the church Bruce accused Comyn of treachery; then he and his followers killed their rival, probably inside the church.

Other versions say the two men quarrelled about who was the rightful heir to the throne, and, according to one account, Comyn accused

When the English and Scottish Parliaments were joined in 1707, the furious people of Dumfries burned papers relating to the union in the market square.

MURDER IN THE CHURCH

Dumfriesshire has had a full share of history makers. Here lived Robert the Bruce, the king who slew his rival before an altar. Here, too, lived Robert Burns, Scotland's greatest poet

Comyn collapsed dying on the flagstones, stabbed by his rival, Robert the Bruce, during an argument in the cloisters of Dumfries church.

Bruce of treachery, who then stabbed his enemy to death.

Comyn's claim to the throne was undoubtedly backed by the people of Dumfries town, while Bruce's claim was supported by the people of Annandale. The cause of their quarrel is still shrouded in doubt.

Long after Bruce ruled, died and was succeeded by other Scottish kings, the county of Dumfriesshire continued as a seat of unrest against the English.

This borderland county of hills and plains sloping down to the Solway Firth lies just beyond the English county of Cumberland. One of the chief roads into Scotland crosses its border near the villages of Gretna Green.

Over The Border

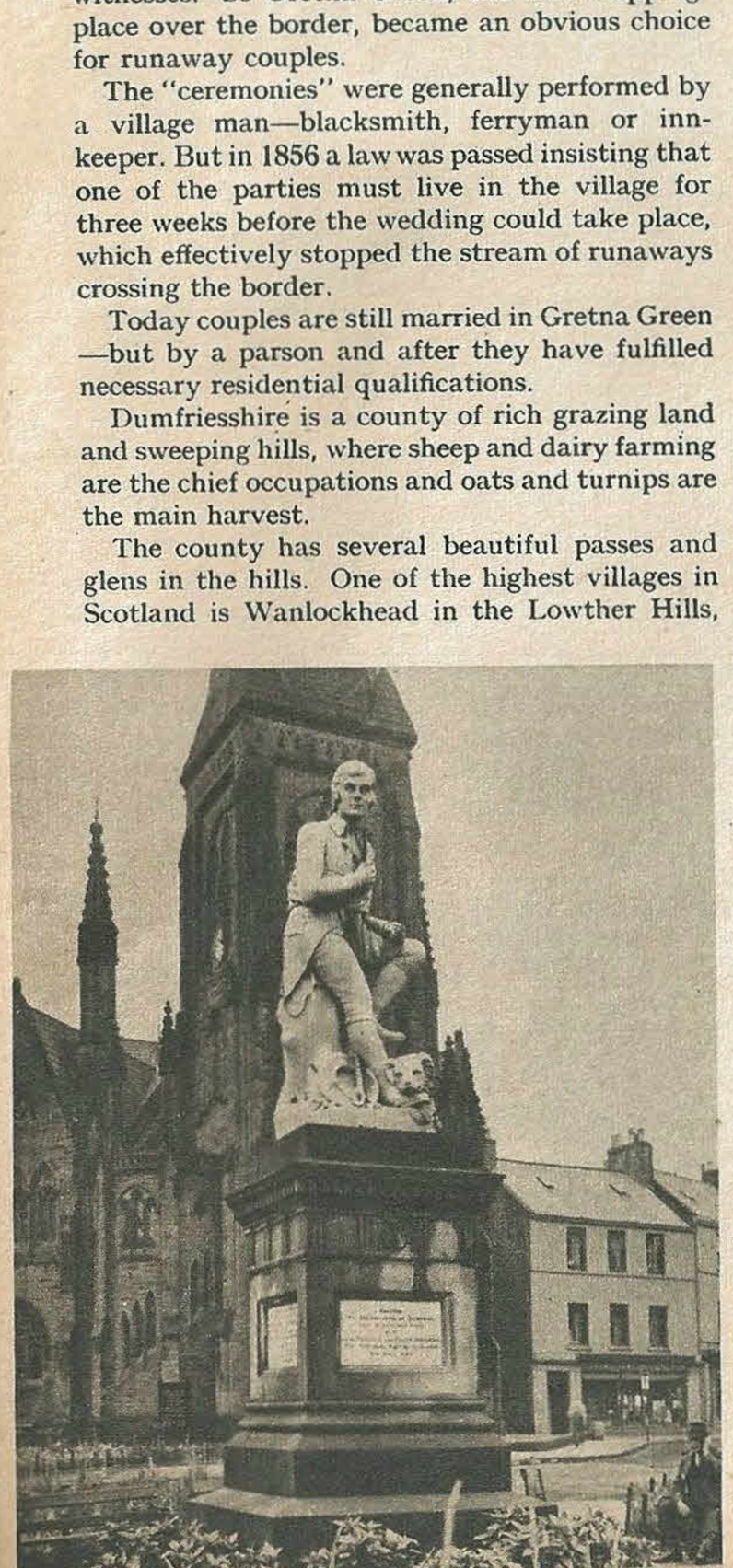
GRETNA GREEN became a popular place for runaway marriages after 1754, when it was no longer legal for couples to be married in London without their families' permission. But in Scotland the law permitted any couple to marry simply by declaring their wish in front of witnesses. So Gretna Green, the first stopping-place over the border, became an obvious choice for runaway couples.

The "ceremonies" were generally performed by a village man—blacksmith, ferryman or innkeeper. But in 1856 a law was passed insisting that one of the parties must live in the village for three weeks before the wedding could take place, which effectively stopped the stream of runaways crossing the border.

Today couples are still married in Gretna Green—but by a parson and after they have fulfilled necessary residential qualifications.

Dumfriesshire is a county of rich grazing land and sweeping hills, where sheep and dairy farming are the chief occupations and oats and turnips are the main harvest.

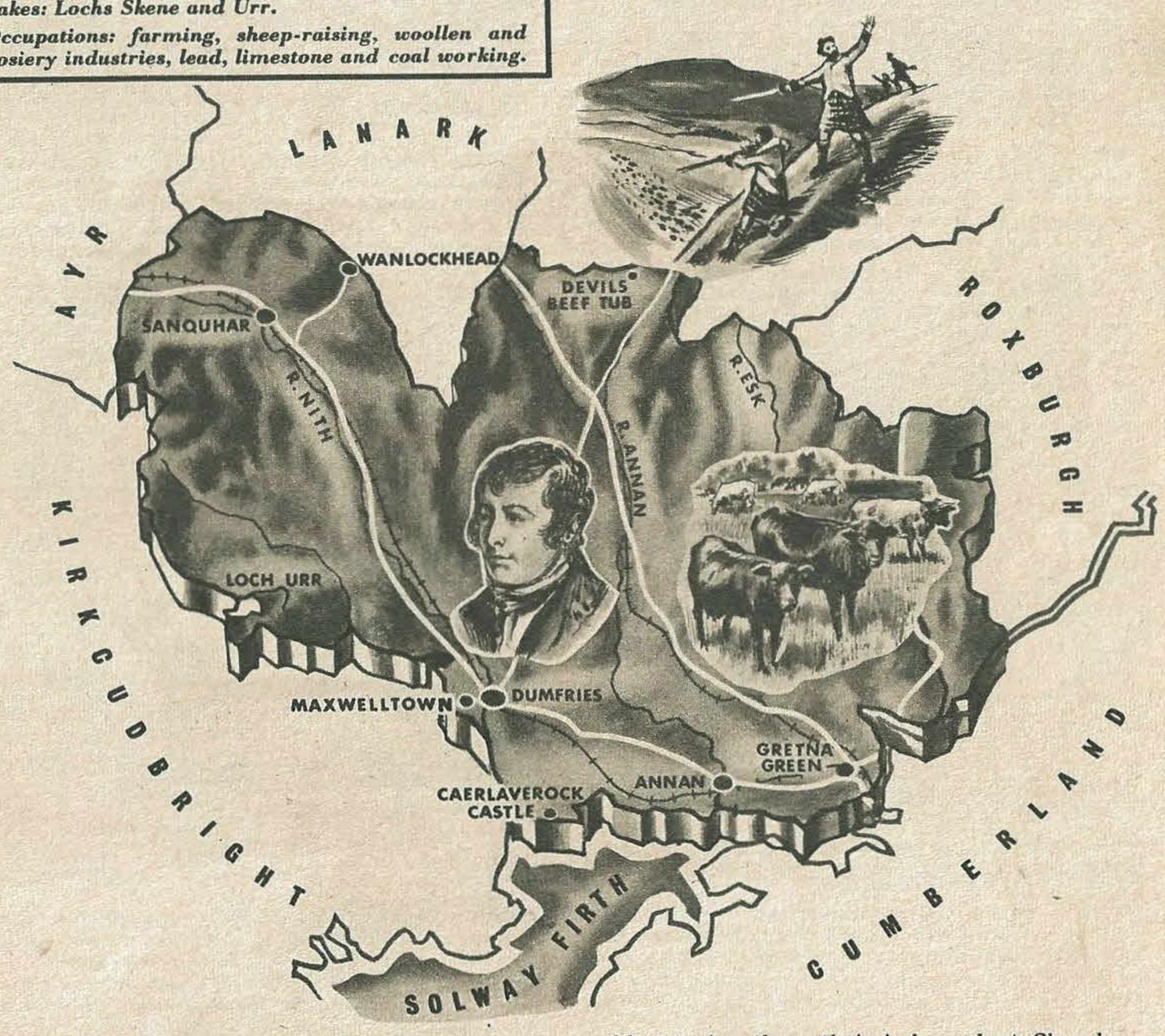
The county has several beautiful passes and glens in the hills. One of the highest villages in Scotland is Wanlockhead in the Lowther Hills,



This statue of Robert Burns, the great Scottish poet, stands in Dumfries, the town where he lived for five years before his death in 1796.

