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16

LOOK AND LEARN

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No. 92, 19th OCTOBER 1963

EVERY MONDAY—PRICE ONE SHILLING

LAWMEN of the LONELY OUTPOSTS

Canadian Mounties' Epic Story—see page 25

LOOK and LEARN

No. 92 19th October, 1963
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OUR COVER PICTURE

In 1873, a band of American fur-traders rode into an Indian encampment in the Canadian hills and traded cheap alcohol for the redskins' furs and pelts. The redskins soon got drunk and became unfriendly towards the Americans, who, afraid that they might be killed, drew their guns and slaughtered many braves, squaws and children. The news shocked Canada, and plans for a mounted police force were put into action. One hundred and fifty farmers and tradesmen volunteered to form the first Canadian Mounted Police—a force which was to become a legend. Their motto: "Uphold The Right." You can read the full story of the Royal Canadian Mounted Police Force, as they are called today, in this week's "From Then Till Now."

BETWEEN OURSELVES

"JIMMY," said the father to his young son, "I'm sorry to tell you that your grandfather has died." "Oh?" the boy answered. "Who shot him?"

That is the story, supposed to be true, told by those who believe that the amount of murder shown on TV is giving young people a very distorted idea of life.

Well, let us look at the fiction first. I cannot remember seeing anybody die a natural death on TV for months, apart from Little Nell in The Old Curiosity Shop. But I can remember hundreds of murders.

Now let us have the facts. In Britain, over 600,000 people die every year. Of these about 150 are murdered. And the next time you see one of those TV films (mostly made to be sold in America) where British crooks fire at the police, remember that the rate at which British police lo heir lives in this way is about one per year.

What you have to remember is that if plays showed you law courts, police stations, hospitals, western ranches, offices and other centres of activity as they are, or were, most of the time, you would switch off through sheer boredom.

Have your high-powered drama if you must, but never delude yourself into thinking that it has much to do with the general pattern of real life.

The Editor

The long distance runner

Do you know the origin of the marathon race? In 490 B.C. news reached the Athenians that the Persians were going to invade the Greek States. Pheidippides, an Olympic champion runner, was chosen to fetch the help of the Spartans. He ran all the way and returned with the news that the Spartans would start at the full moon. Meanwhile the Persians had landed and the Athenians set out to meet the invaders in battle at Marathon. The Athenians won the battle and Pheidippides ran to Athens to tell the citizens the good news. He ran the twenty-two miles from Marathon to Athens, but fell dead on the outskirts of the city as he gasped, "Rejoice, we conquer!"

SALLY DURHAM
Scarborough, Yorkshire.

Marathon runner L. G. Edelan breasts the tape as winner of the Windsor-Chiswick race in 1963. Time: 2 hrs. 14 mins. 8 secs.

Free Post

Do other readers know what the G.P.O. term "franking" means? This comes from the French word *franc*, or free, and franking means free use of the postal service. This privilege was granted to both Houses of Parliament in 1764. Members could send ten letters a day and receive fifteen free of charge. In 1840 this custom was abolished, but letters franked by Government Departments are still sent free of charge.

RICHARD PHILBY
Skegness, Lincs.

Aesop's Fable

If we hear somebody deriding something he cannot have, we sometimes say: "Sour grapes!" This saying comes from the ancient fable by Aesop, called "The Fox and the Grapes." The fox in the story attempted to eat some grapes hanging from a vine by jumping up at them, but he soon became tired and consoled himself by saying, "Well, probably the grapes would have been sour, anyhow."

SIMON STEPHENS
Markinch, Fifeshire.

One Tongue

Can you tell me the origin of Esperanto, the international language?

N. SLOAN
Belfast, N. Ireland.

Esperanto was invented by Dr. L. L. Zamenhof (1859-1917), a Polish eye-surgeon. He published his first book in 1887 but, although the language is used in some civilized countries, it has not achieved its real purpose of becoming a single language to be used throughout the world.

Fill That Gap

What kind of metal does a dentist use for filling teeth?

JEAN SUMMERS
Bude, Cornwall.

Dentists use a special alloy called amalgam, made from powdered silver or tin. It is soft and pasty when first mixed, but sets like cement in a few minutes.

Up and Up

In Ceylon, where I live, bamboo plants grow as high as 120 feet, (only eighty-two feet shorter than Nelson's column). In some areas these bamboos shoot up as much as eighteen inches in a day after heavy rainfall. Bamboo poles are used for building houses, bridges and for making furniture and wickerwork baskets. The juicy young shoots are even cooked as food and served like asparagus, or salted and eaten with rice.

PATRICK SING
Ceylon.

Quick Quiz

LITERATURE

1. Was Samuel Richardson (*a*) a poet, (*b*) a playwright, or (*c*) a novelist?
2. Who wrote *Castle of Otranto?*
3. Can you supply the missing word—and name the author of this rhyme?
"The time has come,
the —— said,
To talk of many things,
Of shoes—and ships—and
sealing wax—
Of cabbages and kings."

PEOPLE

1. What have Ptolemy and Mercator in common?
2. Who was President of the United States before John Kennedy?
3. What is the title of Princess Margaret's son?

MUSIC

1. How many movements are there in a symphony?
2. What was Beethoven's great affliction?
3. Who wrote the opera *Madame Butterfly?*

GEOGRAPHY

1. Which of these distances would you say is nearest the length of the French Mediterranean coastline: (*a*) 100 miles, (*b*) 350 miles, (*c*) 850 miles.
2. Which eight countries border on Germany?
3. In which ocean are the Gilbert and Ellice Islands?

LEGEND

1. What kind of animal reared Romulus and Remus?
2. What was the name of King Arthur's Queen?
3. Who unchained Prometheus on the mountainside?

NATURAL HISTORY

1. Is a wombat (*a*) an animal, (*b*) a bird, or (*c*) a simple plant?
2. In the animal kingdom to which division does Homo Sapiens belong?
3. The onion belongs to the same family as a well-known flower. Which flower?

HISTORY

1. Agrippina was the wife of Claudius. Who was he?
2. Who was Protector of the Commonwealth after Oliver Cromwell died?
3. Who were the principal contestants at the Battle of Tewkesbury?

ART

1. To which art movement did Delacroix belong?
2. What was the nationality of the artist Hobbema?
3. Pieter Brueghel the Elder had two famous artist sons. What were their names?

ANSWERS ON PAGE 29

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MUSEUM IN A PIECE OF CHALK

Under the microscope chalk tells the fascinating story of life in the sea millions of years ago

IF you look at a tiny fragment of blackboard chalk through a fairly powerful microscope, a fantastic world is opened up before your eyes.

Each speck of chalk is seen to have a most unusual shape: here is a tiny white star, there is a small sphere covered with minute holes, there again is a minute and delicate sea shell.

All these white stars and hollow globes are in fact the skeletons of microscopic sea creatures that lived in the sea many millions of years ago.

In their living state most of these animals looked like tiny blobs of jelly less than a hundredth of an inch across. Through the holes in some of the skeletons thin jelly-like tentacles projected out into the surrounding sea water, intertwining to form tiny nets to collect food.

Some of the blobs of jelly spun round and round through the water, propelled by rapidly vibrating little hairs called "cilia."

Earth Upheavals

MOST of the star-shaped and sharp spiky skeletons are the skeletons of tiny sponges.

Mixed with all these strange skeletons we can also see crushed fragments which are the powdered remains of skeletons of other living creatures, such as sea-urchins.

When all these microscopic and primitive living creatures died their skeletons slowly drifted down to the sea bed, and formed a layer of creamy mud or "ooze."

Slowly, over millions of years, the ooze became thicker and thicker and hardened into vast areas of solid chalk which covered hundreds of square miles of the ocean floor.

This is a highly magnified cross-section of blackboard chalk, which is a soft form of limestone made up of delicate skeletons and shells of primitive marine animals.

Later, upheavals in the Earth's crust gradually raised many parts of the chalk layers above sea level. In fact it is believed that the whole of Europe was once a great chalk plain. Today this chalk is cracked and covered with layers of clay and sand.

But practically the whole of Southern England rests on a sheet of chalk more than a thousand feet thick. This chalk extends across to France—and in the Straits of Dover we can see how the Channel currents have gradually worn it away, cutting out the famous White Cliffs.

Chalk consists almost entirely of "calcium carbonate," the substance formed when the metal calcium combines chemically with carbon dioxide, the familiar gas which makes ginger beer fizzy.

Tiny Bubbles

IT is easy to prove that chalk contains a gas by dropping a little powdered chalk into vinegar. You will see tiny bubbles rising from the chalk dust, as the acid in the vinegar combines with the calcium in the chalk and releases bubbles of carbon dioxide gas.

In a chalk quarry you would see further proof that chalk came from under the seas. Imbedded in the face of the quarry at intervals you would find sea shells and fossils of primitive sea urchins and marine creatures of all kinds.

Chalk is a very cheap material, and no wonder, considering that millions of tons of it lie waiting to be quarried under most of Britain.

Using chalk to write on blackboards is a very minor part of the chalk industry. Finely-powdered chalk is put in toothpastes and powders to act as a mild abrasive.

Mixed with linseed oil chalk becomes putty. It is also used as a filler to give bulk to many familiar materials—china clay, face powder, paint and plastics.

Large amounts of chalk also go back into living things—in the form of fertilizers in agriculture.

◄ First sight of England—the famous White Cliffs of Dover, made of solid chalk, greet the Continental traveller.

ASSASSINATION

Two bullets killed ten million men

In a minor European province seven assassins plotted the murder of the Archduke Ferdinand. Their grisly day's work began the greatest and most terrible war in history

NO men throughout the whole of history (and history is liberally littered with such men) had greater reason to cry: "Oh, if only we had known . . ." than the seven who took up their appointed places in Sarajevo, the capital of the then Austrian province of Bosnia, on June 28, 1914, to assassinate Archduke Franz Ferdinand, heir to the throne of Austria-Hungary.

For within five weeks their grisly day's work had plunged the world into World War I and the bloodiest four years it has ever known, with ten million dead and a further twenty million wounded.

But the only thoughts, apart from the fear of discovery, that occupied their minds that sunny morning were that they were about to strike a great blow for their ideal—the formation of a Greater Serbian or Yugoslavian Empire—by removing the great block that stood in the way of such an Empire.

The oldest of the assassins was twenty-three, the youngest nineteen. All were members of the Black Hand, the secret Serbian terrorist society who plotted the whole affair.

At the turn of the century, the Austrian-Hungarian Empire was in a state of ferment. An earlier war, some twenty-five years previously, had destroyed the Ottoman Empire and had granted independence to Serbia and Rumania and self-government to Bulgaria. It had also given Bosnia and Herzegovina to Austria to occupy and govern. The Serbians were angry because they wanted these territories as part of a Greater Serbian nation. Behind this dream of a great Serbian Empire was Colonel Dragutin Dimitrijevic, chief of the Serbian Intelligence Department and the driving force behind the Black Hand society. Nicknamed Apis—the bee—because of his energy, he plotted unceasingly against Archduke Franz Ferdinand's own plans for expansion and reforms in a greater Austria-Hungarian Empire.

But Apis and his Black Hand needed unrest to whip into unrestrained nationalism if they were to advance their dream of a Greater Serbia. So Franz Ferdinand had to be murdered.

Once the deed had been decided upon it was essential that Apis be no longer concerned, or that the plot could be in any way traced back to him, for his position as Intelligence Chief would have implicated the Serbian Government in the plot.

So his right-hand man in the Black Hand, Major Voja Tankosic, actually chose the assassins, recruiting them in the coffee shops of Belgrade where young students and partisans talked about the dream of a Greater Serbia for hours on end.

First Attempt

TANKOSIC chose three of them named Cabrinovic, Princip, and Grabez. All three knew each other, were nineteen, came from poor families, had endured unhappy childhood. They were not in the common-sense of the word, trouble-makers. They were killing simply to bring about the Greater Serbian Empire they had talked so much of during those hours spent in the Belgrade coffee bars.

As Princip said at his trial: "I meant to do a good deed."

When they agreed to do it the youths were given the four revolvers and six bombs with which they were to commit the crime—and some cyanide. Their orders were to commit suicide after killing the Archduke.

The Archduke was to be in Sarajevo on June 28 for a civic reception following manoeuvres in the region, and this was the destination of the three killers when they set out along the underground route in Bosnia from Belgrade in late May.

The three assassins arrived in Sarajevo. They had been joined by the twenty-three-year-old schoolmaster and revolutionary Danilo Ilic, who had himself gained three local recruits, a Moslem, Muhamed Mehmedbasic and two students, seventeen-year-old Vaso Cubrilovic and Cvijetko Popovic, eighteen.

All the players knew their parts but only Princip, and Ilic probably, had any real idea of why they were playing them.

When the Archduke's train drew into Sarajevo Station the seven assassins were all in position along Appel Quay, the route of the civic procession. As the cars approached at 10.15 their hearts beat faster, their hands perspired around the bombs and pistols.

This was their moment of destiny.

But the Moslem, Mehmedbasic, surrounded by that crowd of cheering loyal subjects, with bunting, flags, Oriental rugs streaming all around, allowed destiny to pass him by. As the Archduke's car drew level with him he did not do a thing. His bomb stayed beneath his coat. The Archduke drove on.

The next assassin in line was Cabrinovic. He did not hesitate for an instant.

In one smooth action he took the bomb from under his coat, knocked the cap off against a lamp post and pitched it truly at Franz Ferdinand's car.

Bungle

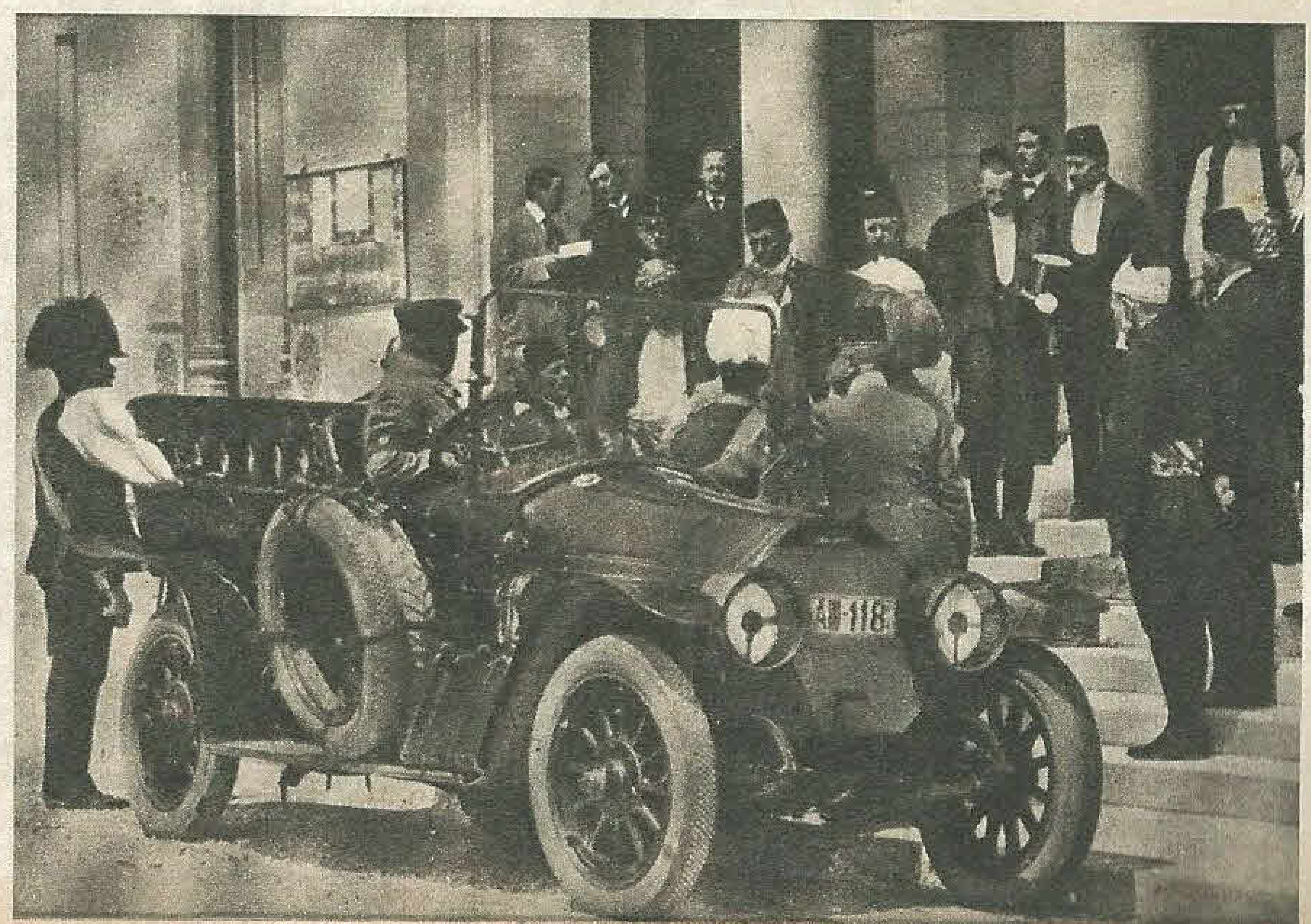
THE driver who had heard the crack as Cabrinovic knocked the cap from the bomb saw an object hurtling towards the car and accelerated. And the bomb, instead of landing in the car, was deflected by the Archduke's hand on to the folded hood from where it fell into the road and exploded.

About a dozen spectators were injured and so were some of the high government officials in the following car. But none seriously.

Having made sure that all the injured were well taken care of Franz Ferdinand with typical arrogance exclaimed: "Come on, the fellow is insane; let us go on with our programme."

The next three assassins along the route were Cubrilovic, Popovic and Grabez. When their chance came they were as useless as Mehmedbasic.

CONTINUED ON PAGE 6



Outside the Town Hall of Sarajevo, the Archduke's car waited while officials planned a new route for his journey through the town.

Officials stared in horror as Princip stepped forward and fired. Then they leapt on the murderer and quickly disarmed him. Below: The effect of two bullets—a scene from the First World War.

 continued from page 4

The car halted—just where the gunman waited

The shots are fired, the assassin arrested—too late to stop a new and ghastly chapter of history

That left Princip.

And he got his chance through a piece of bungling of majestic proportions. A Town Hall conference decided that as Franz Ferdinand was determined to continue his programme—now he wanted to visit a bomb victim in hospital—then he should go by a new and speedier route.

But they neglected to tell the one person who should of all people have been told—the Mayor's chauffeur, who was driving the leading car and from whom all the other drivers were taking their cue.

It was not until they were turning into Franz Joseph Street that General Oskar Potiorek, Governor of Bosnia and Herzegovina, realized they were still on the original route.

He called on the Archduke's chauffeur to stop and back up to get on to the right road. The chauffeur did as he was told—and presented a sitting target of the Archduke to Princip, who was standing outside the Moritz Schiller delicatessen.