FACTS AND FIGURES

Area: 1,068 sq. miles.
Population: 87,686.
Chief town: Dumfries.
Rivers: Nith, Annan, Esk.
Highest peak: White Coomb, 2,695 ft.
Lakes: Lochs Skene and Urr.
Occupations: farming, sheep-raising, woollen and hosiery industries, lead, limestone and coal working.



where lead is still mined, and in the mountains is a great hollow called the Devil's Beef Tub, where in former days cattle-stealers hid their herds.

Three rivers flow south into the Solway Firth—the Nith, Annan and Esk, all famous for their trout and salmon fishing. On the shores of the Firth itself salmon are netted with special meshes called "haafnets."

Border Raids

THE county has many memories of the Scottish king Robert the Bruce, who lived at Annandale. Among its castles is Caerlaverock, where Bruce's General Wallace held out against Edward I for two days.

Later the fields and hills became the scene of raids and reprisals between Scots and English until in 1592 King James VI of Scotland wiped out lawlessness on the Border.

In the seventeenth century the hills and wild passes were a retreat for Scottish Covenanters who plotted against King Charles II when he would not give them their independent Church of Scotland. From Sanquhar in 1680 they published a declaration against the King.

England and Scotland had been united under one king since 1603, but the Parliaments were not joined until 1707. The people of Dumfries so disapproved of this last act that not only did their Provost vote against it at Edinburgh, but a body of Cameron men burned papers relating to it in the market place.

Much later, when feuds and fighting had finally died away, the county became the home of the poet Robert Burns. He farmed at Ellisland on the Nith river for three years, then spent the last five years of his life in Dumfries, where he wrote famous songs like "My Luve is like a Red, Red Rose." He was buried there in 1796.

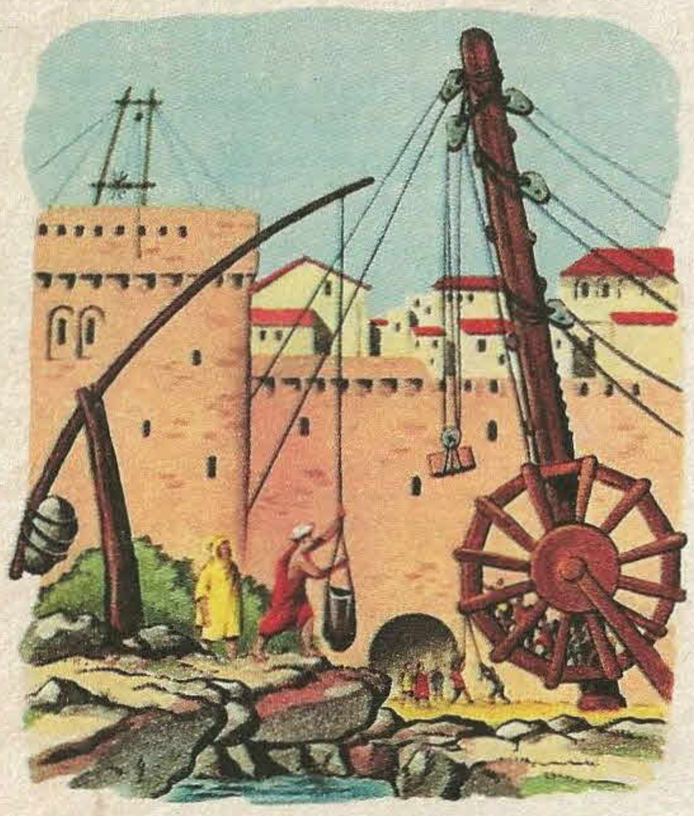
Dumfries is famed for its tweed industry, the manufacture of stockings, and the beautiful buildings which have earned it the title "Queen of the South."

In 1929 the city was amalgamated with Maxwell Town across the Nith, to which it is joined by four bridges. One of the bridges was built seven centuries ago by Devourgillia, mother of an uncle of Red Comyn who died in Greyfriars Church, Dumfries.

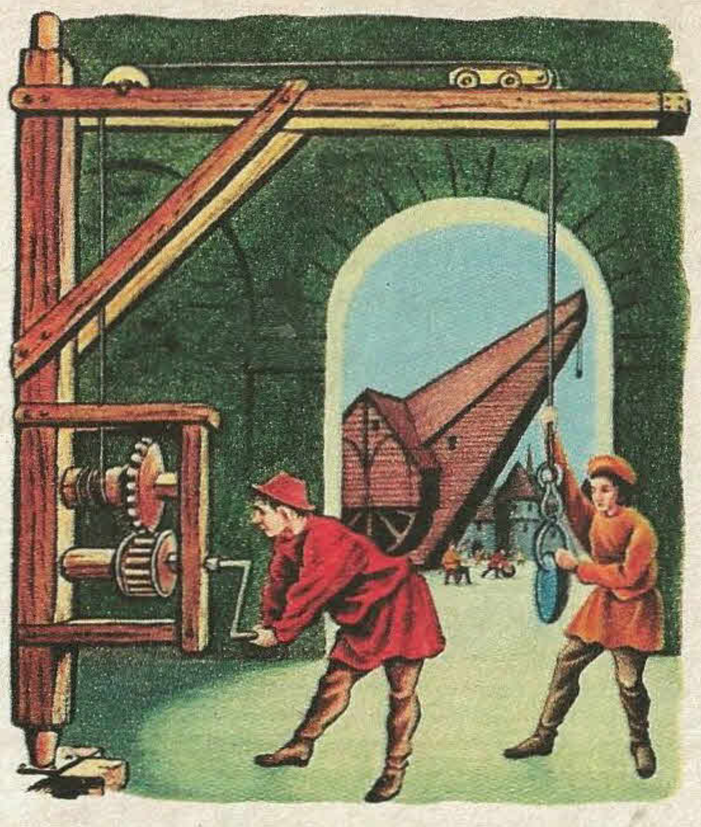
FROM THEN TILL NOW

LIFTING THE LOAD

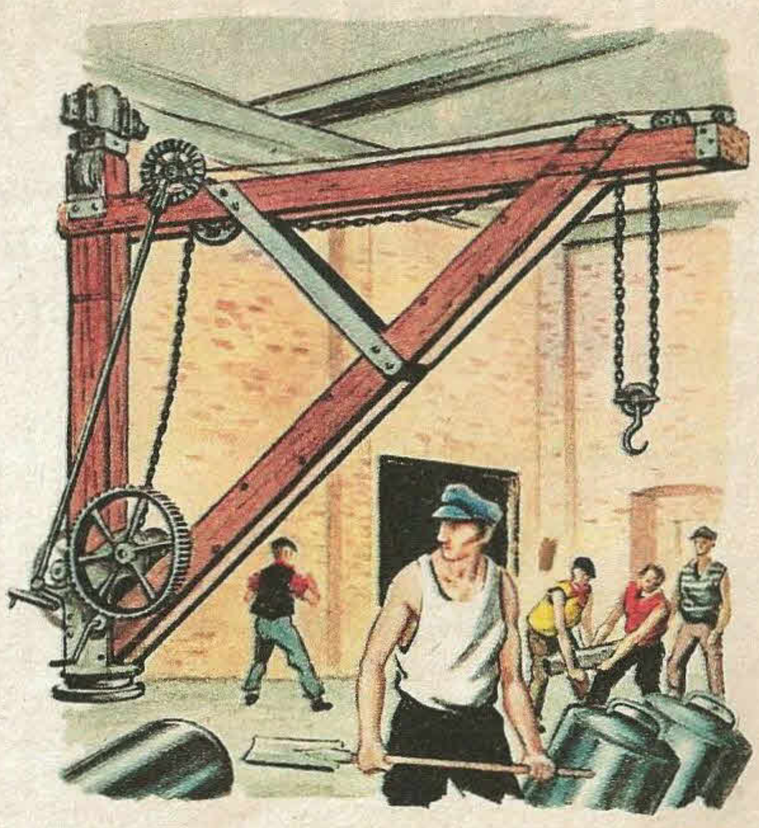
The dictionary describes a crane as "machine for raising, lowering or placing heavy objects in position," and the use of such a device has been known through centuries of history. But the crane was not developed into the engineering marvel we know today until the coming of steam, hydraulic and electric power



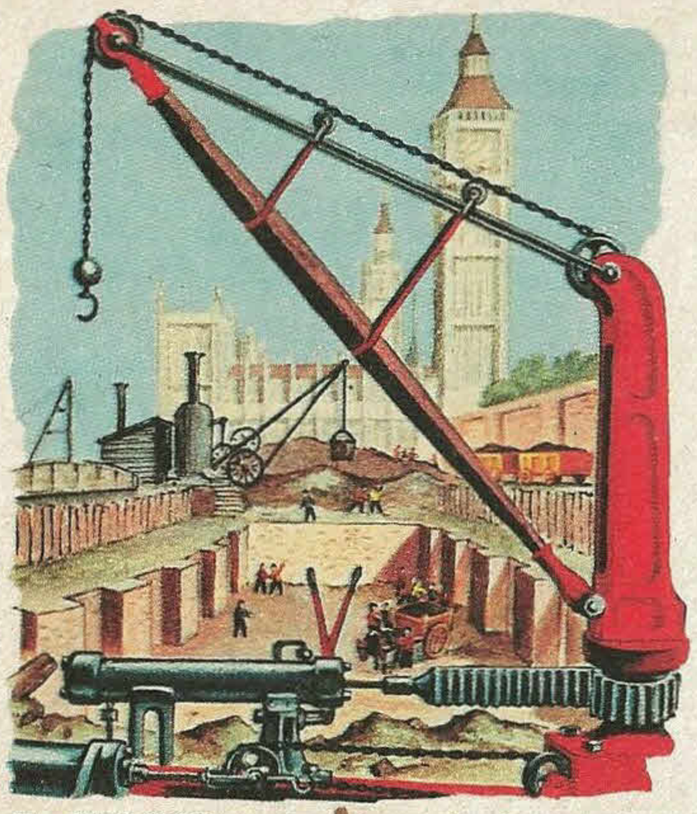
An early Egyptian crane is shown on the left. A heavy stone acted as a counter-weight to the load, making lifting easy. On the right is a Roman crane of the second century A.D. operated by men walking inside a treadmill.