The frail, slightly built Princip with his tight lips and pale face stepped forward and from a range of five feet shot twice.

Franz Ferdinand was struck in the neck, Archduchess Sophie in the abdomen. They both died shortly afterwards.

Evasive Reply

MEN leapt forward to seize the assassins, and Princip joined Cabrinovic in prison. Then followed Ilic. And piece by piece the whole plot was uncovered—where the assassins had got their weapons, how they had come to Sarajevo along the underground route, who had helped them on their way. Well, not the whole plot.

For although the investigators got as far up the ladder as the name of Major Tankosic they did not discover the name that mattered—Apis.

And when the Austrian Government report of the investigations was made it could find no reason even to suspect that the Serbian Government had been aware of the plot.

It weakened Austria's case considerably. Had their intelligence service been at all efficient it must have been able to discover the existence of the Black Hand and the part it played in the Archduke Franz Ferdinand's death.

Then the Austrian Government could have presented Serbia with a firm demand for arrests rather than the woolly ultimatum which they issued on July 23, 1914, and the world would have viewed the affair rather differently.

This gave the Serbian Government just forty-eight hours to stop Serbian propaganda and subversive activities on Austrian Hungarian territory, to arrest Tankosic and another plotter who had been named by the assassins and to allow Austrian-Hungarian agencies into Serbia to investigate the assassin's Serbian links.

Of the Black Hand there was no mention.

The Serbian Government's reply was as evasive as the Austrian's had been woolly. It was not good enough for Emperor Franz Joseph. And on July 28, 1914, Austria declared war on Serbia.

Russia, as Apis had been assured in the early days of the plot by the Russian military attaché in Belgrade, announced that it would fight with the Serbians. World War I was in sight.

Austria and Germany had a pact against attack by Russia and Germany declared war on Russia on August 1. Russia and France had a pact against attack by Germany and two days later France declared war against Germany.

Then in an attempt to beat France before Russia broke through on the East, Germany invaded Belgium's neutrality and Britain declared war on Germany on August 4. World War I had begun. As for the assassins—Mehmedbasic had escaped to Montenegro—five of them, Princip, Cabrinovic, Grabez, Popovic and Vaso Cubrilovic were found guilty at Sarajevo on October 29, 1914, of treason and murder. They could not hang as they were under 20.

The first three were sentenced to the maximum of twenty years imprisonment, Cubrilovic received sixteen years, Popovic, thirteen. All except Popovic had to fast one day a month and spend each June 28 in solitary confinement.

Ilic was sentenced to death and so were two others who had assisted the assassins.

Apis Arrested

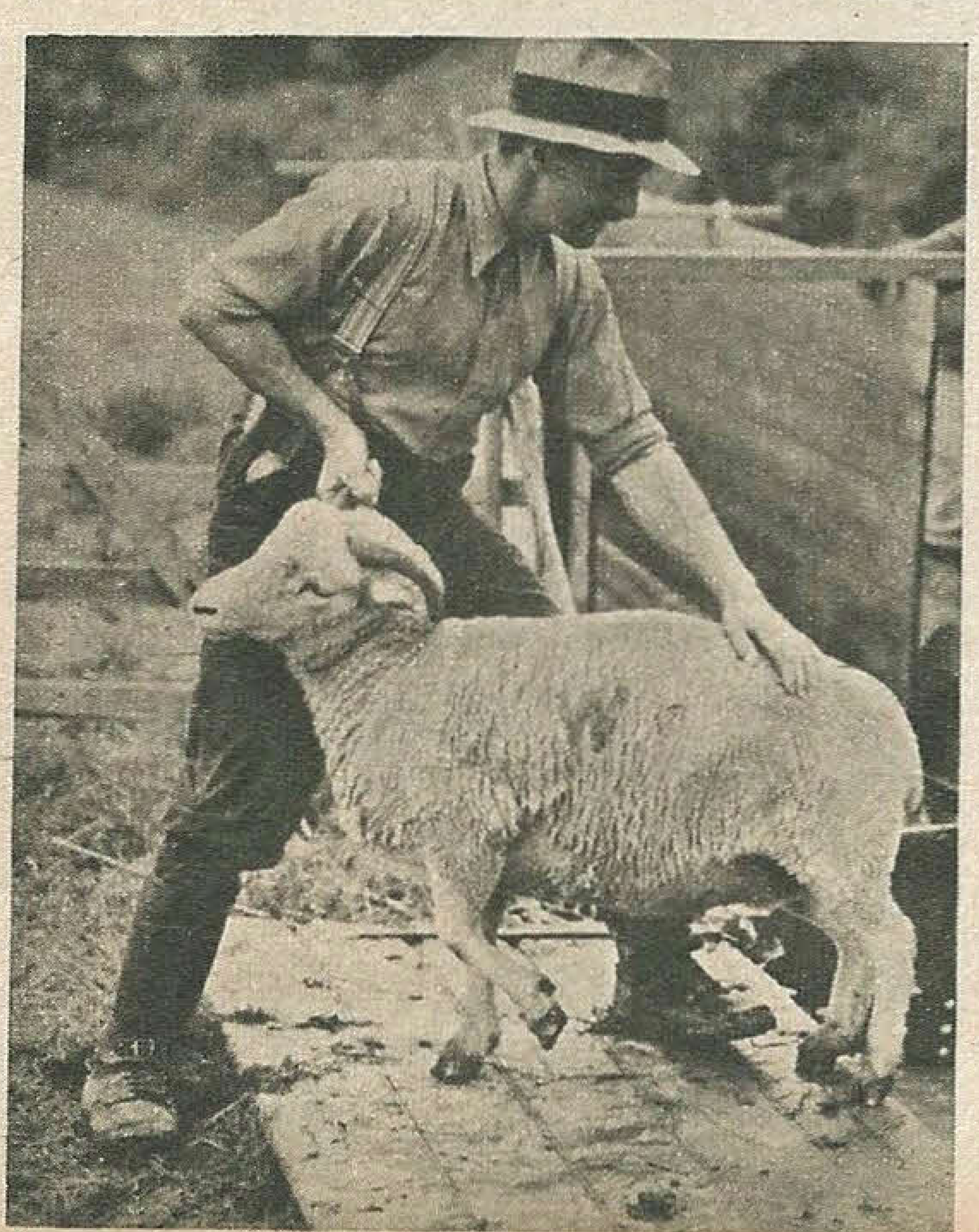
BEFORE World War I ended Princip, Cabrinovic and Grabez had all died in prison of tuberculosis. Cubrilovic after serving his sentence went on to become a university professor, Popovic too served his sentence and became a curator at Sarajevo Museum. Mehmedbasic eventually returned to Sarajevo and lived quietly as a gardener and carpenter until he died during World War II.

As for Apis, he was arrested by the Serbian police in March 1917 on charges of treason and attempting to assassinate the Prince Regent, Alexander. Both charges were false.

But Prime Minister Pasic had decided to break up the Black Hand—for what reason nobody really knows—and Apis had to go.

Obviously one of the reasons why he was better out of the way was the part he played in the assassination of the Archduke Franz Ferdinand, which of course involved the Serbian Government directly in the plot. He was shot on June 26, 1917.

NEXT WEEK:
THE GREAT CHICAGO FIRE.



WORD OF THE WEEK • BRAND

SOME of our words were brought in by the Vikings from the Scandinavian languages, and one is *brand*, derived from the Teutonic *brinnan*, to burn. In old English it meant a piece of burning wood. We use the word *firebrand* to describe either a flaming torch or a person who stirs up trouble by firing others with discontent.

Anything which had a mark burned into it with a hot iron was said to be *branded*. Such a brand was often put on animals—and also on goods such as wine-casks—for the purposes of identifying their rightful owner. So in time a brand became any distinguishing trademark, and also a particular make of goods. We may speak, for example, of "a well-known brand of breakfast cereal." *Brand-new* means quite new, as though only just branded by the makers.

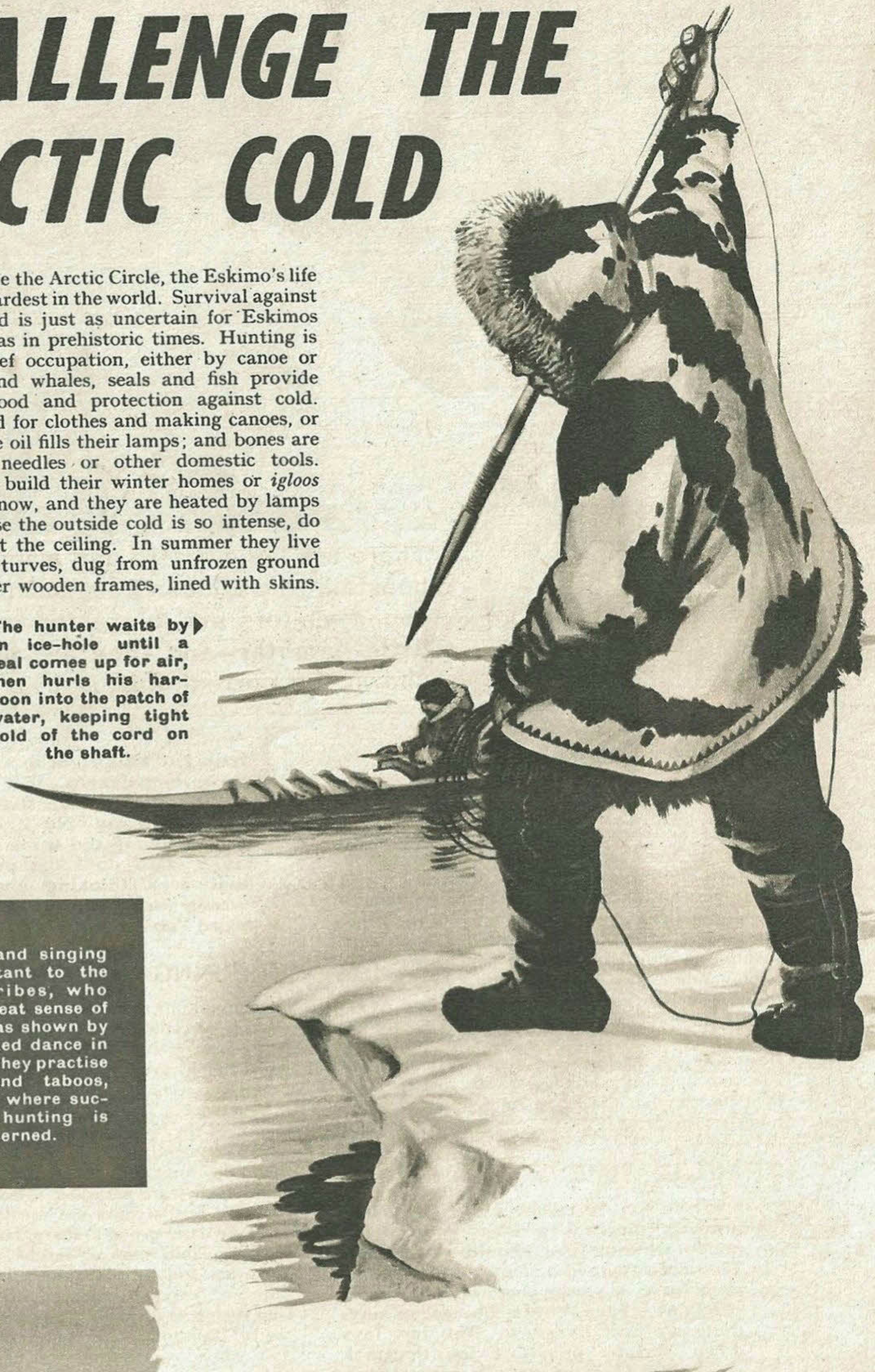
Long ago criminals, too, were branded with a mark from a hot iron, so that they could be easily recognized. Nowadays, however, when a man is "branded a thief" it is in an abstract sense only, meaning that his reputation marks him as one.

In poetic language a brand is also the flashing blade of a sword. Hence our word *brandish*, to wave like a sword.

ESKIMOS CHALLENGE THE ARCTIC COLD

Frostbite is a constant danger, and this Eskimo mother is warming her child's hands. Eskimo women carry their youngest children next to their body under their jackets.

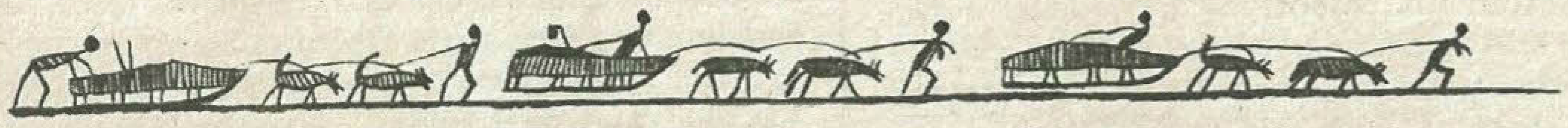
Dwelling inside the Arctic Circle, the Eskimo's life is one of the hardest in the world. Survival against the bitter cold is just as uncertain for Eskimos today as it was in prehistoric times. Hunting is still their chief occupation, either by canoe or dog-sledge, and whales, seals and fish provide their main food and protection against cold. Skins are used for clothes and making canoes, or *kayaks;* whale oil fills their lamps; and bones are carved into needles or other domestic tools. The Eskimos build their winter homes or *igloos* of blocks of snow, and they are heated by lamps which, because the outside cold is so intense, do not even melt the ceiling. In summer they live in houses of turves, dug from unfrozen ground and built over wooden frames, lined with skins.



The hunter waits by an ice-hole until a seal comes up for air, then hurls his harpoon into the patch of water, keeping tight hold of the cord on the shaft.

Dancing and singing is important to the Arctic tribes, who have a great sense of humour, as shown by this masked dance in Alaska. They practise rituals and taboos, especially where success in hunting is concerned.

The temporary igloo home is built in a short space of time along the hunter's trail. Lamps heat it to nearly 60 degrees F., but outside the Eskimo is protected by a hooded jacket with fur fringe.



The Eskimos love decoration of all kinds, and they do beautiful carving and ornamental work. This carving is from a special bow made of walrus ivory.

In their summer home the family sit and sleep on this raised couch, which is covered with furs. The woman is chewing skin to soften it for making clothes, and the man is eating meat which is almost raw.

PET TALK

by EDMUND BURKE

There are lions, tigers and many big beasts at the London Zoo. But these young visitors are interested in the little hamster—and they are being shown the correct way to hold one

NATURE IN THE RAW

I was watching a kitten the other day, playing quite happily with a ball of wool. It was so beautiful to watch, so swift, you could barely follow its movements, graceful and always in complete control of its body.

Puppies are inclined to sink in the middle or look as though they are coming apart at the joints, but never a kitten. Cats are different, a law unto themselves and we never really tame them.

Sometimes when we are watching a cat in front of the hearth or dozing on the garden wall we are inclined to forget that inside the mildest, sweetest cat you have ever seen is a killer. Nature made them that way and nothing man has done in the past four or five thousand years has changed a bit of it. Remember that, next time your cat brings home a victim.

TRAIN IN TIME

While we are on the subject of young animals there is a little point about puppy training you should remember. Those of us who live in the country have a problem if a young dog starts to chase chickens, sheep, cattle, horses, or anything we call livestock. The law lays down serious penalties for livestock chasing and it is up to you to control your dog.

The best way is to stop it before it ever starts by putting your pup on a lead and letting it walk right in among a flock of sheep or chickens. If it makes a single move toward them, snatch it back and say very firmly "No."

Keep doing the same thing time and time again until the pup understands that even thinking about chasing is wrong—and also incidentally, what the word "no" means.

GLIPPING THE CLAWS

Many of our cage birds have toe-nails, or claws that grow rather fast. Sometimes they are too long, curving back towards the bird's feet, and when this happens it can be very painful for your pet. Keep a sharp eye on them and try to prevent it happening.

One of the best ways is to use perches covered with fine sandpaper. When the birds roost on them the rough surface wears down the excess claw, so they are naturally "filed."

If the bird's claws are too long already they must be cut, using a sharp but strong pair of scissors. Hold your pet firmly but gently around the wings and body, making all your movements slow and easy so that you do not frighten it. Clip each nail in turn, but be sure you do not go too far back toward the toe itself.

If you look carefully you can see where the little blood vessels end, a darker area in the claw. Always cut forward of this, because otherwise you can hurt your bird and cause bleeding which is hard to stop.

WORD OF THE WEEK • IRON

IRON is a metallic chemical element obtained from the earth. Its name comes from the old English *iren*. A preparation of iron is used in medicine as a tonic. As a metal, mixed with carbon, it is used for tools and building construction.

Cast iron is hard and brittle. Wrought iron is comparatively soft and capable of being hammered into shape when red hot. This has given us such phrases as "to strike while the iron is hot," meaning to act at the appropriate time, and "to have too many irons in the fire," that is, to have taken on too many jobs at once.

Many implements gained their names through being made originally of iron, though nowadays they may be manufactured from other metals. We have grappling irons (instruments for hooking or grasping), fire-irons (poker, tongs and shovel), and the old-fashioned flat-iron used when heated for smoothing out linen. From this, we still speak of *ironing* clothes.

Prisoners with their hands and feet fettered in iron shackles were said to be "clapped into irons." A type of iron-headed golf club is known as an iron.

This hard metal has become the symbol of strength. "A will of iron" is a determined spirit which cannot be broken.

SIEGE AT BLACK HILL

On the summit was Caradoc, proud King of the Ancient Britons. Below were the Romans, skilled, ruthless and determined to conquer all Britain

THERE are men who never know when they are beaten, when their battle is hopeless from the start. Such a man was Caradoc, an ancient King of Britain who for years defied the might of Rome. The Romans called him Caratacus.

"By the gods of our fathers what a slippery upstart this barbarian is," cried the Roman Ostorius Scapula despairingly. "Do you mean to say you have let him escape again?"

Ostorius glared accusingly at the unhappy face of the commander of one of his legions.

"Now look here, I am taking personal command of this campaign from now, and by Jupiter if I can't catch this Caradoc may I never win a chariot race again."

So it was that in A.D. 50 the most determined effort yet to hunt down and catch the elusive Caradoc was launched. For nearly ten years the Briton had rallied tribes about him and harassed the Romans wherever and whenever he could.

He had attacked their supplies and stolen their food, set fire to their camps and caused many a Roman general to lose more than a few nights' sleep worrying over how to lay their hands on this evasive man.

Caradoc's guerrilla warfare had been conducted mainly in the region which we now know as Wales, and it was into the heart of Wales that Ostorius was determined to drive his spearhead of two legions, and so corner the Briton once and for all.

The Fight Is On

BUT Caradoc, clever enough to remain alive all those years, was clever enough to anticipate the Roman action now being taken against him.

One of his scouts brought him news that Ostorius was making camp at the foot of the Wrekin in Shropshire, and this camp he called Unicorium. From here the Roman proposed to drive Caradoc before him and on into Wales, cutting him off from all retreat.

"So it's a fight they want is it?" roared Caradoc. "Well then, we shall give them one. Get me my horse."

In a cloud of dust Caradoc rode off to raise help from the various tribes of the area. The ancient Britons, whooping and shouting, gladly rallied to him. If there was one thing that united them it was their mutual dislike of the Roman invaders.

Caradoc, having gathered his forces, now turned his attention to the task of preventing a Roman invasion of Wales. He set his forces to building two forts some fifteen miles apart.

Both these forts were called Caer (fort) Caradoc, and represented a considerable feat in engineering. The ditches had to be hewn out of solid rock and ramparts were built up with the excavated material.

Caradoc sent his wife and family to the second or base fort and left a smaller force at the advance post, thinking that he would bring up reinforcements when the Romans started their attack. But the speed of their advance took him by surprise and when news of the battle at the first fort, at Church Stretton, reached him, the Romans were already in control there.

Caradoc set out immediately with the rest of his forces but he was still five miles from his advance fort when he was met by the retreating troops, who told him that the Romans had quickly over-run their position.

That, the Britons realized sorrowfully, meant first blood to Ostorius.

Caradoc was reluctant to withdraw to his base fort, and now looked for a position where he could make a stand. Half way back, the river Clun ran across the track that linked the two forts. Here was a ford, and just beyond the ford the road ran over a ridge between two high hills.

On the one side rose Black Hill, gaunt and steep, to a height of fourteen hundred feet. On the other, slightly lower but equally forbidding, was Clunbury Hill. Around these hills Caradoc dispersed his troops.

Hasty ramparts were thrown up, rocks broken up to make lethal missiles, spears tested and shouts of encouragement hurled about from one lusty warrior to another.

Caradoc surveyed the scene a trifle grimly. In his heart he knew that this would be a last desperate battle.

If he won he would escape the Roman net for years to come. If he lost—well, if he lost there would be no escape for him. But the Romans were in no great hurry and the Fourteenth and Twentieth legions under Ostorius made camp in the night at Church Stretton.

They were in high spirits, and the noise of their carousing draped a merry blanket of sound over the otherwise silent night.

At dawn the centurions raised themselves, shook sleep from their eyes and damp grass from their feet, and formed up. There were in all some 20,000 men, battle hardened warriors who had fought and been wounded in many tough campaigns.

They marched as far as the River Clun and there Ostorius called a halt. During the night rain had fallen and the muddy waters of the river flowed swiftly by. Beyond it, apparently as firm as Black Hill itself, Ostorius could see the Britons' positions. He hardly cared for what he saw.

To attack, his troops would have to fight uphill all the way and at the end of it would still have to take the Britons' positions, which were well dug into the hill.

From the top of Black Hill, Caradoc looked down on the Roman Army. His men were hurling a whole barrage of taunts, catcalls and insults across the river at the Romans.

This did no apparent damage to the Romans but it did boost the morale of the Britons. Against the Roman army of 20,000 Caradoc had 15,000 men and now he rode along his long line of battle distributing appropriate words of encouragement. Wherever he went he was loudly cheered.

Across the River

OSTORIUS heard the cheers and his eyebrows rose a trifle. He was in two minds whether to attempt a frontal assault or try an out-flanking movement.

The problem was solved for him. His troops were now thoroughly riled by the shouts from across the river and were urging immediate attack to teach the barbarians a lesson.

Ostorius shrugged his shoulders. So be it. The first wave crossed the river and began climbing Black Hill.

To those unfortunates it must have seemed as if the heavens had opened to fling down upon them a torrent of rocks, stones, spears and boulders, such as they had never experienced, nor for that matter had ever wanted to.

It was hardly a pretty sight as men had the life crushed from them. The centurions faltered, the line broke and that was the end of the first attack.

Ostorius pursed his lips. Now he was angry, angry at this loss of Roman life, angry with himself for having permitted this rash attack.

Another column of troops were attacking Clunbury Hill, where the Britons were commanded by Caradoc's brother. Here the Romans were more successful and drove the Britons back. Caradoc called his brother over and told him to withdraw his men to Fort Caradoc in the rear. He asked him to warn his wife to take their family away to safety. But an act of treachery delivered them all into the hands of the Romans.

One of the villagers living near Fort Caradoc reported the position to the Romans, and a contingent was sent there while the battle was still on. Caradoc's wife and children were captured.

Meanwhile Ostorius was lining up his men for another assault on Black Hill. This time the Romans formed themselves into their famous *Testudo*. This simply meant that crouched closely together, with their shields held in front of them, they advanced up the slope like a ponderous tortoise.

Now the missiles of the Britons bounced ineffectively off this solid canopy of shields. Up went the Romans, driving the Britons back to the ramparts.

There fierce fighting broke out. Caradoc was in the thick of it, laying about him with a heavy axe that split Roman heads like nuts. But for the luckless Britons it was a battle against overwhelming odds, and the trained troops of Rome fought on to their inevitable triumph.

Caradoc himself was finally captured and brought before Ostorius. "You are a brave man," said the Roman general. Caradoc spoke no Latin. Instead, he spat eloquently upon the ground.

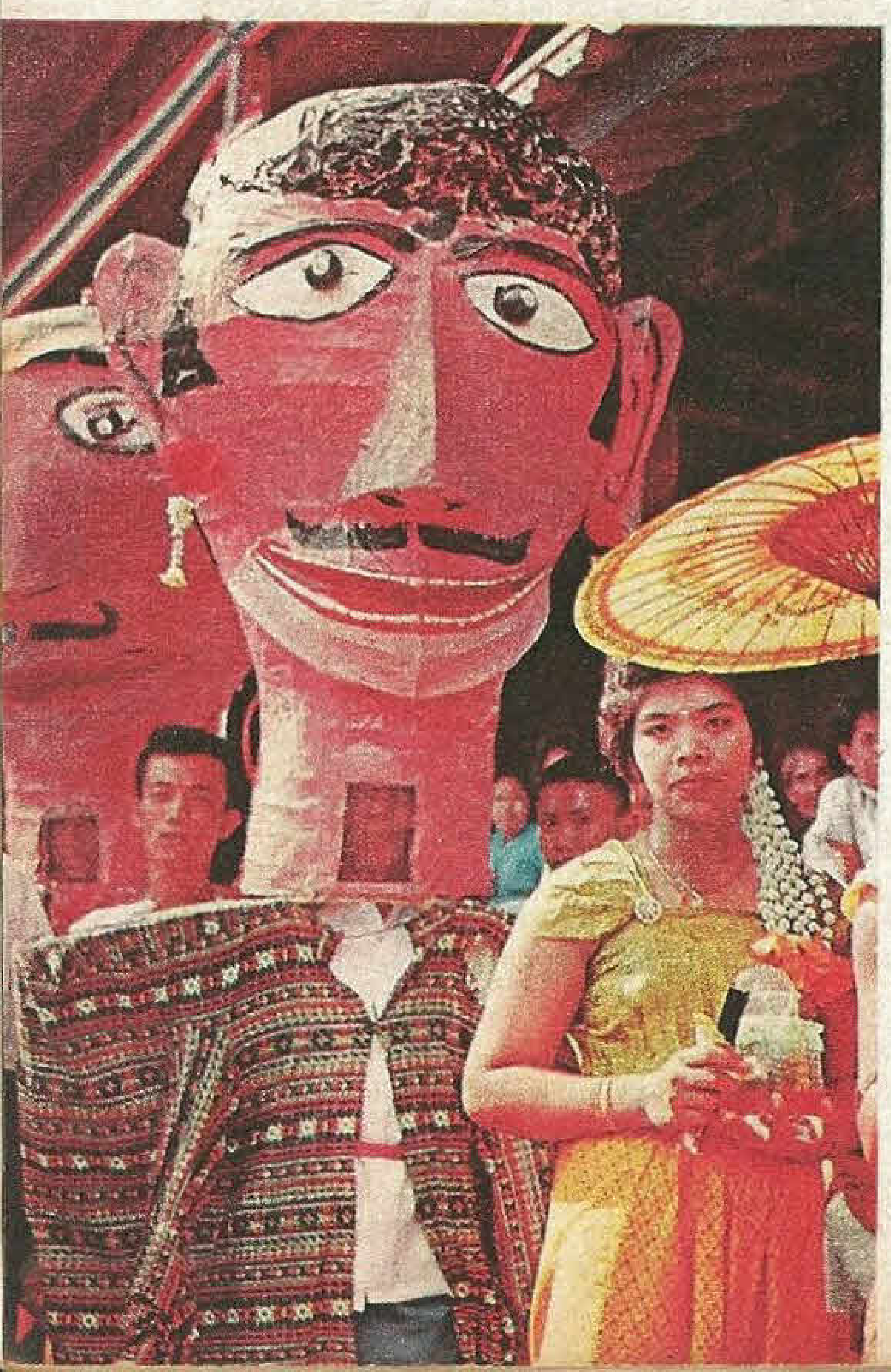
Such was Caradoc's fame that Ostorius took him back in triumph to Rome. He was treated like a hero—and his life was spared.

OUR COLOUR CAMERA IN THAILAND FOR THE . . .

FESTIVAL of FREEDOM

IN 1939, the kingdom of Siam changed its name to the native title of Maung Thai, which means "land of the free," translated into English as Thailand (pronounced ti'land). Each April the people hold the religious Songkran Festival to celebrate their freedom and welcome the new solar year. As a symbol of freedom they release thousands of cage birds, and fish. The Thais are Buddhists and their ancient custom of sprinkling water over religious statues and old folk has developed into a free-for-all water fight among the youth of Thailand. Water is hurled by the bucketful and even hose-pipes are used, but beneath all the fun lies the religious heart of the festival—a thanksgiving for freedom and life.

Escorted by fan-bearers, a beauty queen mounted on a model elephant parades before the spectators. White elephants in Thailand are regarded as sacred, and at one time all elephants were the king's private property, being allowed to roam wherever they wished.



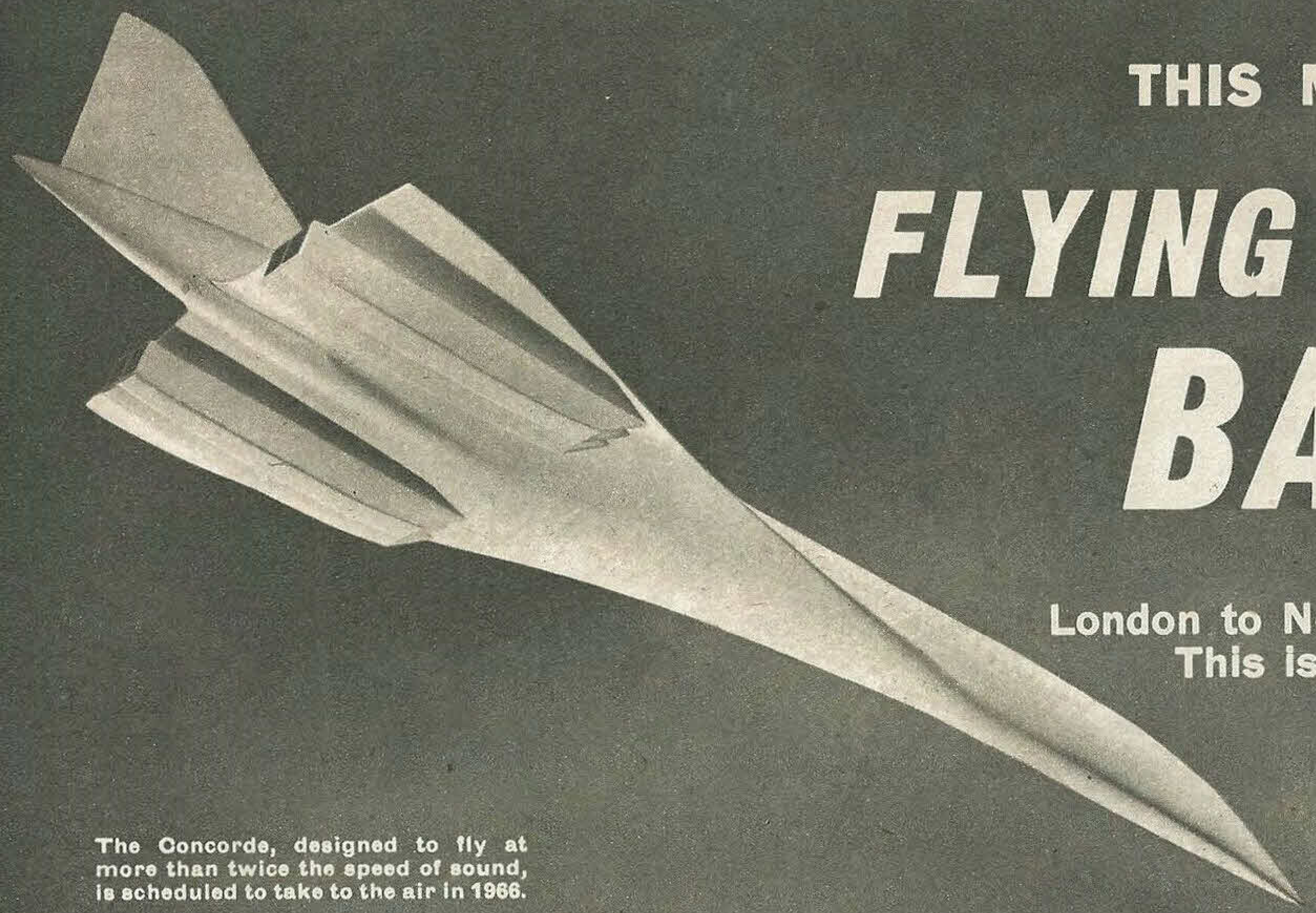
Left: Carnival masks, bands, floats and bright costumes all add to the gaiety and colour of the festival. Above: Thousands of caged birds, bought from stalls outside the temples, are carried in procession to a spot where they are set free. Freeing a bird is really an offering to Buddha, like a sacrifice, for because the Thais are Buddhists they dislike killing animals.

Fish, like the birds, are bought for the ritual and are taken to the rivers to be freed. Giving an animal its freedom, say the Thais, is an act of mercy that brings merit to the person and the community.

THIS MODERN AGE

FLYING WITH A BANG!

London to New York in two hours! This is what you will be able to do when planes bang through the sound barrier at 1,800 miles an hour



The Concorde, designed to fly at more than twice the speed of sound, is scheduled to take to the air in 1966.

FIFTY years ago, the idea of man flying through the air at a hundred miles an hour was really astonishing. Today, people are so used to flying by jet at 600 miles an hour that they are almost bored by the experience.

During such a flight, the ground is hidden from sight by a white blanket of clouds, the plane is free from vibrations, and passengers while away the time by eating pre-cooked meals.

But the air traveller will not be bored in the future. For we are about to enter the "hypersonic" age, when aircraft will hurtle through the skies at speeds two or three times the speed of sound. Hypersonic (from the Greek "hyper," meaning over, and "sonic," meaning sound) planes are not just faster than jet planes; they are a completely new kind of air travel.

The Americans are designing a hypersonic aircraft that will fly at over 1,800 miles an hour, and they are even talking seriously about a "missile" airliner that could make the long journey from London to Tokyo in ninety minutes. It sometimes takes as long as this to travel to London Airport from the capital itself when the roads are jammed with traffic.

Radiation Danger

NEARER home, the British and French are at this moment co-operating in the design and manufacture of the first "hypersonic" airliner. The airliner has the appropriate name of "Concorde"—which means "agreement" or "harmony."

What will the traveller experience in this plane, and what are the problems that face the pilot and engineers as they contemplate speeds two or three times the speed of sound?

The Concorde will fly at 1,400 miles an hour. At this speed the metal can be heated by air friction alone to the temperature of molten lead, and ordinary aluminium alloys used in aircraft can buckle and crack.

This means that the wings and fuselage of the Concorde will have to be made of expensive stainless steels, and will probably have to be artificially cooled.

At 70,000 feet above the earth, the height at which the Concorde will fly, there is the ever-present danger of cosmic radiation. Much of these radioactive rays arise suddenly from violent "flares" or storms on the surface of the sun.

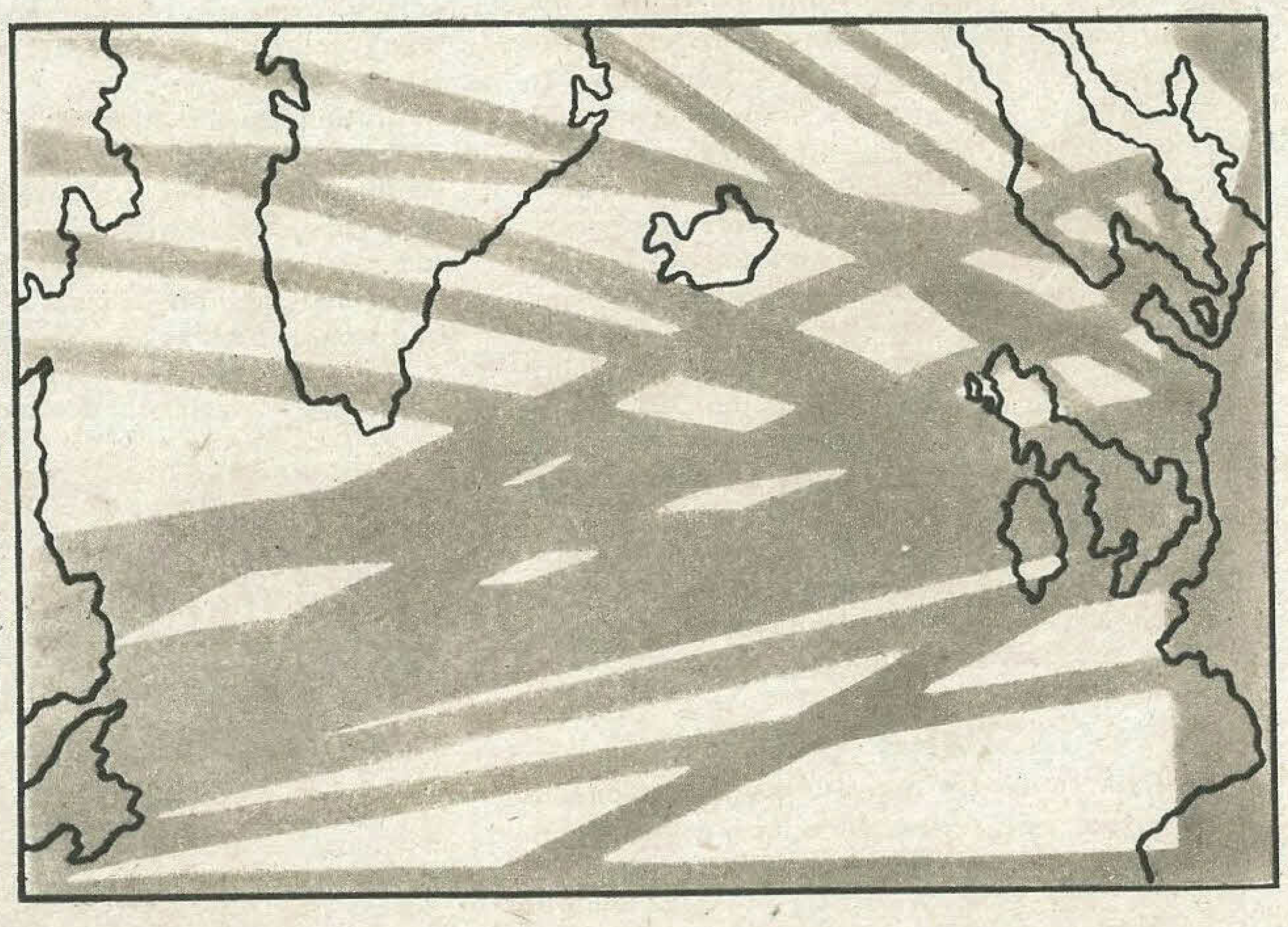
The pilot will have to avoid flying into such radiation, and so he will have to be able to detect it in advance with special instruments.