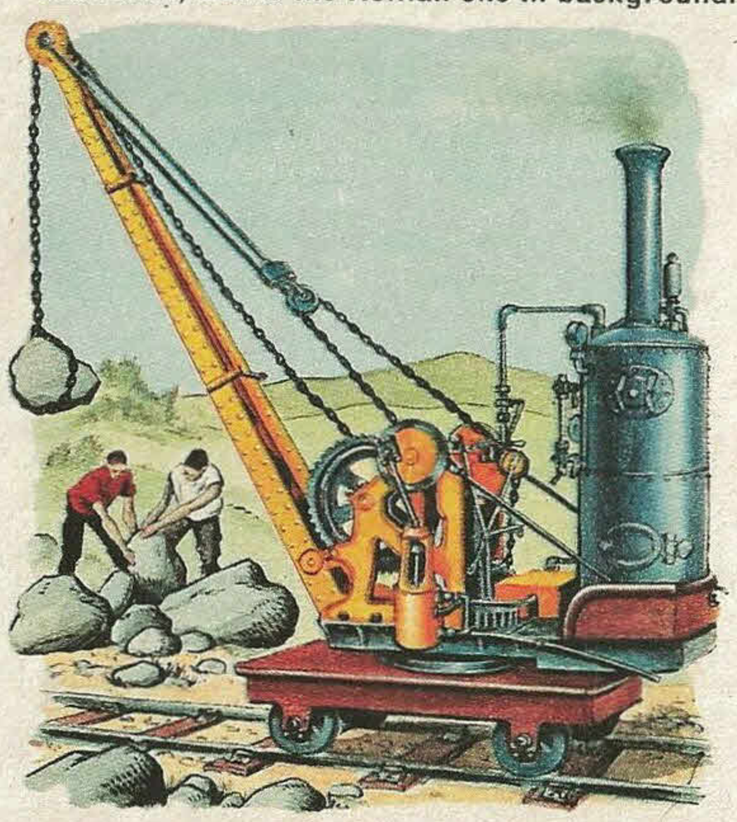
This sixteenth century "derrick," or gallows-type crane, was winched by hand. A primitive trolley on the arm (or boom) moved the position of the load. The boom was fixed, but the crane swivelled, unlike the Roman one in background.



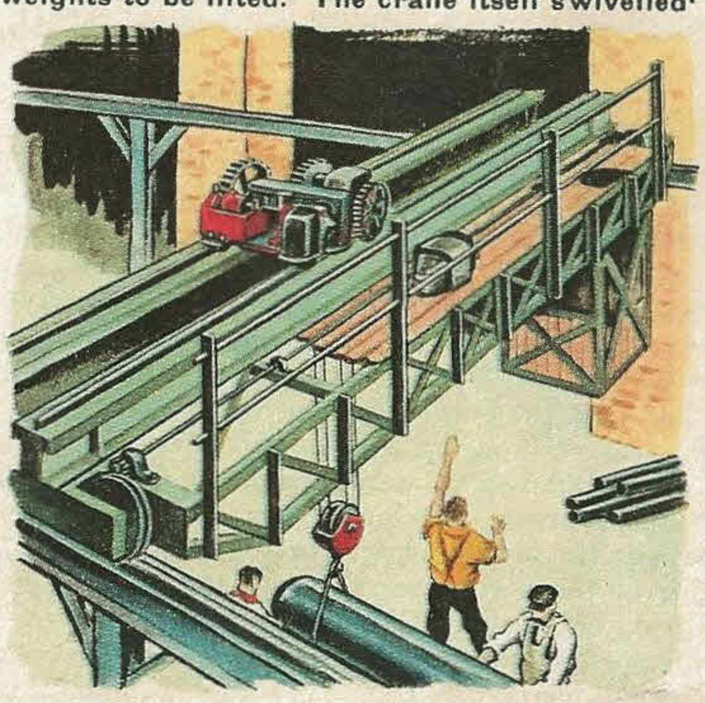
The same hand-winding method was used up to the early nineteenth century, but by now the gear principle was used; turning a small gear wheel engaged with a big one enabled really heavy weights to be lifted. The crane itself swivelled.



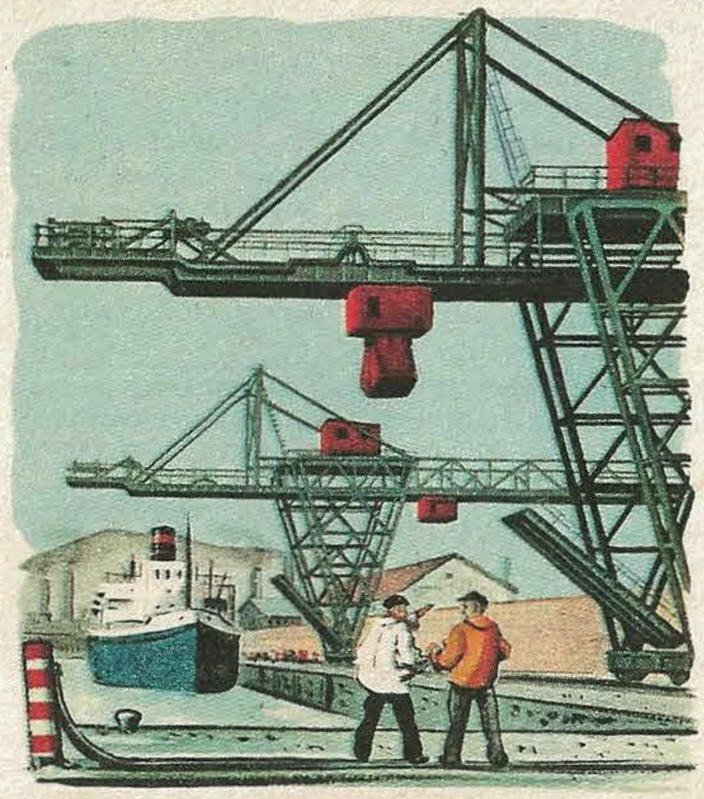
By 1859 William Armstrong had invented the hydraulic crane which used water from special high-pressure mains to lift loads, adjust the height of the arm and turn the central body of the crane. This one was used for building.



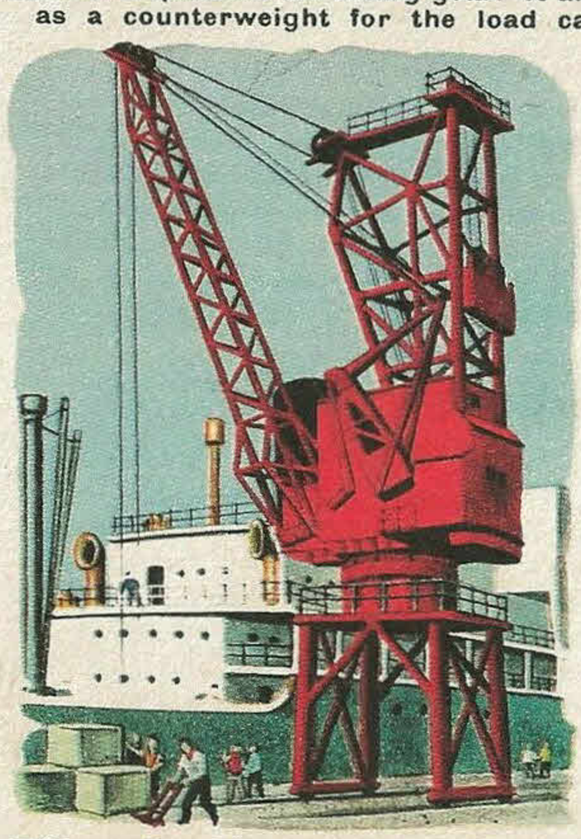
Booth's locomotive steam crane of the late nineteenth century was a self-contained unit. The boiler at the back drove the crane along rails and operated the lifting gear. It also acted as a counterweight for the load carried.