Should these instruments register a sudden rise in radiation, the pilot will have to reduce his altitude, so that he will be flying in the denser atmosphere that screens the plane from the harmful radiation.

But in doing this the plane might run right into a cloud or rainstorm, an impact which might be rather like running a car straight into a wall. So the plane will also have to carry special weather-detecting instruments on board.

In flight, the Concorde will, of course, pass the "sound barrier," the point at which the plane's speed reaches and passes the speed of sound (at sea level this is about 760 miles an hour, but it rises the higher the plane flies). When this happens, a shock wave or "sonic boom" is produced, which travels continuously down to the ground where it may break windows, wake people from their sleep, and damage property.

Still, the idea of racing the sun is a very exciting one. As New York is five hours behind us in time, in the future we will be able to get up and have breakfast, then nip across to New York Airport by hypersonic plane, drive into New York by car and still be in time to meet friends just getting up to eat *their* early-morning breakfast!



This map shows the "carpet" of sonic booms which would stretch across the world on air routes from the British Isles. The higher the plane flies the more the booms are reduced in intensity by the time they reach the ground. The Concorde is expected to fly high enough so that the boom trails will not cause damage on the ground.

WHY THE BANG?

AS an aircraft moves forward in flight, it pushes the air aside, causing it to flow over the wings and fuselage. The air in front of the aircraft is compressed and pushed out in a pressure wave which travels in front of the aircraft at about 760 miles an hour (the speed of sound at sea-level).

If the aircraft is travelling at a moderate speed, the airflow over its wings and fuselage is comparatively smooth, as shown in Fig. 1. When the aircraft speed approaches that of sound, the air is compressed so quickly that the air strikes the wings and surface of the plane with great force, so that the plane is pushed about by violent air eddies (Fig. 2).

Carefully designed wing shapes do much to reduce the effect of a turbulent airflow. The Concorde's swept-back wings, for example, will slice the air like a knife.

The bang that is heard when the aircraft flies faster than sound is simply the explosion of the air compressed by the aircraft. As the compressed air must expand again, it rushes into the airless space behind the aircraft, and there expands violently and returns to normal pressure. This expansion, causing the bangs, continues as the plane flies through the air. It causes violent blasts which shoot down to the ground like a thunder-clap. By the time a person has heard one blast, the plane has already flown on so the next blast is out of his hearing range.

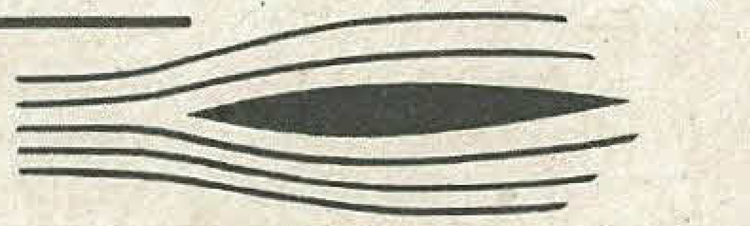


FIGURE 1

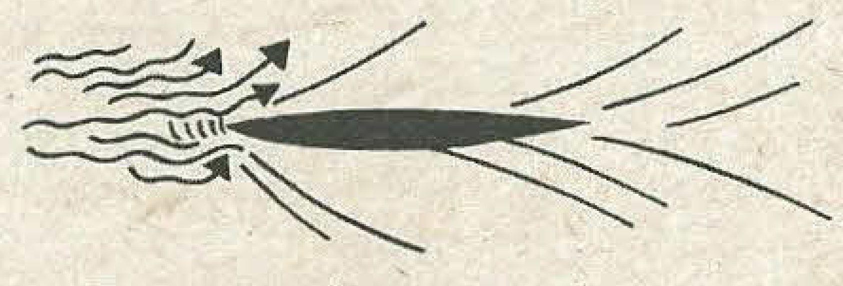


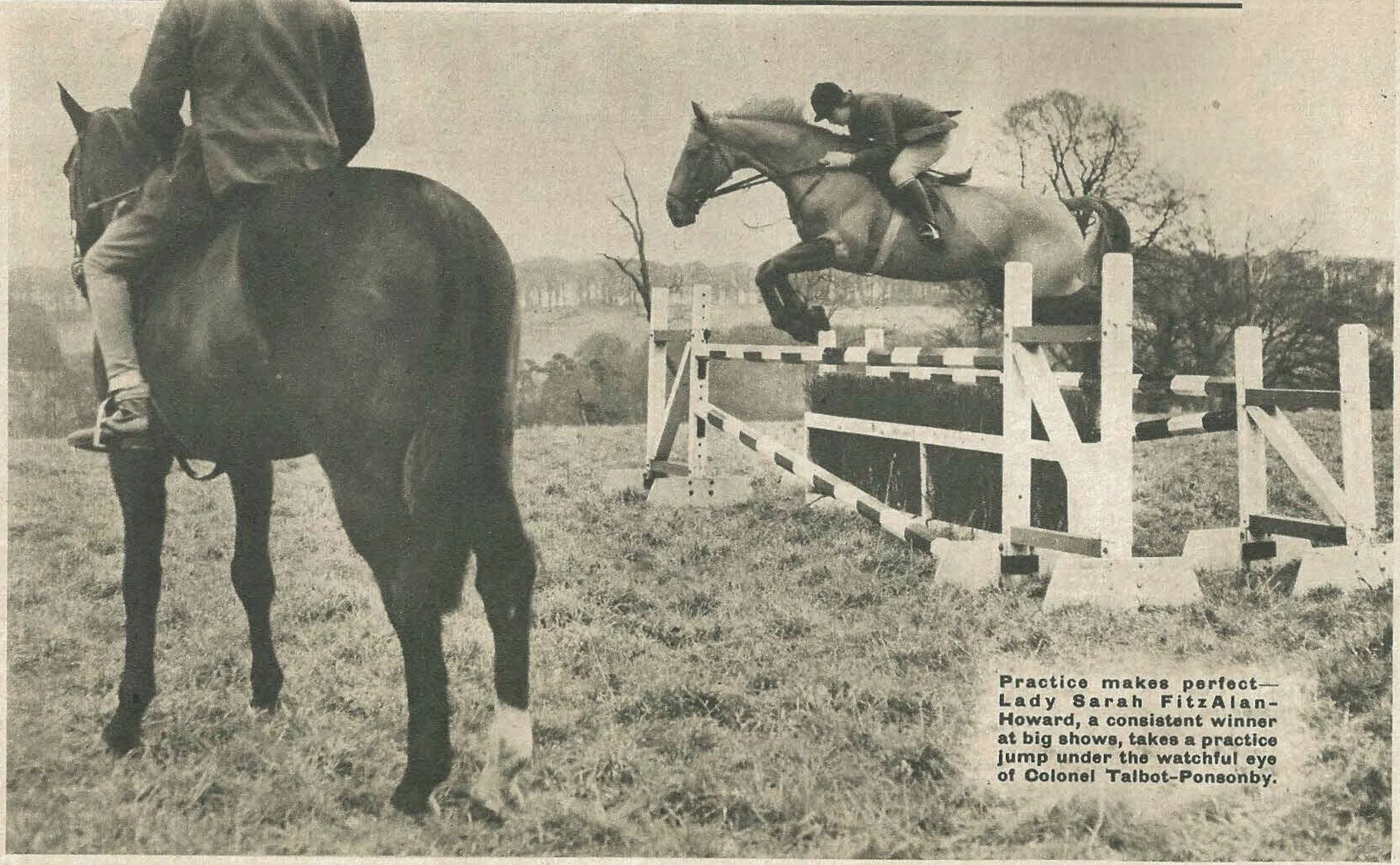
FIGURE 2

THE 'JUMP' TO THE TOP

OUR FRIEND THE HORSE Part 4

by ALAN OLIVER

Britain's International Show Jumper writes specially for Look and Learn



Practice makes perfect—Lady Sarah FitzAlan-Howard, a consistent winner at big shows, takes a practice jump under the watchful eye of Colonel Talbot-Ponsonby.

Could you win a big show prize at the White City? Well, this is the way to set about it

A GREAT number of people say to me, "I envy you tremendously—travelling round to all those shows with your horses all through the summer. What a glorious time you must have!"

Of course, they are right—to a certain extent. But they tend to ignore the work involved. Up before the sun is above the hills, groom the horses, put them in the lorry, load up with tack and hay, then a long drive to wherever that particular day's show is being held.

Then a day's jumping—and the rider is just as tired as his horse after each competition. So back into the lorry, drive home, bed down the horses, water, feed, clean the tack, and you are lucky if you are in bed by eleven. Six hours later, it all begins again.

That is only the day-to-day work. Far more gruelling is the schooling of your jumpers.

Good show-jumpers can be made—but the brilliant ones, well, they must be born with a jumping saddle already on their backs!

Patience and kindness are the two great points to bear in mind when schooling your horse—treat him roughly and he will not forget it. He will go sour on you, and refuse jumps.

Take Off

ONE of the chief objects when schooling a "green" (inexperienced) horse is to teach him obedience to commands given him, and also balance. He must learn to present himself properly at each fence—then he will take off correctly.

A horse must have "impulsion" (that is, a free, forward movement) to jump the width, and if he can jump the width he can jump the height.

So you school your horse, you take him to the local shows, and he does well. He enters for "Foxhunter" competitions (named after Col. Harry Llewellyn's grand old show-jumper), and soon he has won more than £40 in prize money—now he is a Grade C horse, no longer eligible for Foxhunter jumping.

And you go on from strength to strength, and next year, as he gains experience, his total prize money is more than £100—and you have a Grade B jumper.

Your horse has got into his stride: he loves jumping, he accepts you as a partner, and to prove his worth wins consistently at larger and larger shows until the day when he has won £200. Now you have a Grade A horse—one of the best.

"He's worth a thousand pounds of anyone's money," you say proudly, and to back up your point, you enter him for the Royal International Horse Show at White City. Now there is no limit to his ambitions (and yours!).

Your competition is in the evening. The stadium is a blaze of arc lamps, a buzz of conversation. The peat in the collecting ring is soft and springy, your horse senses the tenseness, the excitement, and pricks his ears. The jumps in the ring look as high as Mount Everest.

You watch the people in front of you go round—you see their mistakes, and wonder whether you will come to grief at the same point. Suddenly it is your turn.

You are in the ring, the judges' bell rings, you are on your own. The loudspeakers blare your name—you do not hear them as you canter through the start. Then everything is forgotten. As you jump, you hear the rattle of a pole, and throw a quick glance over your shoulder. It's still there—good! Then you're turning, jumping again, the stile, the brush, triple bars—two to go—a double and the gate.

Your horse comes to the double—he flies it! Only the gate to go, the crowd is cheering—your horse gathers himself for one tremendous leap—and he's over! Clear round!

Back in the collecting ring you dismount, pat his neck, throw a rug over him. There are other clear rounds, and you will have to jump off over higher and fewer fences. Will you do it?

I wonder!

No difficulties here for the famous partnership of Pat Smythe and Scorchin at Hickstead this year.

LOOK AND LEARN

FOCUS on THE ATOM

EVERYTHING in the world, whether alive like animals or plants or "dead" like the pencil and paper you use for your homework, consists of one or more elements.

But although there are millions of materials and things in the world, nature has provided only ninety-two elements from which they can be made.

Some quite common materials consist of only one element. Iron, copper, carbon, lead, gold and silver are examples of one-element materials.

The thousands of other materials which are made up of a mixture of two or more different kinds of elements are called compounds. The air we breathe is a compound because it consists of several different kinds of gas elements. The water we drink is a compound because it consists of two different elements, oxygen and hydrogen.

Eleven of the elements are gases, two (mercury and bromine) are liquids, and all the rest are solids.

All elements, whether solid, liquid or gas, are made up from minute particles called atoms. But the atoms are so small that they cannot be seen through the most powerful of microscopes.

We can only believe that atoms exist because it is only a "something" which scientists call the atom that can explain why some elements act in ways different from other elements and have different effects.

For example, there are elements such as copper which will conduct electricity, but many other elements do not. Then there are the elements like radium which glow in the dark, whereas most elements give out no light at all.

Some elements can be made to release heat and energy. Others are quite "dead."

When detecting and measuring instruments

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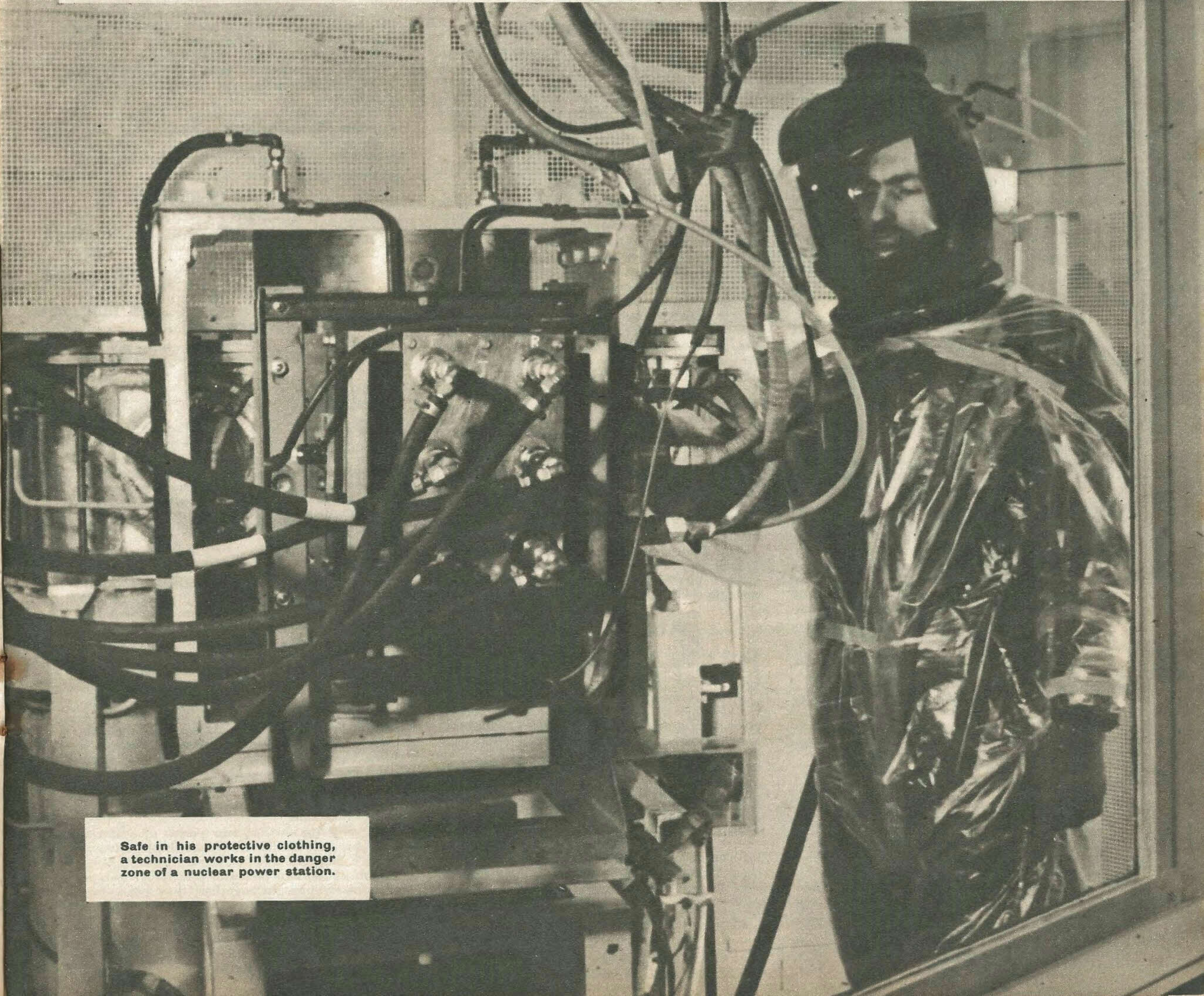

Safe in his protective clothing, a technician works in the danger zone of a nuclear power station.

FOCUS on THE ATOM

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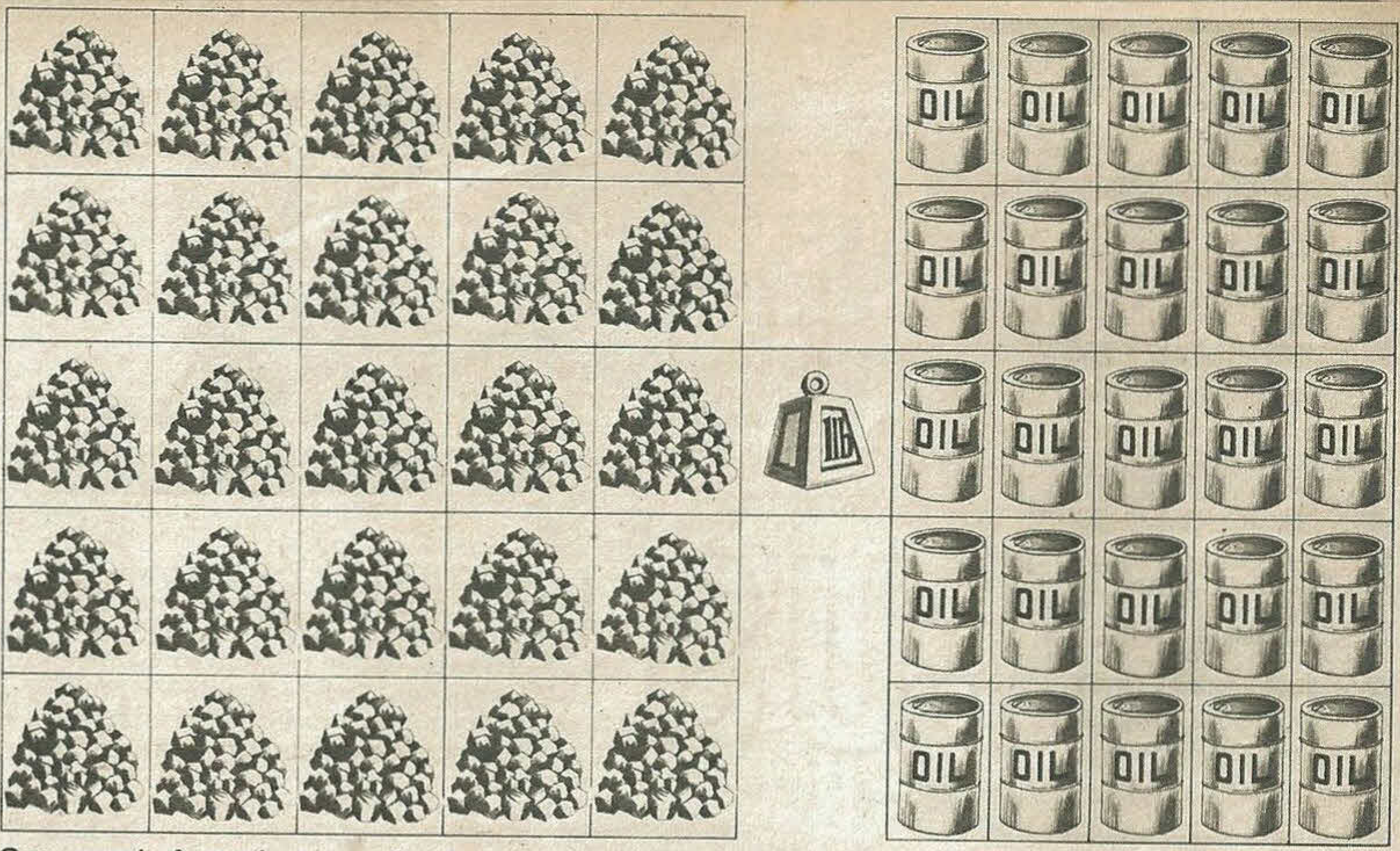


One pound of uranium contains in its atoms the same amount of energy as 2,200 tons of coal or 350,000 gallons of oil. In this drawing, each heap of coal represents 88 tons (a total of 2,200 tons) and each drum represents 14,000 gallons (a total of 350,000 gallons).

are applied to elements, some give one kind of result, others respond quite differently.

Scientists have decided, therefore, that elements must contain some kind of invisible "works" which cause them to act in the many strange ways that they do. And it was to try to explain these "works" that the atomic structure of elements was evolved.

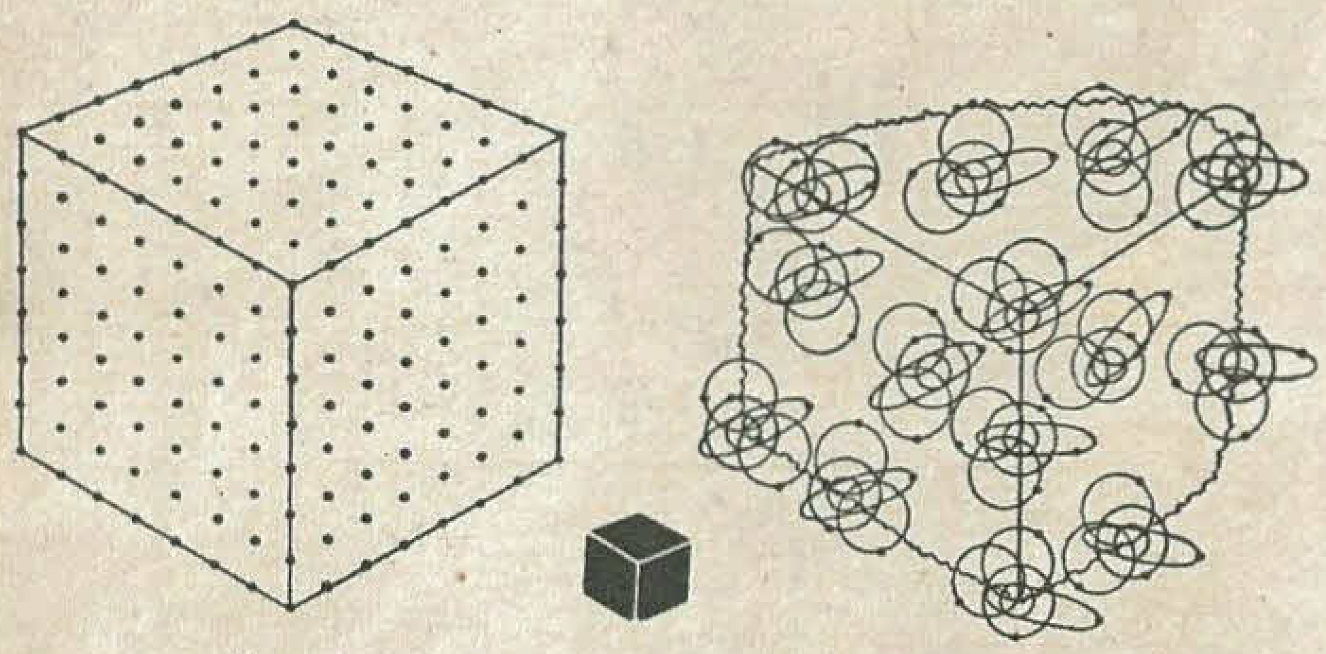
Every element has its own kind of atom. An atom of iron is not a bit like an atom of copper.

When we say "atom" we are using a word that comes from the Greek *atomus*, meaning something so small that it cannot be divided into two parts. When scientists began to study elements, they coined the word "atom" to describe the smallest possible part of an element.

For example: if you kept on dividing and dividing a piece of iron until you could not divide it any more, you would reach a stage when your piece of iron was broken down into its smallest possible portions. You would have separated the iron into its atoms. Yet each atom would still be a particle of pure iron.

Of course, long before your piece of iron had been broken down into atoms, the dividing process would have resulted in specks of iron millions of times too small to be seen through the most powerful of microscopes. But every one of the invisible specks of iron would be made up of millions of iron atoms.

Trying to see a single atom of iron, or an atom of any other element, would be rather like hoping to pick out the shape and size of a single drop of water in the sea while flying in an aeroplane ten miles above the ocean.



Atomizing a cube of iron. In the centre is the cube as seen by the naked eye. On the left, part of it has been magnified millions of times to show its atoms. On the right that part has been magnified many million more times to show how each atom is built up.

At that great height the ocean, provided the air was clear enough for you to see down through it, would be seen as only the result of a great many drops of water having come together. You would never be able to pick out any one of the countless millions of millions of drops of water in only a cubic inch of sea water.

In the same way, when you look at an iron poker you cannot see any single atoms of iron. What you see is a mass of iron atoms so solidly packed together that one atom cannot be distinguished from another atom.

We can only use our imagination to get some idea of the atom's invisible size.

It has been estimated that a single raindrop contains 3,300 million million million atoms.

Let us use our imagination again. This time to get some idea of the fantastically small size of one particular kind of atom—the hydrogen atom.

Hydrogen is a gas, and the lightest of all in weight.

If you had a small box measuring inside one inch wide by one inch long by one inch deep and filled it with hydrogen, your box would contain one cubic inch of hydrogen. That single cubic inch of hydrogen would then contain 880 million, million, million atoms of hydrogen.

Now if the cubic inch of hydrogen, that is the amount of hydrogen in your inch-square box, could be expanded so that it became a cube 8,000 miles long by 8,000 miles deep and 8,000 miles wide, we could see the hydrogen atoms. But each atom of hydrogen would be only eight inches in diameter.

Invisible Machinery

Although the unbelievably small atom is the invisibly smallest part of an element, it is not empty. There are a lot of things inside an atom.

Actually, an atom is a very active bit of invisible "machinery," and its parts are always working. The atoms of some elements have machinery that works much faster than the machinery in the atoms of other elements.

It is these fast-working atoms that can be made to give us atomic energy.

With the exception of the hydrogen atom, which is the most simply "made" of all atoms, an atom consists of three main parts, or particles as they are called. Some atoms have more of these parts than do the atoms of other elements. But, again with the exception of the hydrogen atom, there are always some particles of each kind in the atoms of all elements.

Two kinds of particles are the proton and the neutron. However many of these there may be in the atom of any particular element, they are always at the centre of the atom. Together they make up what is called the atom's nucleus.

Whirling around the nucleus are the third kind of particles. These are called electrons.

If you swing around your head a stone attached to a piece of string held in your hand you will get some idea of what goes on inside an atom.

Your body is then the nucleus of the atom and the whirling stone is an electron. Of course the whirling of an electron inside an atom is millions of times faster than you could ever swing your stone at the end of its string.

The hydrogen atom has the most simple "machinery" of any atom. Its nucleus or centre consists of a single proton around which whirls a single electron.

Atomic Weight

But as we move up from element to element we find the machinery of the atoms of other elements becoming much more complicated.

At the very top of the scale is the atom of a metal element called uranium. It has a nucleus containing ninety-two protons and one hundred and forty-six neutrons. Around this elaborate nucleus there spin ninety-two electrons.

An atom always has the same number of electrons revolving around its nucleus as it has protons in its nucleus.

Adding together the number of protons and neutrons in an atom's nucleus gives us what is called its atomic weight. For example, the 92 protons and the 146 neutrons in the uranium atom found in nature add up to 238; there is also the man-made uranium 235.

The number of electrons whirling round the nucleus of an atom gives that atom what is called its atomic number.

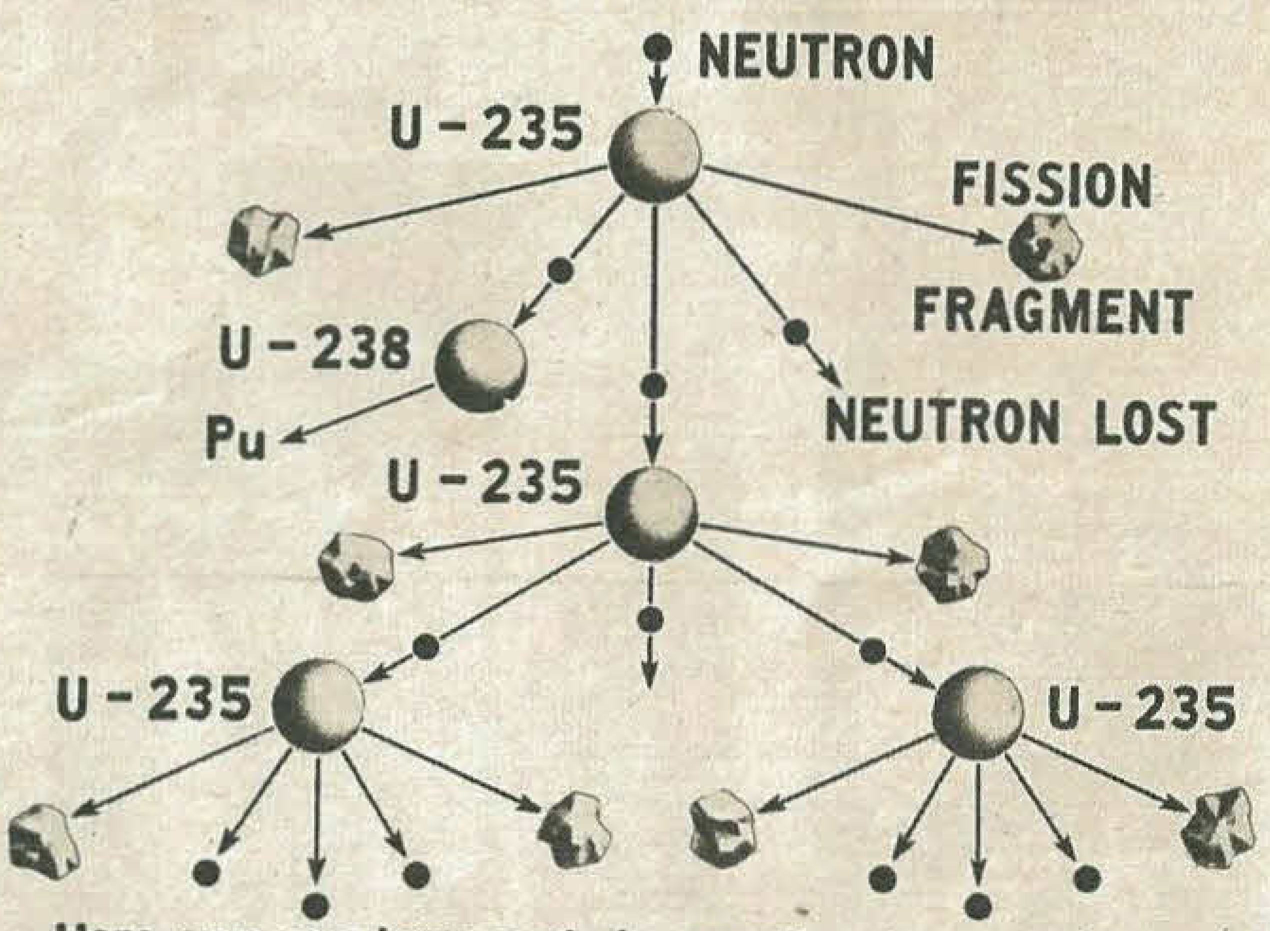
Because the hydrogen atom has only one electron whirling around its nucleus its atomic number is one. But as the uranium atom has ninety-two electrons whirling around its nucleus its atomic number is ninety-two.

We have said that the whirling of the electrons around the nucleus of an atom is rather like swinging around your head a stone attached to a piece of string. If you let go of the string or if it broke, the stone would fly away.

Therefore something must hold the electrons to the atom's nucleus to prevent them from flying away.

What is this holding power? It cannot be a system of microscopic strings.

Electrons are kept swinging around the atom's nucleus by means of something called electrical repulsion and electrical attraction.



Here you see how a chain reaction is caused when a neutron strikes the nucleus of a uranium atom called 235. The chain reaction also produces another kind of uranium atom (238) and an atom of an element called plutonium (Pu).

Repulsion means some force that pushes or repels anything away from it, and attraction is a force that pulls or attracts anything towards it.

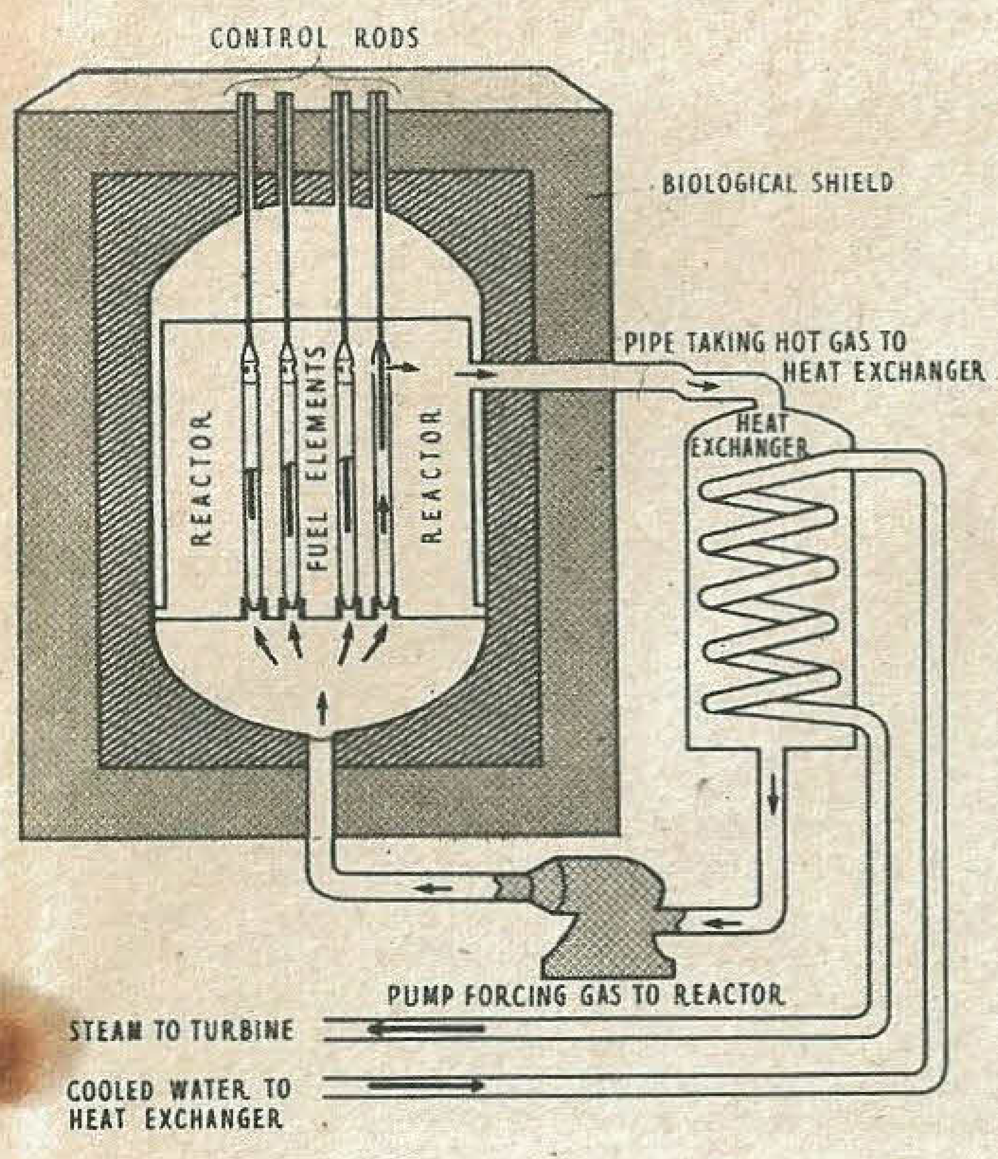
These two forces are part of the nature of electricity. This is because there are two kinds of electricity—negative and positive.

If you look at a torch battery you will see at each end a brass strip. The strip at one end is marked with a cross or plus (+) sign and is called the positive terminal and gives what is called positive electricity. The strip at the other end of the battery is marked with a straight line or minus sign (−) and is called the negative terminal because it gives what is called negative electricity.