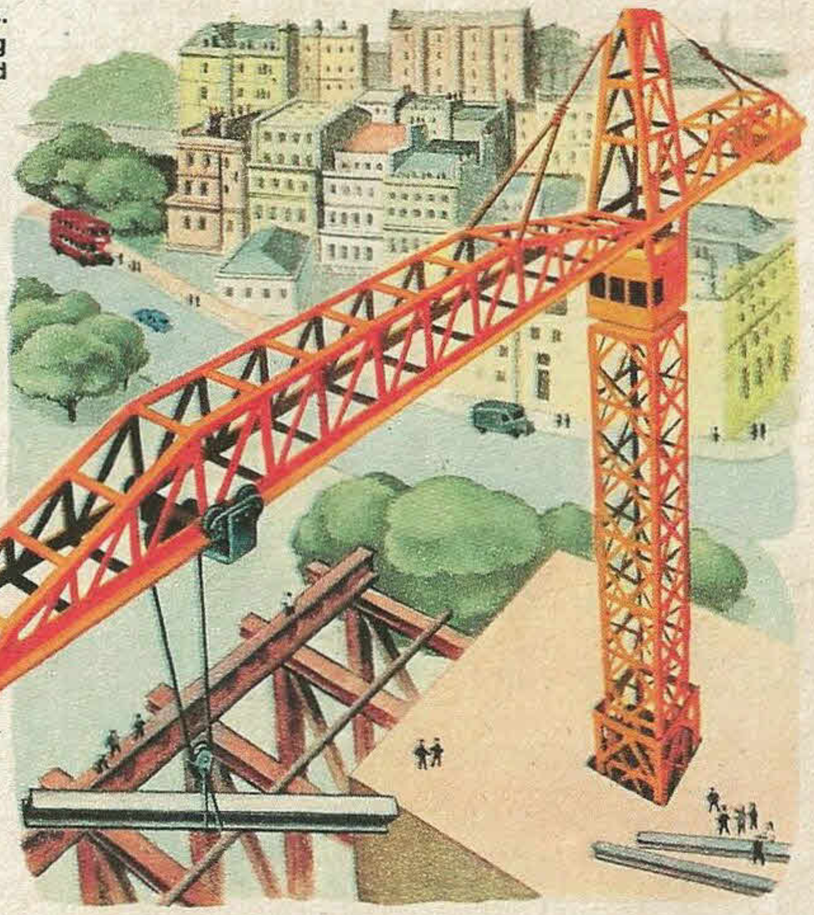
Electricity saw the introduction of various cranes, including this overhead one of 1903 for use in factories. The grab was suspended from a carriage travelling on rails and girders between the walls. It was operated by a driver at one end.



Similar in principle to the overhead crane is this dockside ore unloader and transporter, which can lift up to five tons in one grab. The boom is moved out over a ship's hatch, the grab lowered and raised and the load deposited on the quay or in a bunker.



This modern high-speed dockside crane moves on rails so that it can reach any part of a vessel. All equipment is mounted on the revolving platform and the crane can thus operate into any hold in the ship. You can see how little it interferes with dockside traffic.



Constructional cranes can now become part of the finished building, the pillar framework afterwards serving as a ready-made lift shaft. This remote-control horizontal jib is fixed to a central tower and can travel round, and up and down.

STORIES FROM THE BIBLE: BY THE REV. JAMES M. ROE

VISION OF THE MOUNTAIN TOP

For one brief moment the three disciples glimpsed the true glory which belonged to Jesus as the Son of God

OF all the strange happenings which befell the followers of Jesus, none were stranger than the things seen by His three closest friends when one day He took them up on to a mountain, to be alone with Him.

It happened not long after Jesus had asked them whom they really thought He was, and Peter had said that He was the promised *Messiah*, or Deliverer, of whom the old-time prophets had spoken.

They walked in silence up the steep hillside. It was hard going, for Jesus was leading them—Peter, James and John—right to the top of the mountain. Towards the end of the journey they found themselves actually in cloud, broken only by an occasional shaft of sunlight, gleaming on the patches of snow which lay on the ground.

Suddenly Peter stopped, and gripping the arm of each of his companions, spoke in a frightened whisper. "Look!" he said. "Look at the Master there ahead! What has happened?"

Jesus had walked on in front, leading the way, and when the three followers looked up they saw a sight which filled them with amazement.

There He stood, the well-known figure, yet bathed in an unearthly light, a white and dazzling brilliance such as they had never seen before. It was as though all the glory of God had suddenly surrounded Him.

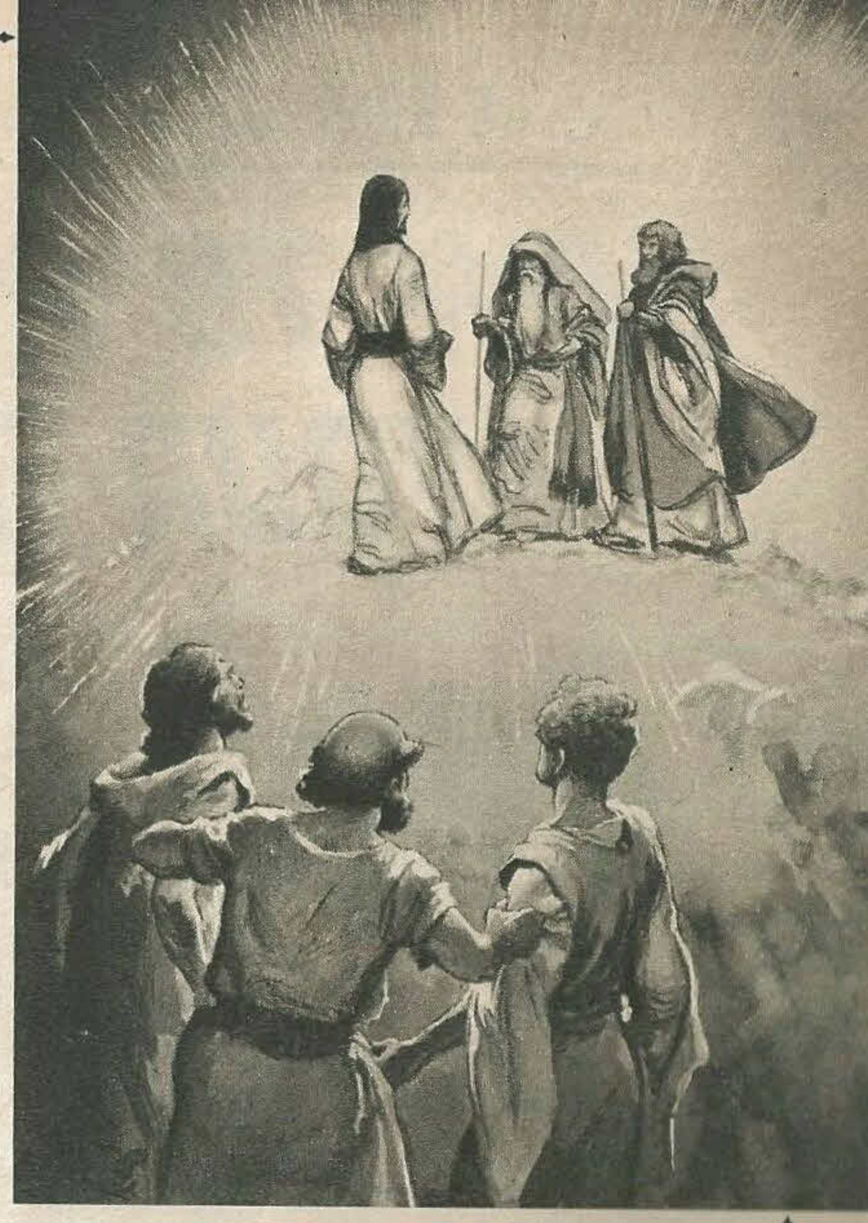
In this light Jesus was speaking to two majestic-looking figures, dressed in the robes of a former age. From their knowledge of the history of their nation the three astonished disciples knew that one of these figures was Moses, the giver of God's Law, and the other was Elijah, the greatest of the prophets.

Peter felt he ought to speak, but scarcely knew what to say. He thought that it would be right to perform some act of respect and reverence to Moses and Elijah, and to consider Jesus as their equal. So he suggested that the disciples should build three tabernacles, or shrines, there on the mountainside, in their honour.

Perplexed

PETER had scarcely spoken before a great cloud rolled across the mountain, and from it a voice was heard saying "This is my beloved Son; hear Him."

Peter then understood that his beliefs about Jesus were true, and that for a brief moment he and his friends had been in the very presence of the Son of God in all His glory.



In another moment the cloud and the vision had passed, and coming towards them, in the reassuring and familiar way, was Jesus as they knew Him best. As they walked home together He told them not to speak of what they had seen until He had risen from the dead..

Perplexed by these words no less than by what they had seen, the disciples returned to their friends. Only much later did they understand that they alone had been privileged to catch a glimpse of the true glory which belonged to Jesus as the Son of God.

Mark, chapter 9, *verses* 2-10.

PET TALK

by EDMUND BURKE

Found lying in the roadway when he was four days old, this tiny hedgehog became a family pet, and was given the name of Spike. He soon thrived on a diet of milk administered every two hours.

They came from South America, part of a large family living there. Long before we knew of them in Europe the Inca Indians had domesticated them as a source of food. To us they are pets and I do not think we would relish the idea of eating one!

The guinea-pig is a rodent and will grow to about ten inches in length and weigh up to two pounds. Oddly, although their legs are short, they can run very fast for a little distance. You must keep them in dry shelters protected from direct sunlights and draughts.

They thrive on a mixture of good clean hay, corn and oats. In the summer they like green food—and it is appreciated in the winter, if you can find it. If there is nothing else available, they quite enjoy apple peelings and cores.

Many people say you do not need to give a guinea-pig water if there is enough moisture in its food. But if you are in any doubt, see that there is fresh water available.

The guinea-pig can be tamed quite easily, especially if you begin when your pet is young. Handle it a little bit each day, and be gentle—because even a guinea-pig will bite if you are too rough.

HOME-GROWN FISH FOOD

BABY fish, whether newly hatched or newly born, need live food to make them grow. One of the simplest foods to get, and one of the best to use, is Infusoria, which looks like a little cloud in the water.

To grow your own, get a wisp of clean sweet hay and boil it in water for a few minutes in an enamel pan. Remove the hay and pour off the water into a clean glass jar. Within a day or so you can see the little cloud-swarm and this is given to the baby fish a few drops at a time.

If you fail on your first attempt it may be because you have used too much hay or boiled it for too long.

Another way of getting Infusoria is to bruise a few pieces of lettuce, put them in a small cloth bag and hang it in clean water. Sometimes you can hang the sack right in the tank with the baby fish. Do not leave a lettuce bag in the tank for many days, because the crushed leaves decompose rapidly and can cause trouble in the tank. It is better to put a fresh one in every third or fourth day.

WATER FOR GUINEA-PIGS?

AMONG the pets I have not yet talked about is the guinea-pig, or cavey. They are nice little animals—friendly and quiet, but I must warn you that they are not very bright.

BIRD FROM AUSTRALIA

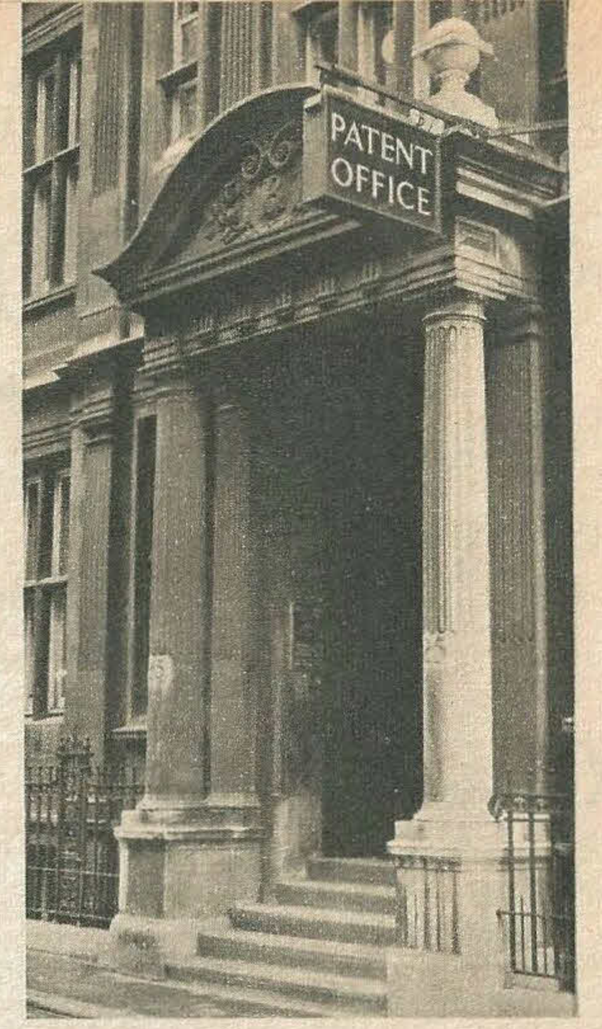
COCKATIELS are the smallest of the cockatoo-type birds we keep as pets, and like their relatives, came originally from Australia. Because they are quite large—up to thirteen inches—Cockatiels live more happily in aviaries than cages. To compensate for that, they are hardy and can be kept out all year round without any artificial heat, if they are sheltered from wind and rain.

They like green food, and sometimes will take finely-cut pieces of apple, but basically they are seed-eaters. A good feeding mixture is made of equal parts of Canary seed, white millet, oats and wheat, with a few sunflower seeds and hemp seed added.

HOW TO PROTECT YOUR INVENTION

After his invention has undergone long and detailed examination by the experts of the Patent Office the final seal is stamped upon the Letters Patent which have been granted to a successful inventor.

Above: The chief librarian points out to visitors a translation of the first-known English patent ever granted. Above it is the original wording, dated A.D. 1449 On its right is a specimen Letters Patent granted in 1836 by King William IV, with its heavy wax seal beneath. Right: Many thousands of patent copies which give details of each invention, are catalogued and stored on the seventeen miles of shelves.



Above: The Patent Office grants patents, deals with literary and artistic copyright, trade marks and designs.

Everyone is a potential inventor. If your idea is a money-maker no one can steal it from you if you take out a patent

SUPPOSE a man invents a gramophone that provides vision as well as sound. By placing a record on the turntable and looking at a television set to which it is connected, you can see as well as hear the singer on the record.

This could be a valuable invention. Many people may want to buy the new vision-grams, for the delight of seeing as well as hearing their favourite stars is bound to be appreciated.

But there are always people ready to copy somebody's original work, to steal an invention or to adapt someone's novel device. To stop this happening, inventors take out a patent.

What is a patent? It is, really, an open letter issued on behalf of the Queen and in her name telling everybody of the patent holder's privilege. It makes him the only person with the right to "make, use and vend" the invention in the United Kingdom, Northern Ireland and the Isle of Man. Vend, by the way, means "to sell."

Patents were first granted in 1331, when they were known as "letters of protection," and until 1623 they applied to things beside inventions—such as the right to be the only person in a town selling sweet wine.

No Fear of Theft

COPIES of patents dating back to 1615 are stored in London's Patent Office. Inventors, or the people to whom they have sold their invention, apply to this office when they want a patent. Usually, they send in the early details of their invention so that they can improve it and publicize it under legal protection.

This is called "filing a provisional specification," after which the inventor can spend up to fifteen months perfecting his device. He can try to find a firm to make it or a business man to lend him money to finance its manufacture without the fear that his invention will be stolen by a rival.

When the patent is finally applied for, the request must not be drastically different from the first application. It should contain enough detail for anybody to be able to make the invention from it, if they had permission.

Officials in the Patent Office then examine their records for the past fifty years to be sure that the device really is new.

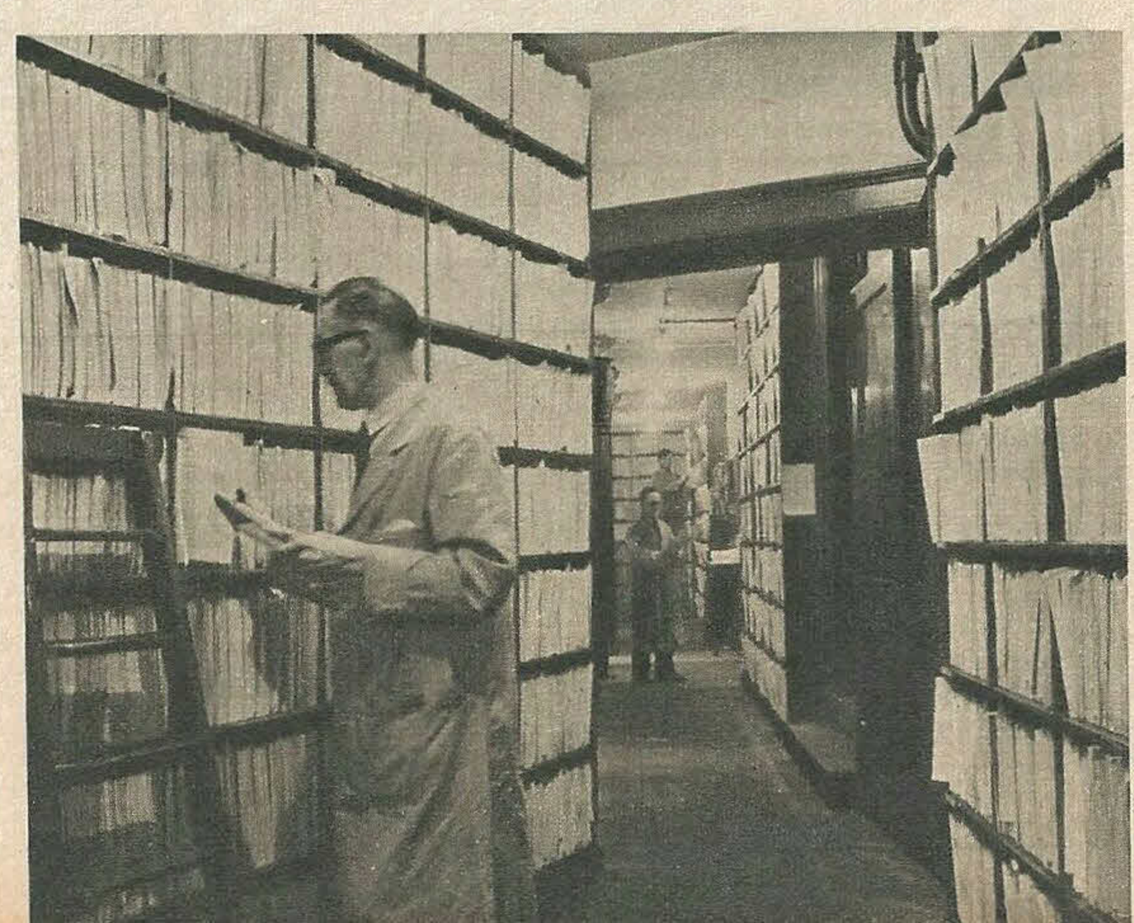
When the invention has been accepted as new the details—or specifications as they are called—are published in the form of a booklet that anybody can see free or buy for a few shillings. Opposition to the grant of the patent is considered and, if it is overcome, the patent is granted. If there is no opposition, a patent is granted three months after its publication.

The patent lasts for sixteen years from the date the complete specification was sent in. It may be extended for a further ten years, provided the renewal fees are paid each year. But these fees are larger each year to discourage the inventor, or the firm that bought his patent, from keeping the invention too long.

Inventions are not always the work of one man. Several chemists in a laboratory may discover a new drug. In that case, the firm employing them may apply for the patent. On the other hand, an inventor may be poor. A man who has invented an electro-magnetic tin opener may be unable to start his own factory to make it, and so he may sell the rights in his patent to a kitchen gadget firm.

If the inventor wishes, he will sell the firm the full rights, or for a limited time or within a certain district. Or he may grant an exclusive licence, which would prevent the inventor from allowing any other firm to make his tin openers. Thus, he gets paid for his invention without risking his own money.

Once the patent has been granted, the holder is protected by law. Nobody may copy his invention. If they do so, he can ask a law court to stop them doing it and, possibly, pay money to him as compensation.