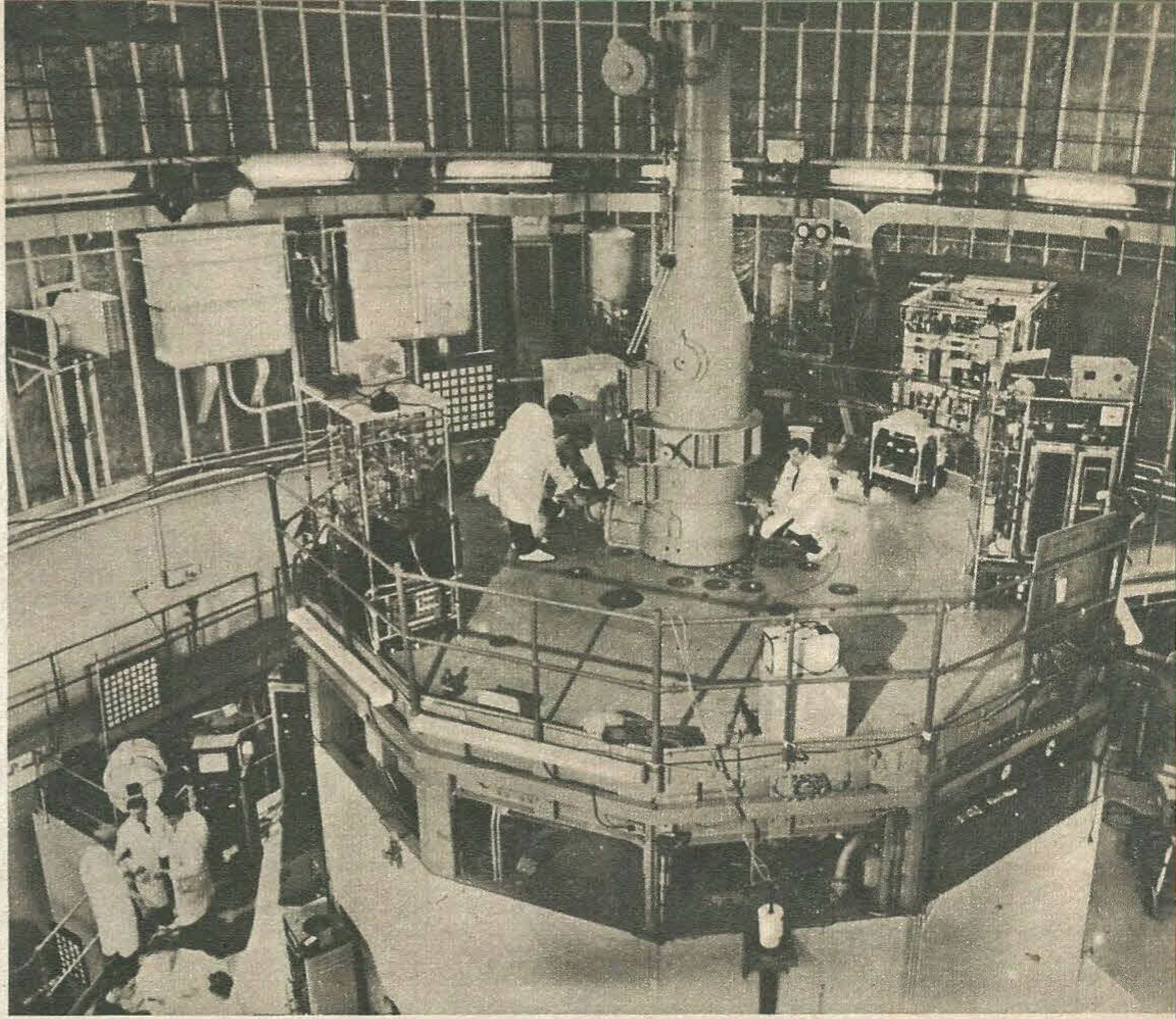
A very strange thing about electricity is that certain materials can be electrified with positive or negative electric charges according to the kind of material.

Let us suppose that two pieces of material have been electrified so that both have a positive charge.

Then, if the two pieces of positively charged material are brought together, they both start pushing away from each other. Exactly the



◀ This diagram shows how gas is pumped through a reactor to be heated and then goes to a heat exchanger where it turns water into steam for a turbine. The control rods govern the heat in the reactor which is surrounded by a biological shield to protect against radiation.



Technicians fitting ▶ the core which will carry the fuel rods generating heat in the reactor of an atomic power-station. The photograph was taken before the reactor became "live."

same thing happens when two pieces of negatively charged material are brought close to each other.

This pushing away is called electrical repulsion.

Next suppose that a piece of material has been given a positive charge and another piece of material has been given a negative charge. When these two pieces of material are brought close together, one draws the other towards it.

This drawing towards each other of the pieces of differently charged materials is called electrical attraction.

Physicists, as the scientists who study atoms are called, have discovered that electrons are tiny particles of negative electricity. They have also discovered that protons are tiny particles of positive electricity.

Neutrons, which with the protons form the nucleus of the atom, do not have any electrical charge at all. That is why the neutron gets its name. Neutron means neutral because the neutron takes a neutral part and does not take sides in the electrical activity of the atom.

The Pushing Proton

It is because unlike electrical charges attract each other and like electrical charges repel each other that electrons can keep whirling around the nucleus of an atom without flying off. Electrons all have negative charges, so they repel or push away other electrons.

In the same way, all protons have positive charges, therefore they push away or repel each other.

Then, because protons have opposite electrical charges to those of electrons there is a certain electrical attraction between the two.

But as the negatively charged electrons are moving at speeds of millions of miles an hour, they travel too fast to be attracted into the nucleus by its negatively charged protons.

The reason why the electrons keep on travelling so fast is that they are all the time trying to get away from each other. But they cannot go very far in a direct line because of the attracting or pulling power of the positively charged protons.

'Dead' Atoms

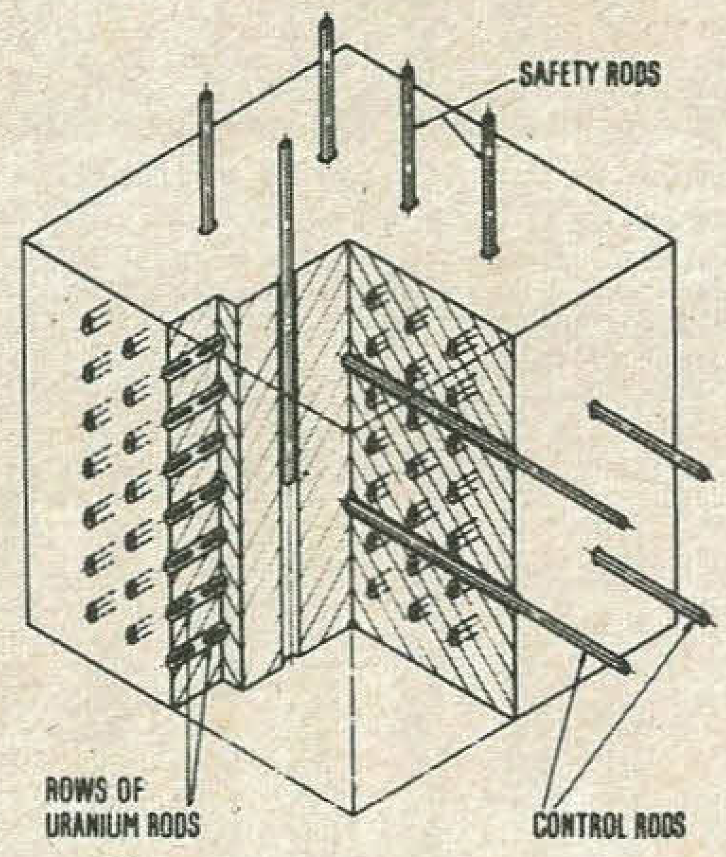
So all that the unfortunate electrons can do is to keep on running around the nucleus.

The positive charge on a proton has the same electrical value or strength as the negative charge on an electron. Also, the atom has the same number of electrons whirling round the nucleus as there are protons in the nucleus.

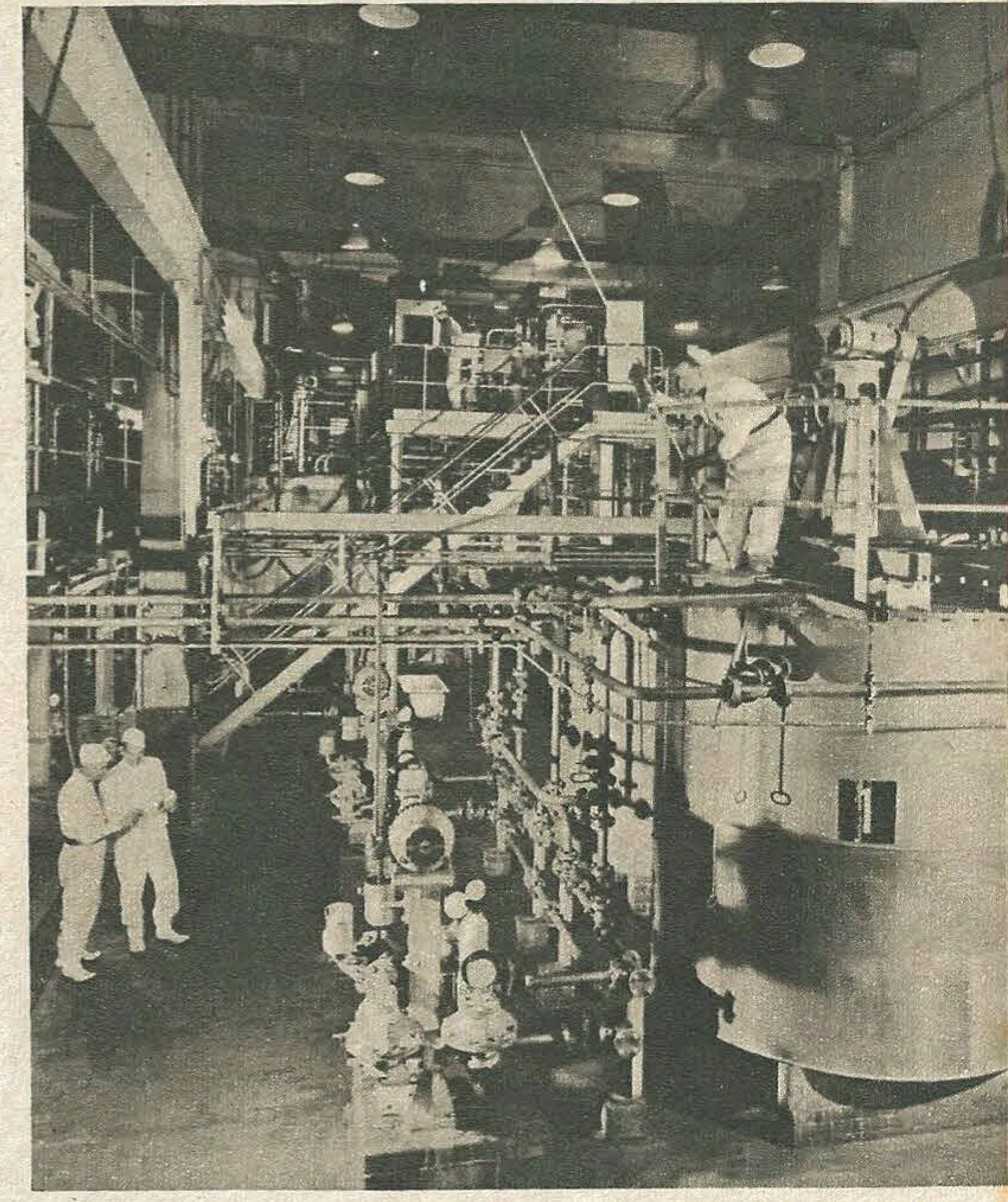
This means that there is an even balance between the amount of electricity in the total number of electrons and the amount of electricity in the total number of protons.

In other words, when an atom has the same number of protons as it has electrons it is quite dead from the electrical point of view. But the protons and electrons still have their charges, although these have no effect outside the atom itself.

CONTINUED ON PAGE SIX

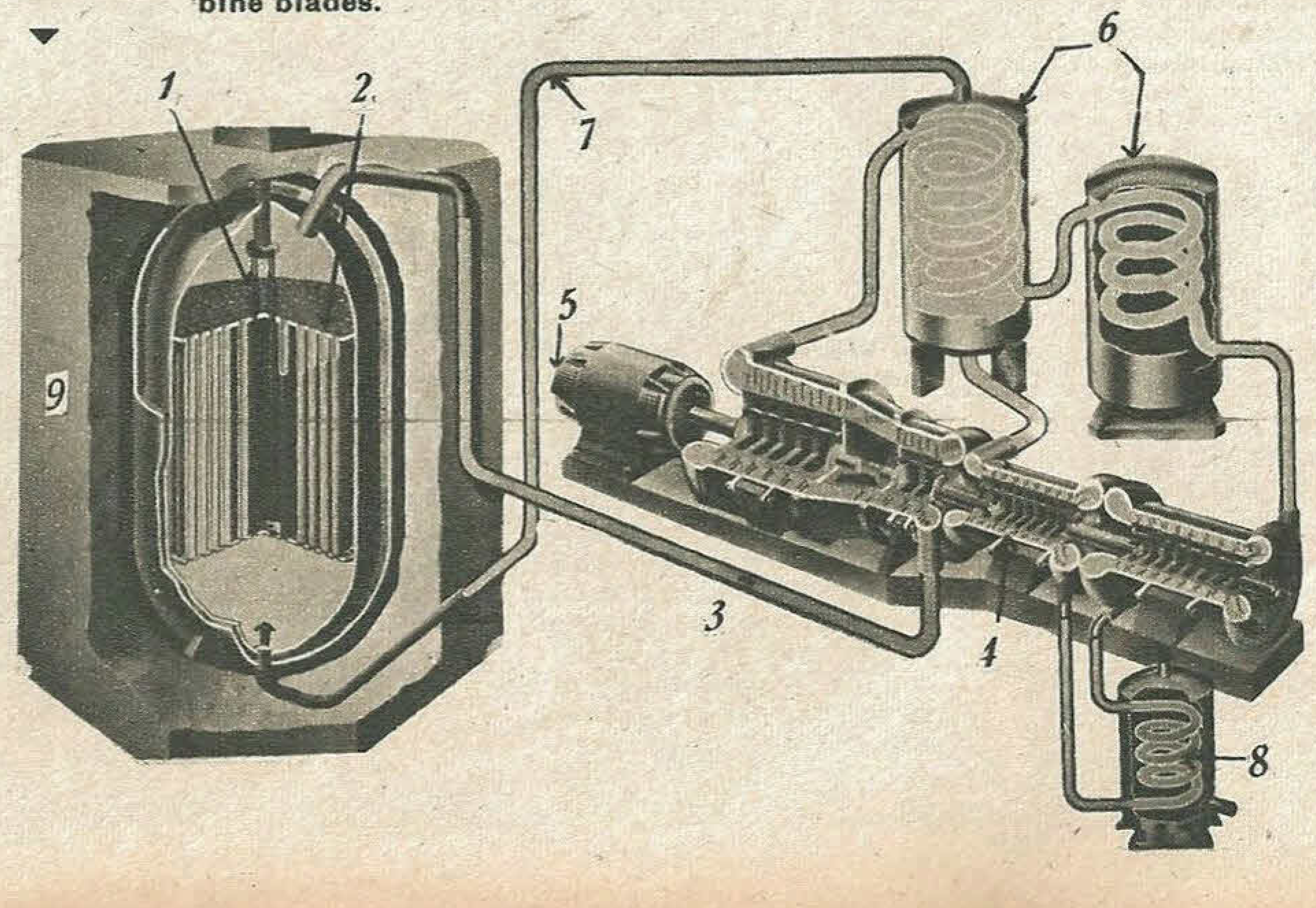


▲ How the control rods are fitted in the core of a reactor to govern the heat generated by the splitting atoms of uranium. The safety rods on top are used only in emergency if the reactor "runs away" and has to be shut down.



These nuclear scientists are wearing special clothing to protect them from deadly radiation while working near a reactor. ▶

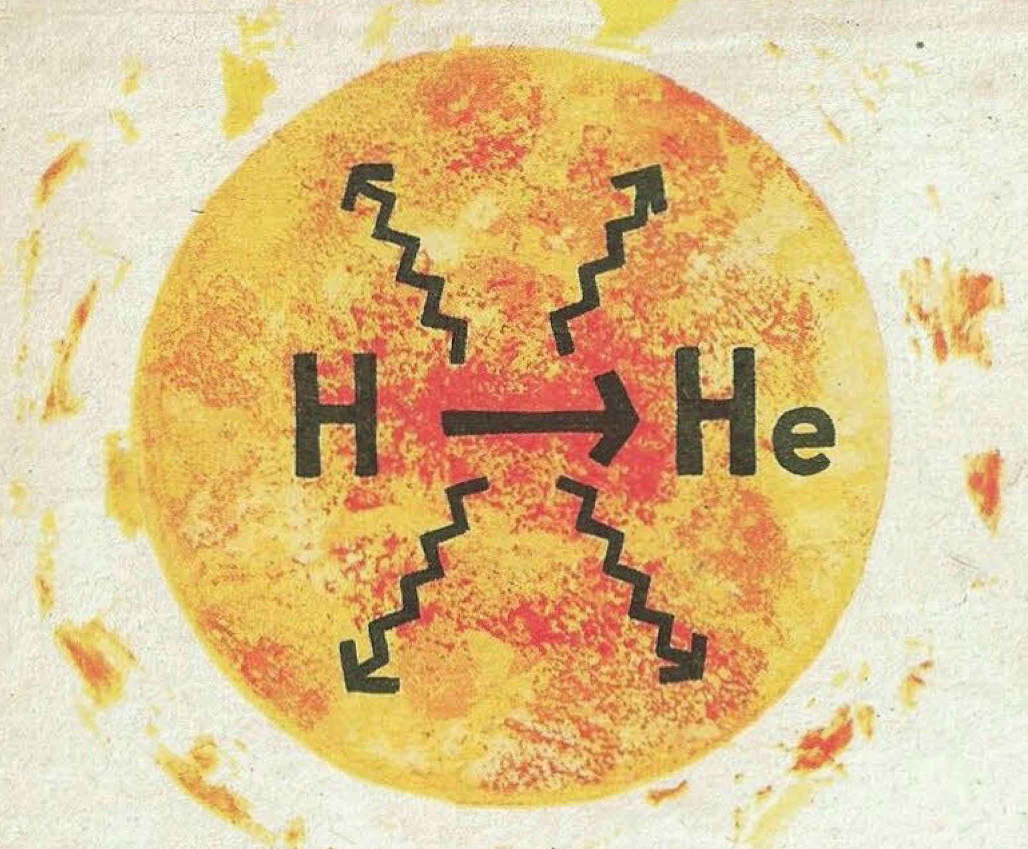
In some atomic power-stations the gas heated in the reactor is not used to turn water into steam. Instead the gas drives the turbines. This can be done because when gas is heated it expands and is made to push against the turbine blades. ▼



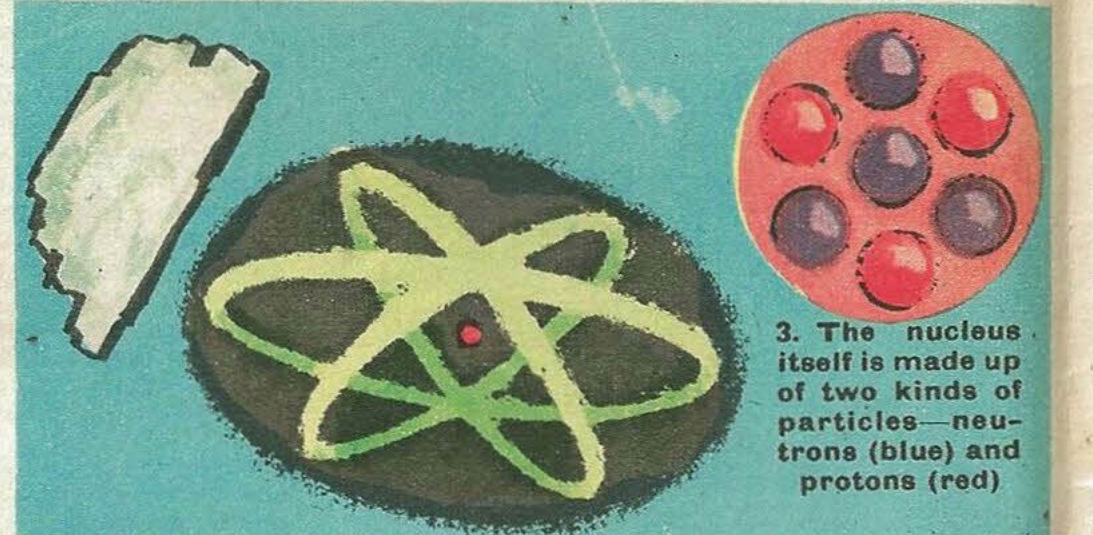
KEY

1. Control rod
2. Uranium fuel.
3. Hot gas going to turbine.
4. Turbine blades.
5. Dynamo driven by turbine.
6. Heat exchangers.
7. Cooled gas returning to reactor.
8. Heat exchanger cooling gas from turbine.
9. Protective shield surrounding reactor.