WHAT A PATENT COSTS

Provisional specification	£1
Complete specification	£11
Sealing of patent	£3
Renewal fees after the fourth year:	
5th year	£5
6th year	£6
7th year	£8
8th year	£10
9th year	£12
10th year	£14
11th year	£16
12th year	£17
13th year	£18
14th year	£19
15th year	£20
Until the patent expires in the 16th year	£20

CONTINUING . . . ANOTHER ORIGINAL STORY OF THE FAMOUS FAT BOY OF GREYFRIARS

BUNTER RUNS AWAY!

BY FRANK RICHARDS

"Hop it!" said Todd. "You're not coming into this study until you learn to behave yourself!" Bunter made a dash for safety.

THE STORY SO FAR

Life seems hard to William George Bunter. He is in trouble with the Captain of the School, he is hard-up—and he is hungry. A local sneak-thief has been operating in the district, and when Billy sees his brother Sammy setting off for the village to buy tuck for a party being given by Loder of the Sixth, the fat Removite has an idea. He borrows a cloak and mask from the "props" of the Dramatic Society and takes an ancient revolver from the study of Mr. Prout, master of the Fifth. Then, in the gathering dusk, Billy waylays his brother on his return from the village. Sammy flees in terror from the "bandit" leaving Bunter smacking his lips at the prospect of the biggest feed of his life!

THE THIRD CHAPTER

The Remove on the Trail!

"HALLO, hallo, hallo—who's this in a hurry?" exclaimed Bob Cherry.

The Removites were standing by the gateway of Greyfriars in the gathering dusk when a small fat figure was seen dashing along the lane in the direction of the school.

Sammy Bunter fairly tore through the ancient gateway and ran into the arms of Bob Cherry and Johnny Bull.

"Hold on, young Bunter!" exclaimed Johnny Bull. "What's the hurry?"

"Yah! Help! Murder! Thieves!" yelled Sammy, struggling. "Lemme go! He's after me! He's got a revolver! I've been robbed! Oh, gosh, it was terrible!"

The juniors looked in alarm at Sammy. For a moment they thought that he had taken leave of his senses. But gradually they learned from him the reason for his terror.

"My hat!" exclaimed Wharton. "D'you mean that rotten crook has been after you?"

"Yes—up the lane near the crossroads!" gulped Sammy. "Horrible looking fellow he was, too! Dressed in a black cloak and a mask! Threatened me with a revolver."

"Great pip!"

The Removites looked at each other and at Sammy in amazement. Then a tall burly figure strode through the gloom. It was Gerald Loder of the Sixth. He glared when he saw Sammy.

"What's happened?" he demanded. "Where's that grub I sent you out for? Haven't you bought it yet?"

"Yes, Loder, I bought it!" gasped Sammy. "But I've been robbed! I was waylaid by that rotten crook and he pinched the tuck! He threatened me with a revolver and—Yow! Leggo!"

Loder took hold of Sammy by his fat ear.

"You lying little rotter—don't try to spoof me with that yarn!" snarled the unpopular prefect. "It won't wash with me, young Bunter. Now, what have you done with my grub?"

Harry Wharton stepped forward and laid a heavy hand on Loder's arm.

"Here, cheese it, Loder!" he rapped. "I believe young Bunter is telling the truth. He came running up just now frightened out of his wits. Give the kid a chance. His story is at least worth looking into, anyway."

"Wharton's right," said Bob Cherry firmly. "Let's make a search for that crook. If Sammy's yarn is true, we might be able to find him."

Loder let go of Sammy's ear.

"All right," he muttered. "You kids can come with me, and we'll go in search of this crook. If I find out that you've been trying to spoof me, young Bunter, I'll skin you!"

Several other fellows, attracted to the gates by Sammy's yelps, eagerly joined in the hunt. Some of the juniors had electric torches, and quite a pack of juniors followed Gerald Loder up the lane.

Sammy went with Loder, and he pointed out the spot where he had been held up and robbed.

Looking into the bushes at the side of the road, Harry Wharton soon discovered a spot where somebody had recently burst through.

"This is where that crook lay in waiting," said the captain of the Remove tensely, flashing his torch from side to side. "Hallo! Here's a piece of cloth hanging from one of the branches."

"Great pip, so there is!" said Bob Cherry. "Then Sammy's yarn is true after all. The crook's been here!"

"Come on!" said Loder. "We might be able to track him across the fields!"

"I—I wonder if he's in that barn?" said Bob Cherry, his voice tremulous with excitement as the outline of the building loomed up ahead. "We'd better go carefully!"

They crowded around it, breathing hard with tense expectancy, looking through the chinks in the old wooden door. The moon, emerging from behind a bank of black cloud, shone through the barn window and lit up a scene that made them gasp with astonishment.

William George Bunter was sitting on a heap of straw, surrounded by the remains of what had once been a fine assortment of tuck. There was still some left, and this Bunter was demolishing as fast as he could. He was making vast inroads into a large pie, and on his plump face there was a beautific smile of great enjoyment.

Gerald Loder burst open the barn door and strode in.

"Bunter!" he roared. "So I've caught you, you little thief!"

"O-oo-er!" gasped Billy Bunter. "I say, you fellows, protect me!"

"That's my tuck!" bellowed Loder, hauling Bunter up by the scruff of his neck.

"Yaroooooh! Leggo!" wailed Bunter as Loder shook him. "I didn't pinch that grub! I found it in Friardale Lane! I—wh-what are you going to do, Loder?"

"Come with me!" grated the enraged prefect, whirling Bunter towards the door. "I'm going to give you the biggest lamming of your career! Don't tell me you found it, you lying little toad! There's the mask and cloak you wore!"

"I found them, too!" Bunter yelled desperately. "They were lying in the bushes!"

"Why, they're our dramatic society props!" said Wharton, picking up the cloak and mask. "And—my hat! This looks like one of old Prouty's revolvers!"

"Help me, you chaps!" Bunter pleaded.

"Not likely!" said Wharton. "You deserve a licking, and I reckon you'll get it!"

Loder took possession of Mr. Prout's revolver and marched the fat junior back to Greyfriars. And there, in Loder's study, Bunter was stretched across the table and the cane descended in a series of loud thwacks upon his person. The Owl of the Remove fairly made the windows rattle with his yells.

"There!" said Loder at last, throwing the cane into a corner. "That'll teach you not to burgle my grub again, you little sweep. Take five hundred lines, and deliver them to me tomorrow morning!"

Billy Bunter got out as fast as he was able, crawling down the Sixth Form passage. A crowd of Removites greeted him at the corner with unsympathetic grins. Bunter went to the Remove passage and opened the door of Study No. 7. As soon as Todd, his study mate, saw him, he picked up a table tennis bat and pointed to the door.

"Hop off, Bunter!" said Todd sternly. "You're not coming in here until you can behave yourself decently! Go along and dig with somebody else!"

"I'm coming in!" roared Bunter. "I've got my prep to do, and five hundred lines for Loder——"

"You can do them in the Form room!" Todd snapped.

"Beast!" growled Bunter. He rolled off to the deserted dreary Form room, sat down and got on with his work. And as he worked, there was a look of more than resentment in his eyes.

"They're all rotters!" he muttered to himself. "I reckon I'm leading a dog's life in this school. Not enough to eat, and when I do try to get some grub to keep up my strength, I get lammed!"

Already, in the strangely reasoning mind of the fat junior, he was the innocent suffering party.

"Beasts!" he muttered. "I'll show them!"

THE FOURTH CHAPTER

The Vanished Junior!

"BUNTER! Where's Bunter?"

Gerald Loder asked that question grimly as he looked in at the door of Study No. 7 in the Remove passage before lessons the next morning.

Peter Todd and Dutton were in there, getting their books ready.

"I haven't seen him since breakfast-time," said Peter shortly. "We've turned him out!"

The lesson bell rang and the Removites moved off in the direction of the Form room.

Mr. Quelch arrived there with the immediate intention of asking Bunter to explain the incident of Mr. Prout's stolen revolver. He was amazed to find the whole form staring at the blackboard.

"Boys, why are you not in your places?" he demanded. "What does this commotion mean?"

"Look on the blackboard, sir!" said Harold Skinner. The Removites made way for their master and Mr. Quelch stood in front of the blackboard and gazed at it like one in a dream. For chalked upon the board in large letters was this message:

I'm fed-up with life at Greyfriars and I have desided to leave. I've been bullied and persycuted long enough and the wurm has turned. You can all go and eat coke. I, the undersined, shake the dust of Greyfriars from my feet. I have gone to seak fame and fortune. Loder is a rotter and Wharton and the others are beasts, but they'll be sorry now that I've gone. Mr. Quelch is a tirant but let this be a lesson to him, W. G. Bunter.

"Bless my soul!" gasped Mr. Quelch. "Is this a—a foolish joke or can it be that Bunter has run away? Boys, have you seen Bunter?"

There was a general shaking of heads. Mr. Quelch's brows contracted.

"The stupid boy!" he exclaimed. "Will there never be an end to his foolishness? I must see to this!"

Mr. Quelch was in a quandary. Dr. Locke, the headmaster, had gone away on business and was expected to be absent for several days. The Remove master went down to the gates, where Gosling the porter was sweeping the drive.

"Ah, Gosling! Have you seen anything of Bunter this morning?"

"Yessir!" Gosling answered promptly. "I saw him go out just before lesson-time. Had a bundle under his arm, he did, and I thought to meself at the time that his manner was very strange."

"Then it is true!" muttered Mr. Quelch. "The foolish, stupid boy has run away!"

NEXT WEEK:
BUNTER THE SAILOR

ANSWERS TO QUICK QUIZ (from page 2)

People
(1) *Duchess of Kent.* (2) *Albert Einstein.* (3) *Charlotte Corday.*

Natural History
(1) *Llama.* (2) *Ermine.* (3) *They are all ducks.*

Geography
(1) *France.* (2) (*d*). (3) *Havana.*

Counties
(1) *Suffolk.* (2) *Huntingdonshire.* (3) *Dorset.*

Sport
(1) *Tokyo.* (2) *West Indies won 3—1, with one match drawn.*

SOLUTION TO CROSSWORD (from page 20)

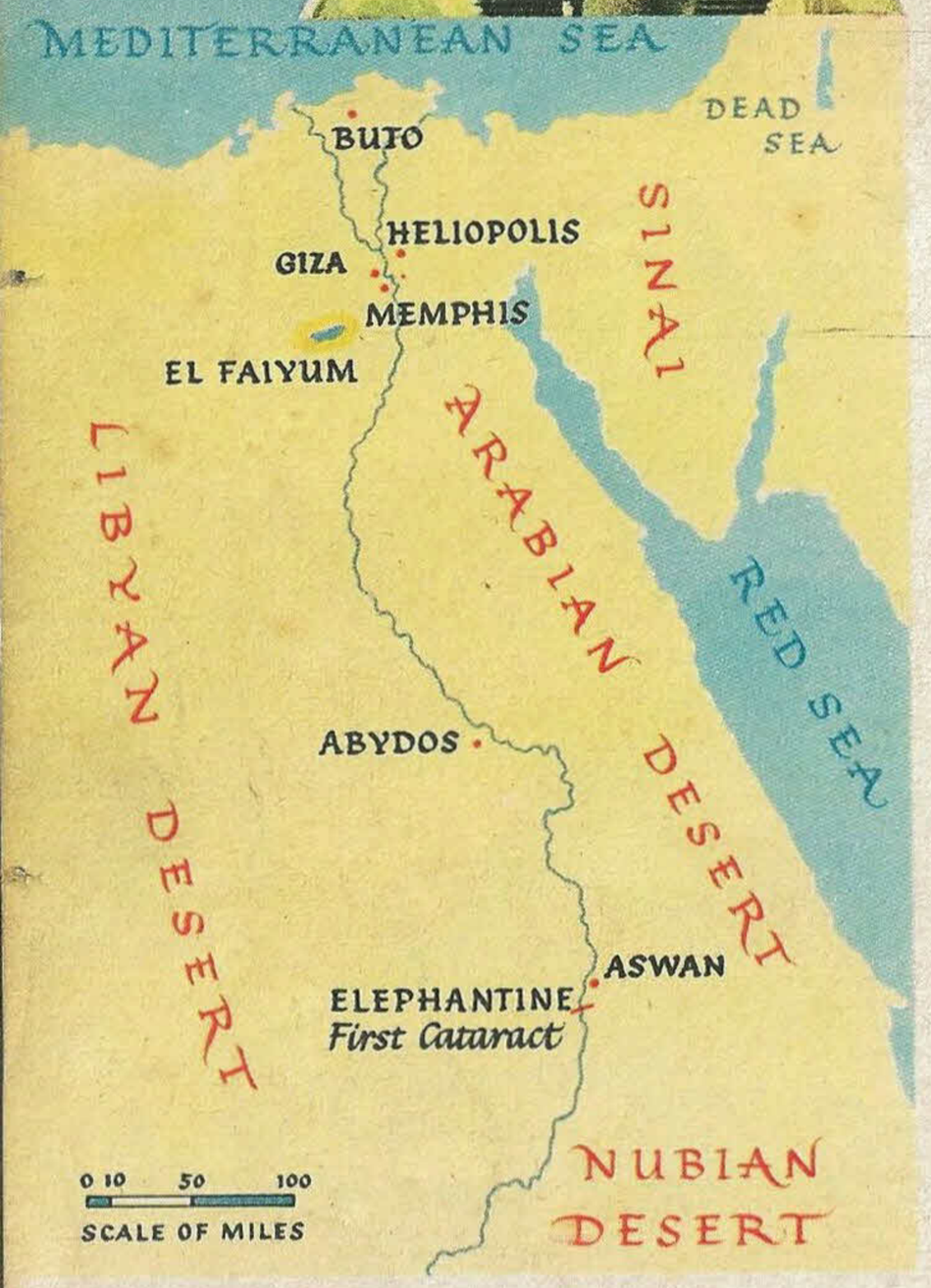
ACROSS: 1. Aviary; 4. Scrawl; 8. Riding; 9. Bridge; 11. Hoar; 12. Columbus; 14. Potato peelers; 17. Purified; 18. Star; 21. Origin; 22. Buckle; 23. Energy; 24. Thanet.

DOWN: 1. Airship; 2. India; 3. Rani; 5. Carousel; 6. Audible; 7. Leeds; 10. Poppies; 13. Stuffing; 15. Termite; 16. Serpent; 17. Phone; 19. Token; 20. Ruth.

EPIC STORY OF THE NILE—PART TWO

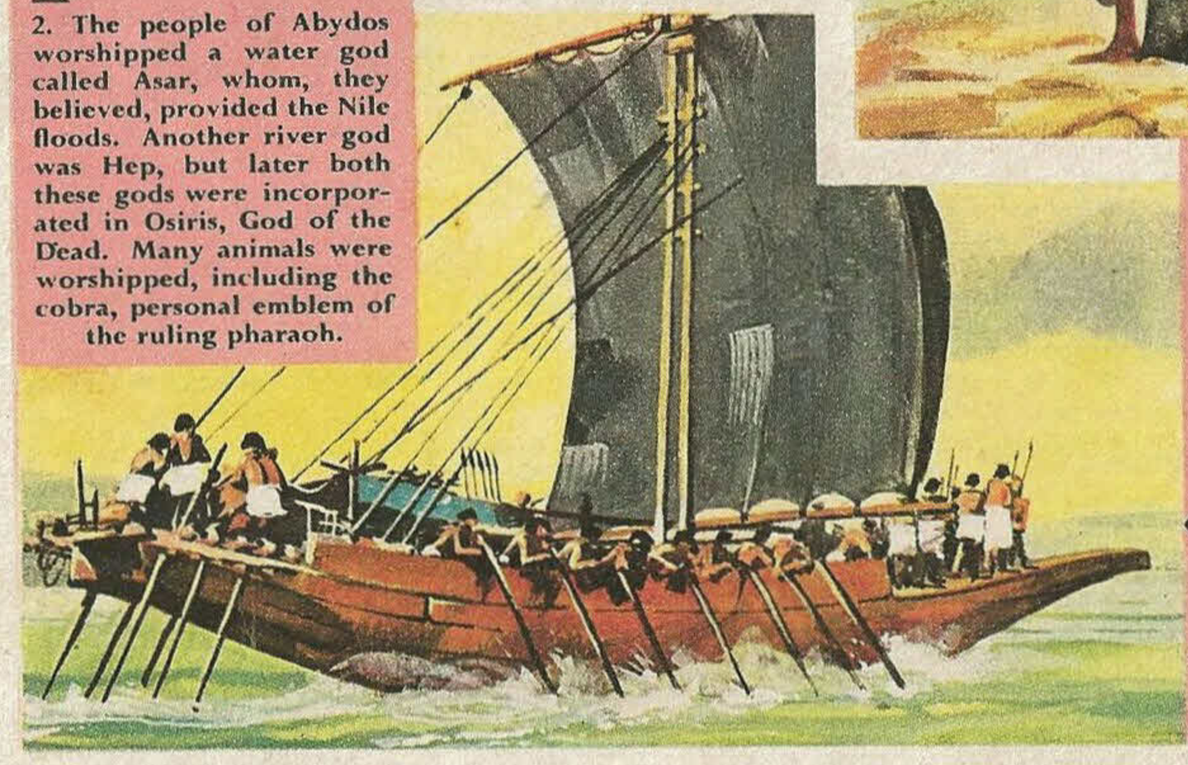
WORSHIP OF THE WATER GOD

1. The first cities of Egypt were built beside the Nile. In about 3200 B.C. the two kingdoms of Upper and Lower Egypt were united by Menes, the first pharaoh, who lived at Abydos and built Memphis.