LOOK and LEARN ★ Focus on THE ATOM

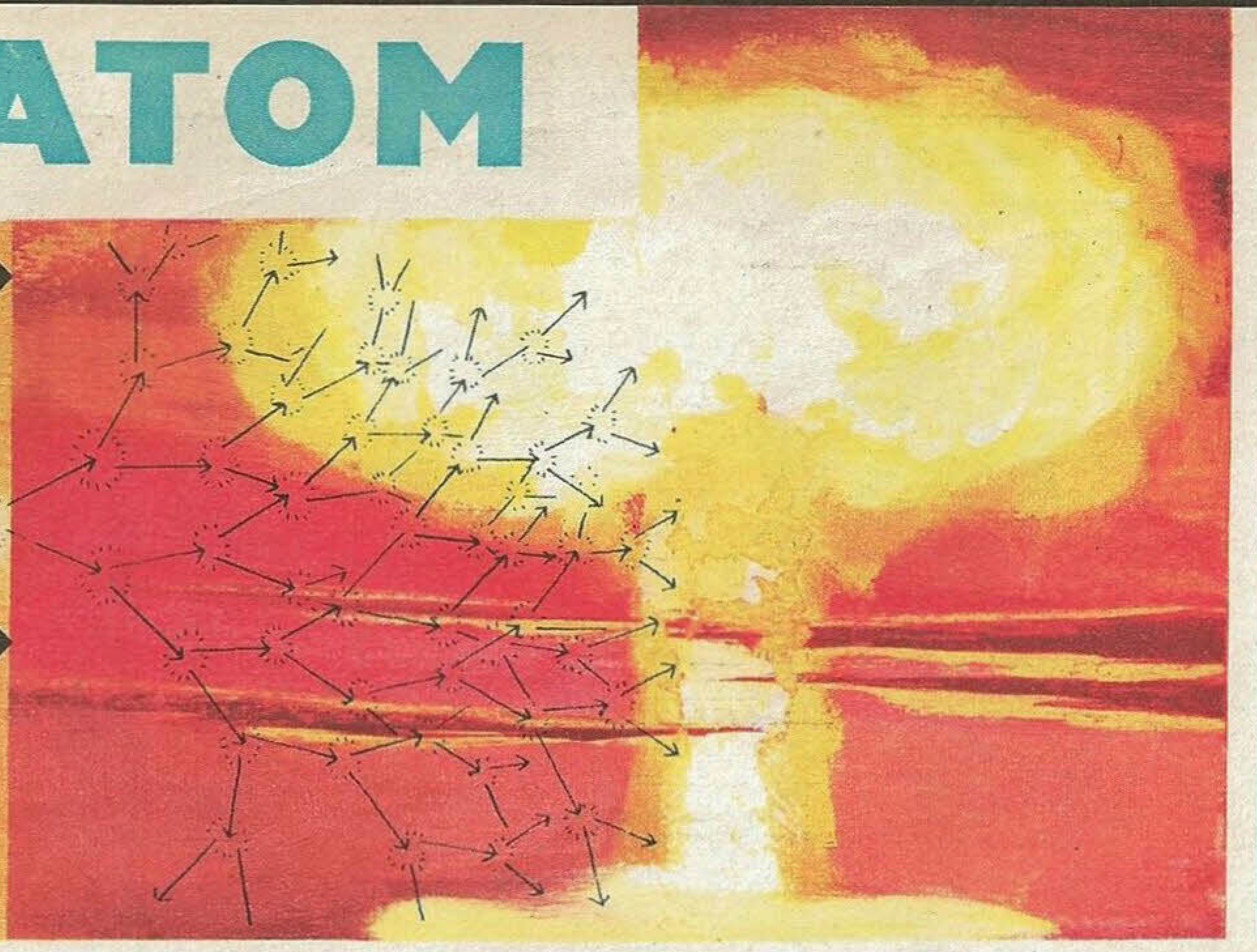


1. Although it is only within the last twenty years that man has been able to harness the atom, he and all other living things on the earth have been kept alive by atomic energy ever since life began. For the warmth and light that sustain life are simply forms of energy radiated by the sun. The sun is a vast nuclear reactor that instead of splitting atoms to release energy, joins them together. This process is called atomic or nuclear "fusion." The diagram (left) shows you what happens to atoms in the sun. At the tremendous temperatures existing in the sun, atoms of hydrogen fuse to form another gas, helium. When this happens, a small proportion of matter is left over (as explained in this supplement) and turned into energy. This energy we receive on earth as light and warmth.



3. The nucleus itself is made up of two kinds of particles—neutrons (blue) and protons (red)

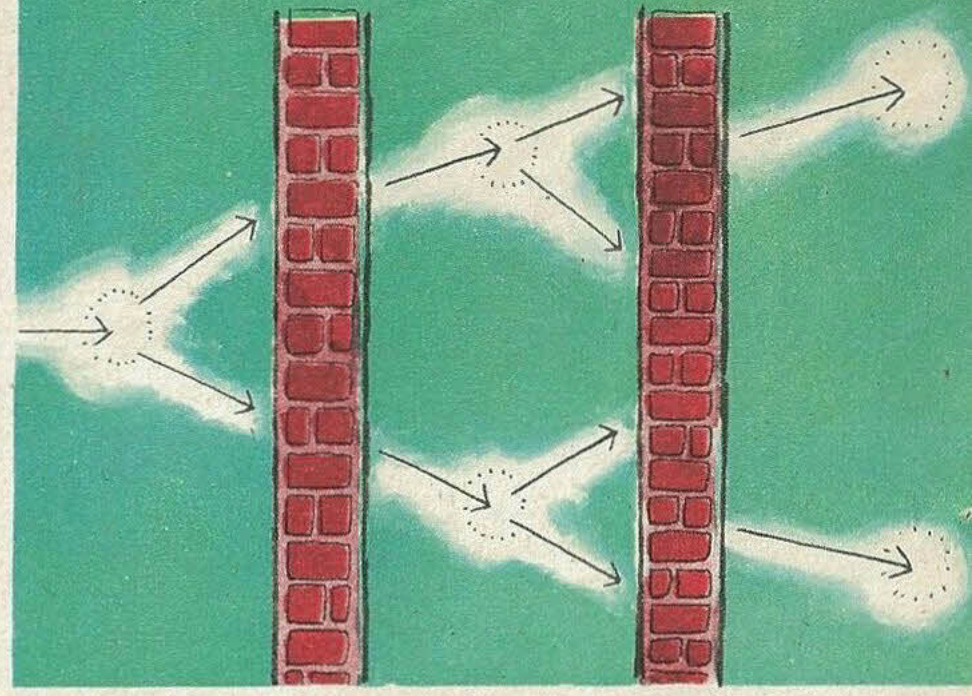
2. An atom is far too small to be seen through even the most powerful microscope. But the drawing above shows you what scientists believe it must look like. In the centre of the atom is the nucleus, and whirling around the nucleus at incredible speeds are the "electrons," tiny particles of energy. The electrons travel in paths or orbits, shown here by the curved lines.



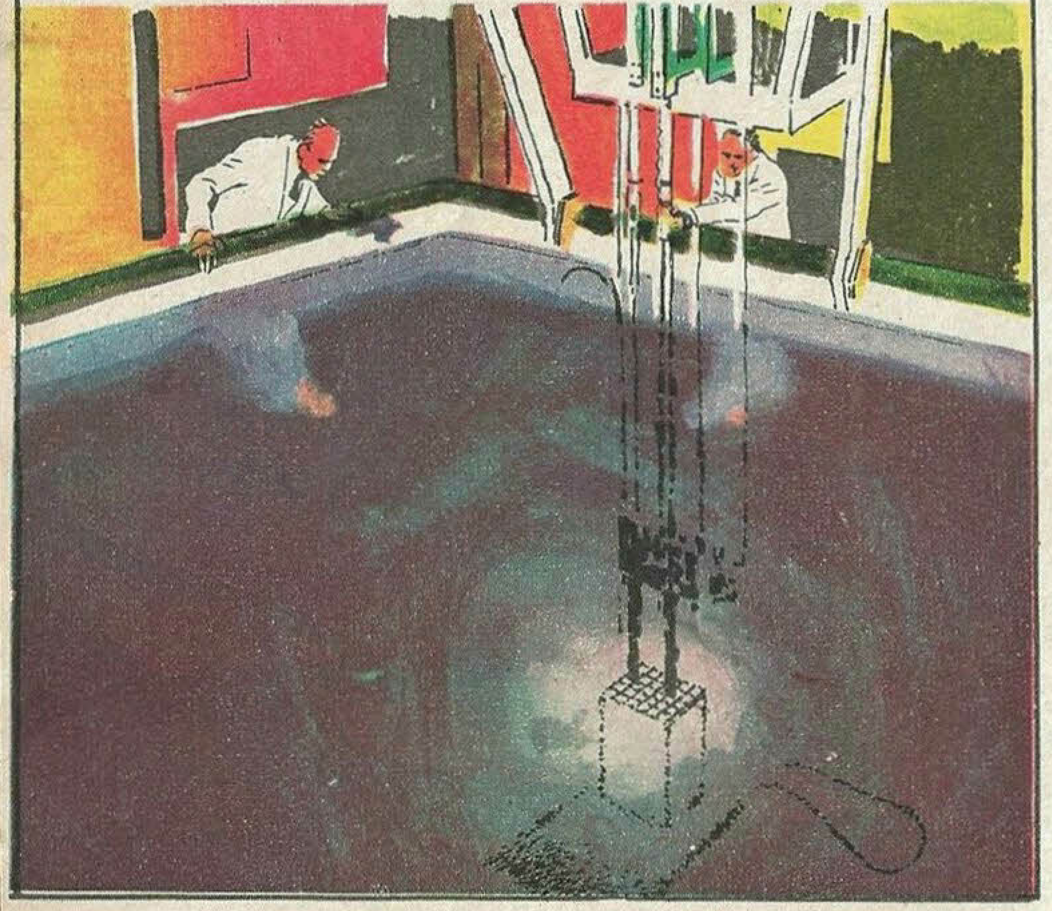
4. It occurred to scientists that if the nucleus of an atom could be split by knocking out a neutron, energy would be released.

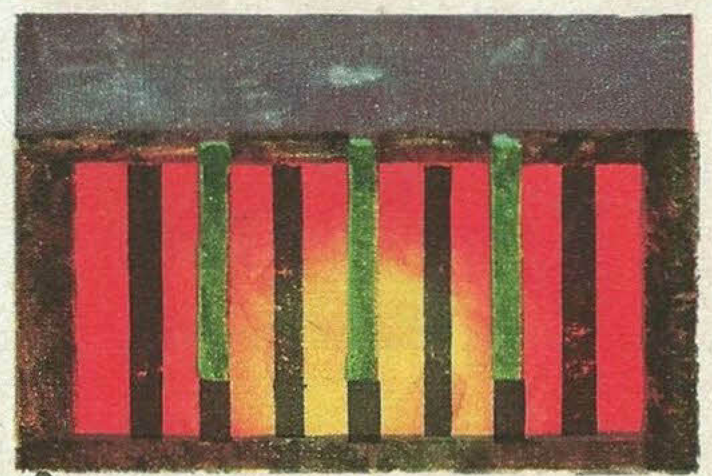
5. As explained in this supplement, the atom can be split by firing against its nucleus another neutron. This in turn releases other neutrons, which in their turn split other nuclei. This process is called "nuclear fission."

6. The continuous splitting of atoms in nuclear fission is called a "chain reaction," and this reaction must proceed at a controlled rate. So a kind of sieve of metals stops too many neutrons striking too many nuclei.

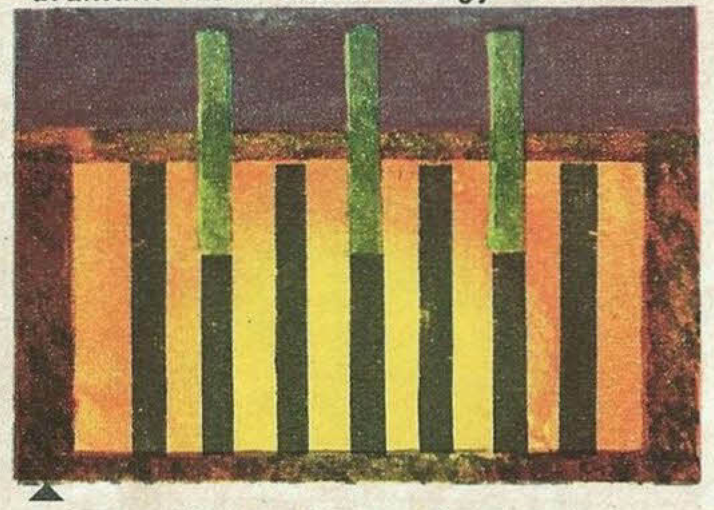


7. Below you see one of the first reactors ever built to release the energy of the uranium atom, which is the heaviest of all the atoms. The reactor is in a tank of water to keep it cool, and the technician in the centre of the picture is adjusting cadmium rods that control the chain reaction. This is explained in this supplement.

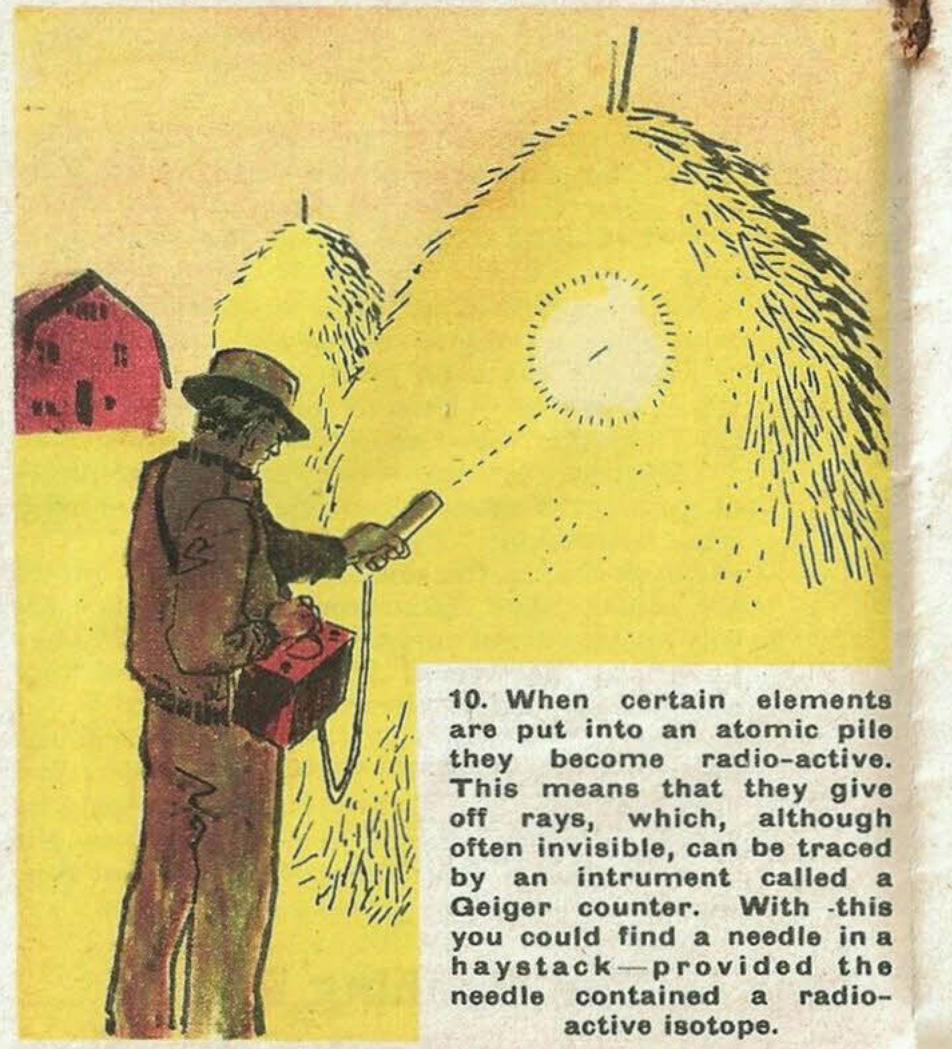




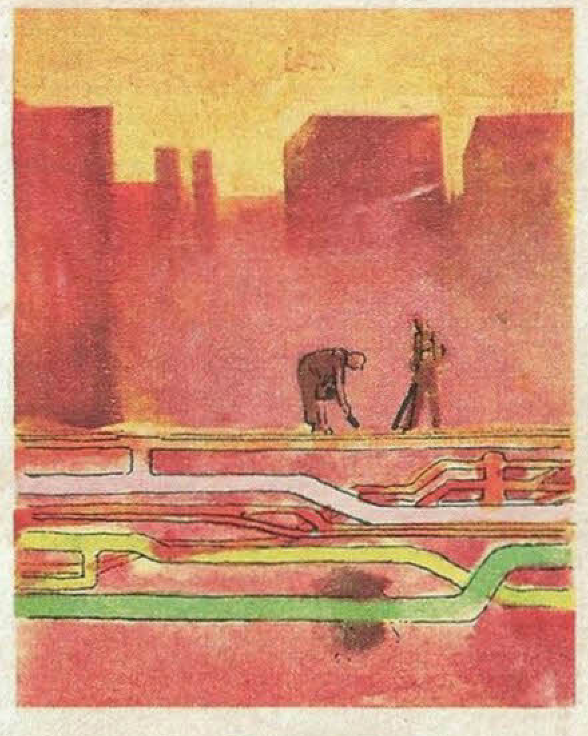
8. Here is the heart of a reactor, called the atomic pile. It consists of a supply of uranium from which energy is released.