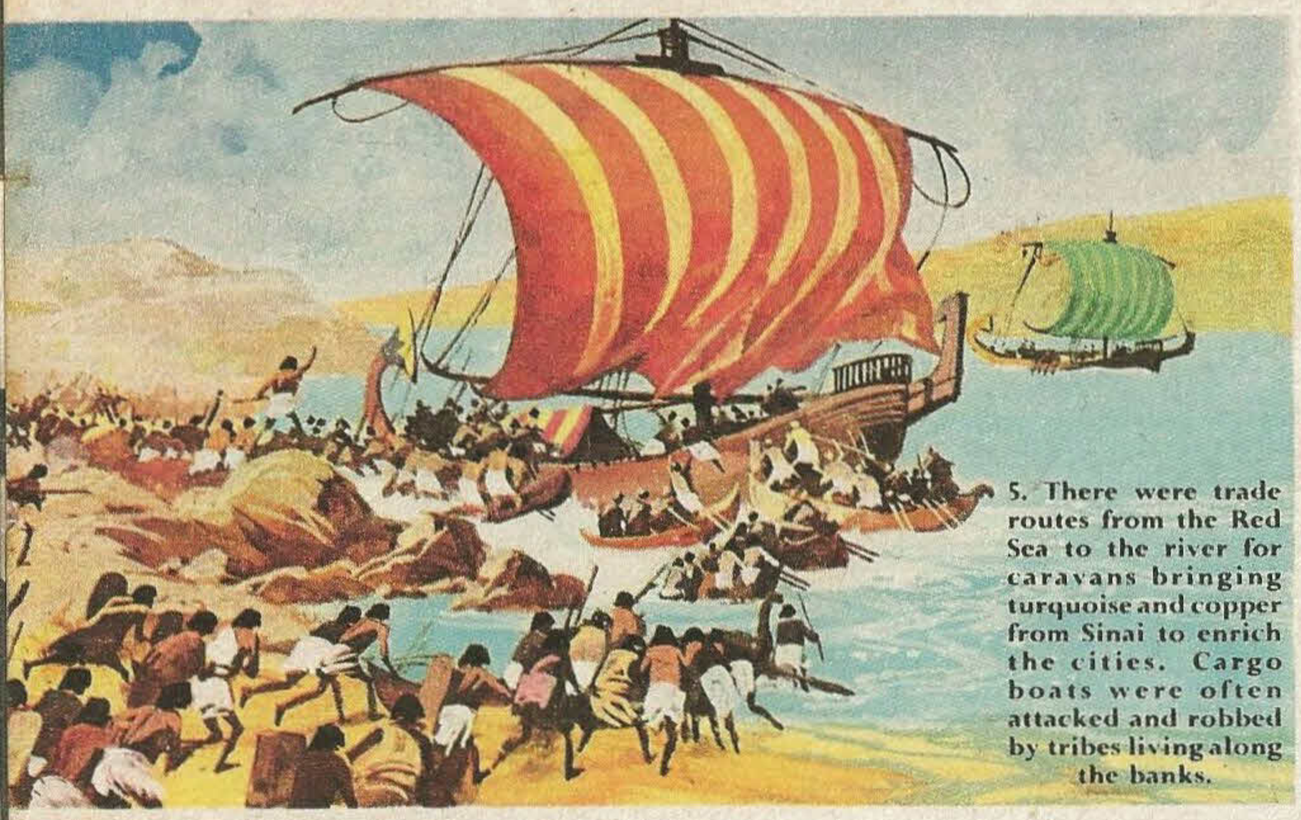


2. The people of Abydos worshipped a water god called Asar, whom, they believed, provided the Nile floods. Another river god was Hep, but later both these gods were incorporated in Osiris, God of the Dead. Many animals were worshipped, including the cobra, personal emblem of the ruling pharaoh.

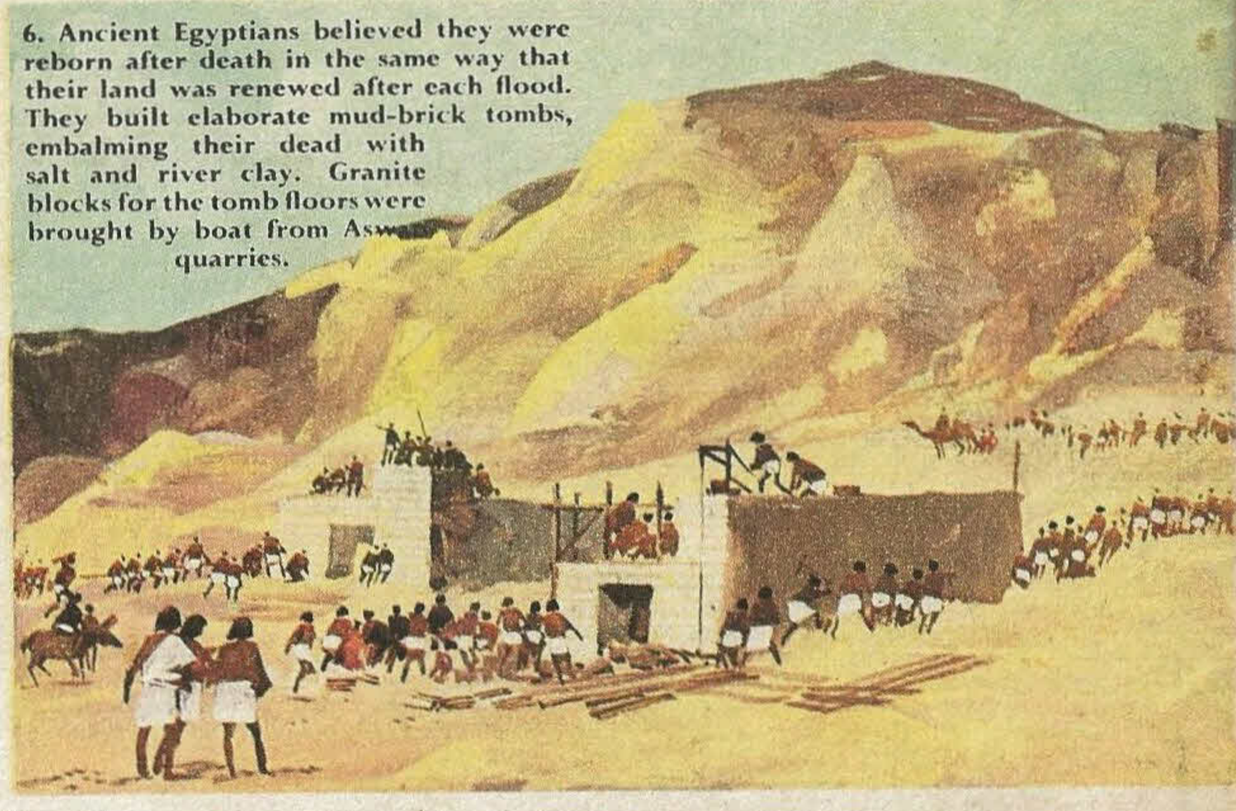
3. Early pharaohs like Menes were believed to possess magical powers over the floods, so rituals were performed each summer to persuade the Nile god to swell the waters. Menes also did much practical work reclaiming land and draining fields.



4. By now boats were made of timber, imported from the Lebanon. Egyptians made armed forays up-river to control savage tribes in the Sudan and extend their rule.

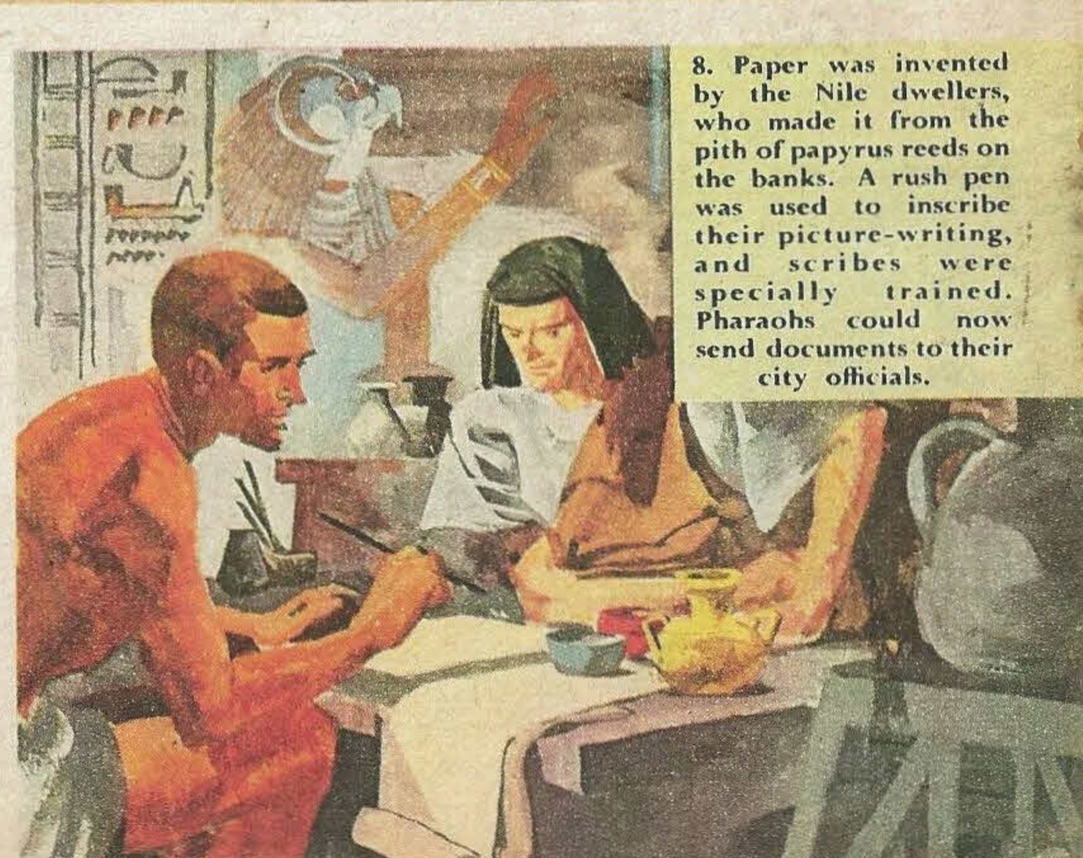


5. There were trade routes from the Red Sea to the river for caravans bringing turquoise and copper from Sinai to enrich the cities. Cargo boats were often attacked and robbed by tribes living along the banks.



6. Ancient Egyptians believed they were reborn after death in the same way that their land was renewed after each flood. They built elaborate mud-brick tombs, embalming their dead with salt and river clay. Granite blocks for the tomb floors were brought by boat from Aswan quarries.

7. Later the huge stone pyramids at Giza were built as tombs by King Khufu, and other pharaohs of the Fourth Dynasty (or Royal Family). Limestone blocks were ferried across the river at high water by barges. The Great Pyramid needed two million blocks, some weighing 15 tons.



8. Paper was invented by the Nile dwellers, who made it from the pith of papyrus reeds on the banks. A rush pen was used to inscribe their picture-writing, and scribes were specially trained. Pharaohs could now send documents to their city officials.

NEXT WEEK: STARS FORETELL THE FLOOD