9. When the rods are raised or pulled out, more neutrons can strike against more uranium atoms, and the chain reaction is speeded up.

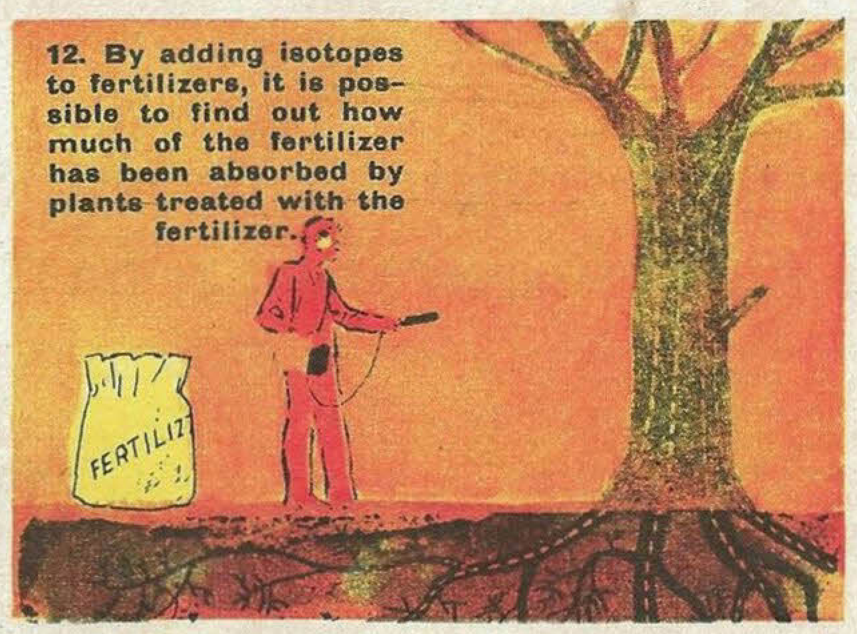


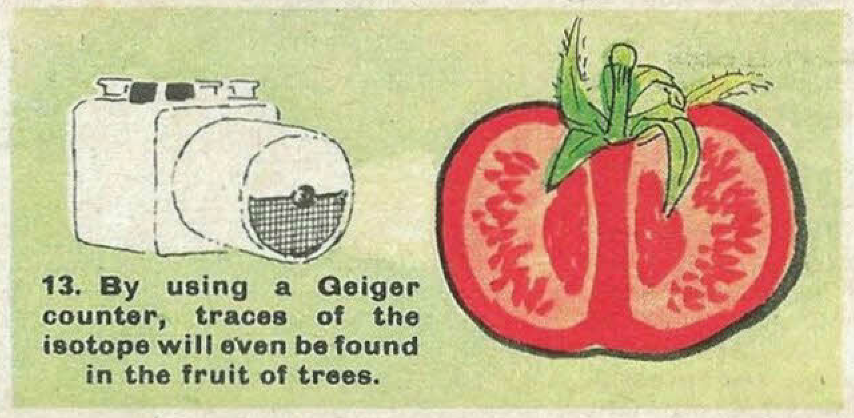
10. When certain elements are put into an atomic pile they become radio-active. This means that they give off rays, which, although often invisible, can be traced by an intrument called a Geiger counter. With this you could find a needle in a haystack—provided the needle contained a radio-active isotope.



11. Here you see how an isotope would show the exact position of a leak in a water pipe buried deep under the ground. The isotope is put into the water at the beginning of the pipe and then travels through the pipe with the water. When the water reaches the leak in the pipe, the radiation is picked up by a Geiger counter.

12. By adding isotopes to fertilizers, it is possible to find out how much of the fertilizer has been absorbed by plants treated with the fertilizer.

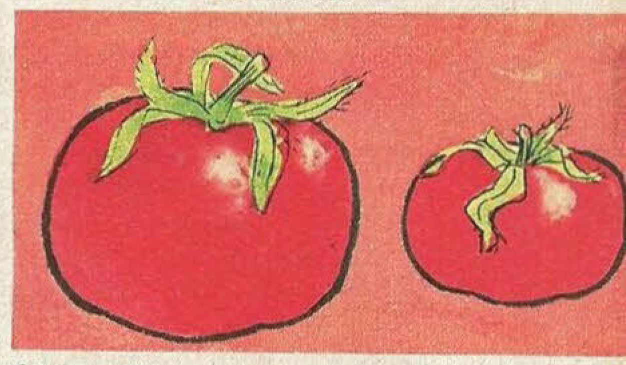




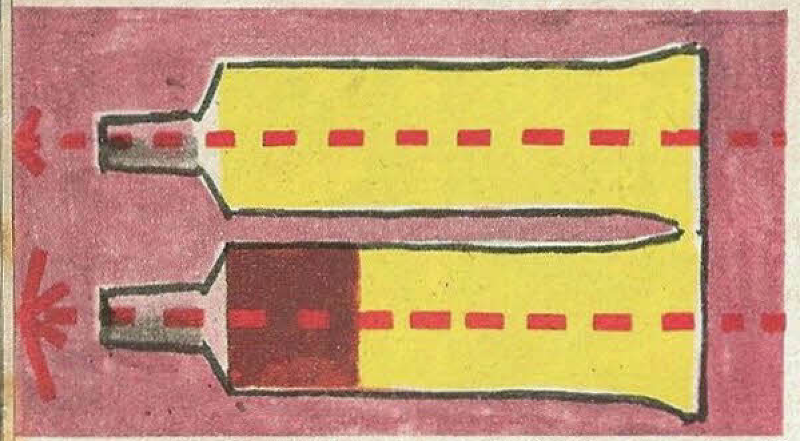
13. By using a Geiger counter, traces of the isotope will even be found in the fruit of trees.

(Above and below)
14. If pebbles are treated with isotopes, and thrown into the sea, the movement of tides can be traced.

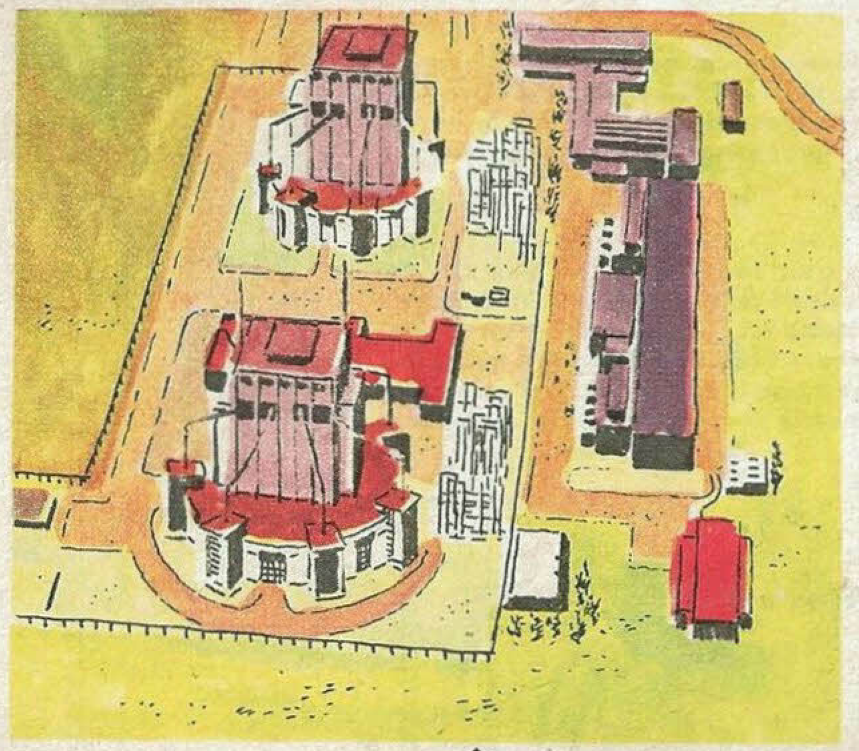
15. Historians are able to tell the age of old objects by their radio-active strength of the carbon found in them.



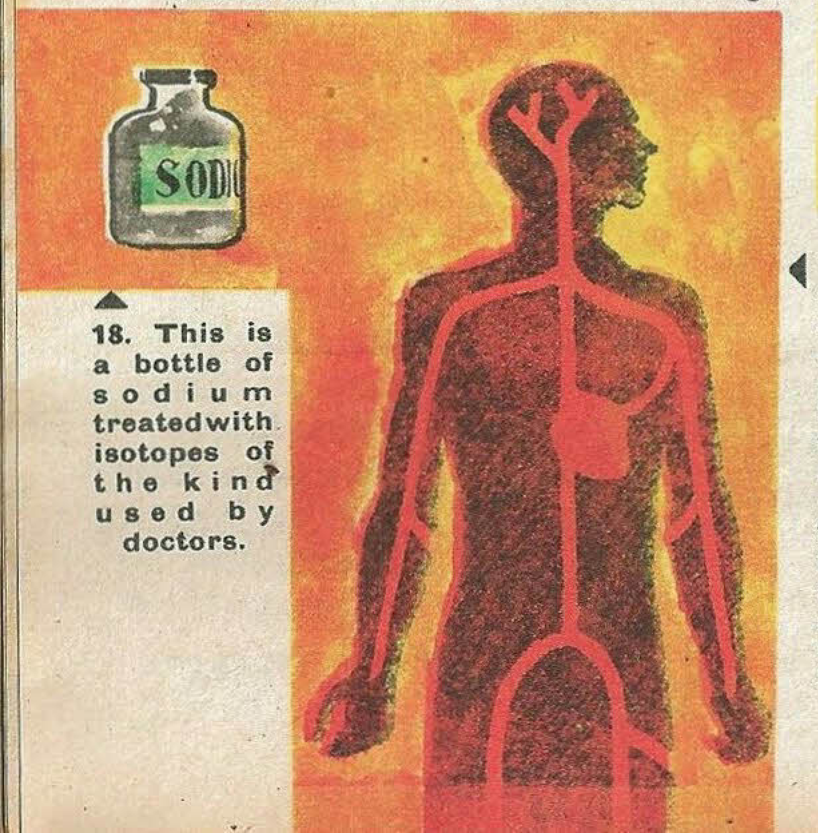
16. Radiation from certain isotopes is used to keep tomatoes and other food fresh.



17. Radiation from isotopes can "see" into containers like toothpaste tubes. If the tube is full no radiation shows through.

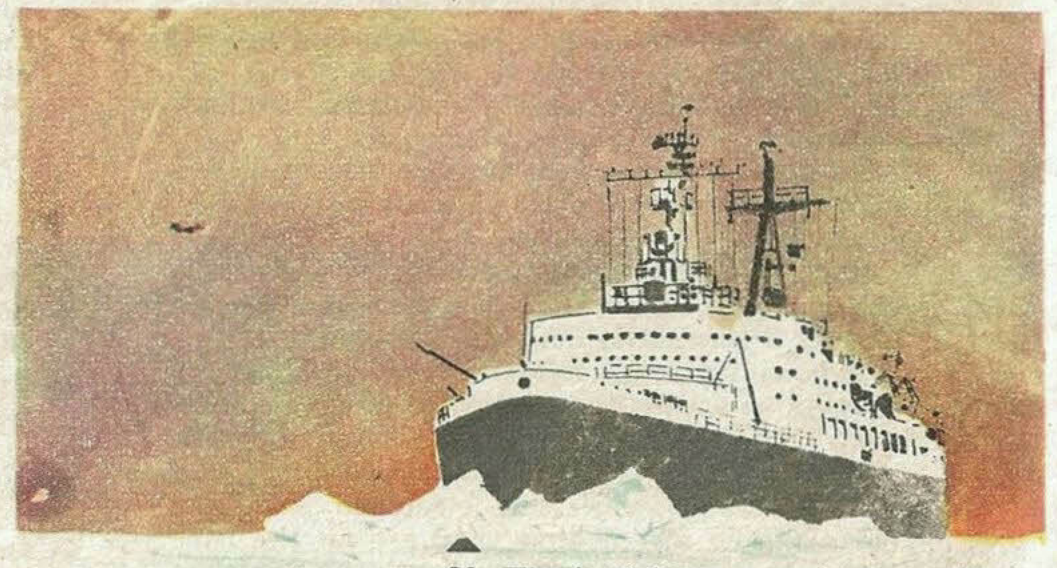


20. Here you see an atomic power station. Its heart is the reactor; a kind of atomic furnace which works in the manner shown in picture 24.



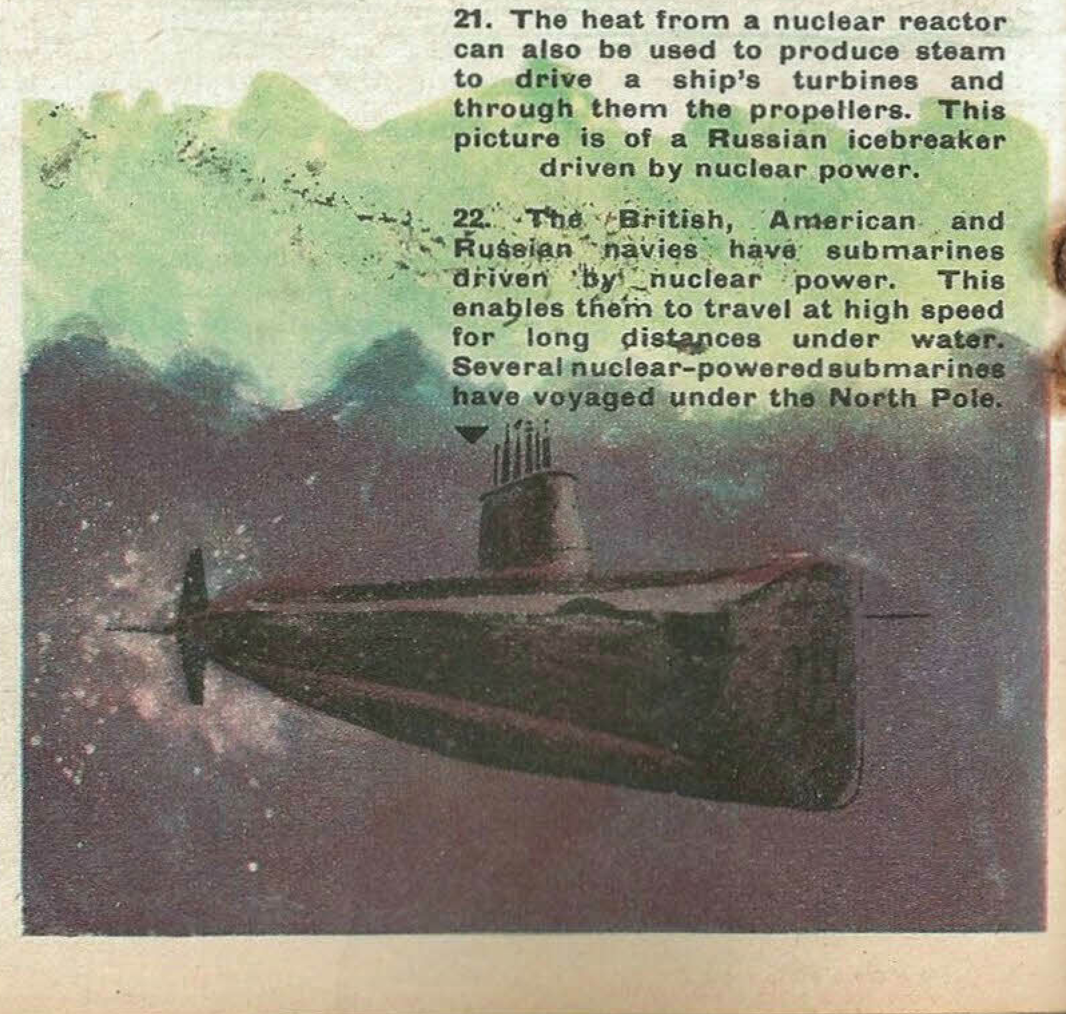
18. This is a bottle of sodium treated with isotopes of the kind used by doctors.

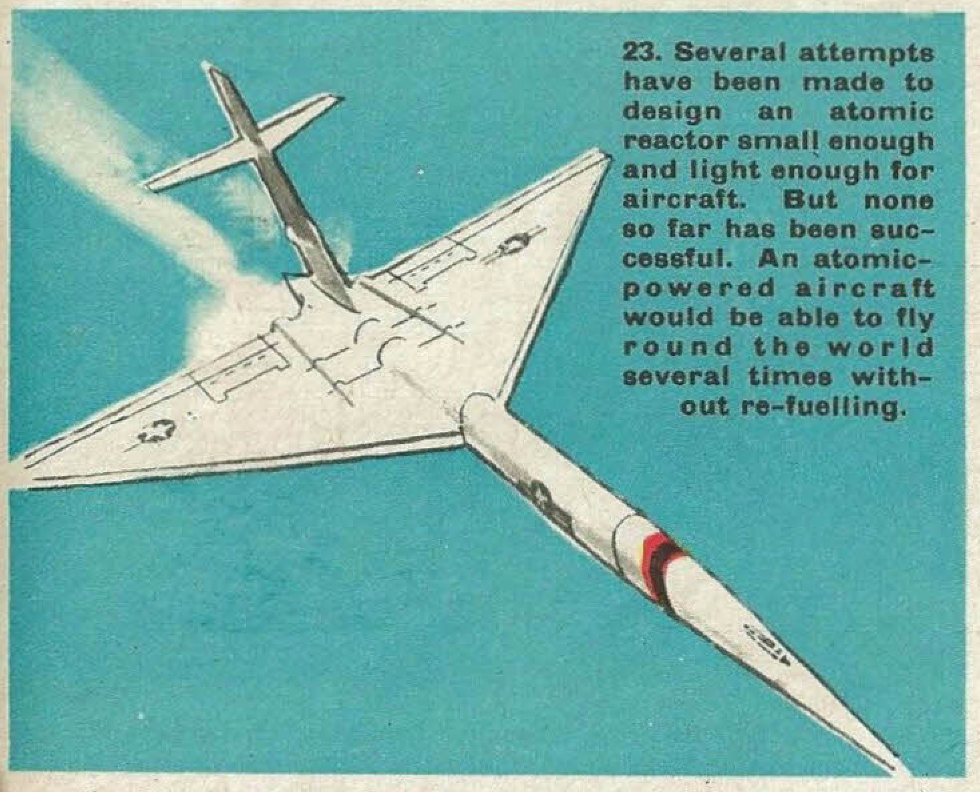
19. When radio-active sodium is injected into a patient's vein, a Geiger counter can follow the path of the sodium as it is carried by the blood to all parts of the body. Any change in the rhythm of the radiation from the isotope during its journey through the body warns the doctor of some disease or other ailment. Isotopes used in this way are quite harmless.



21. The heat from a nuclear reactor can also be used to produce steam to drive a ship's turbines and through them the propellers. This picture is of a Russian icebreaker driven by nuclear power.

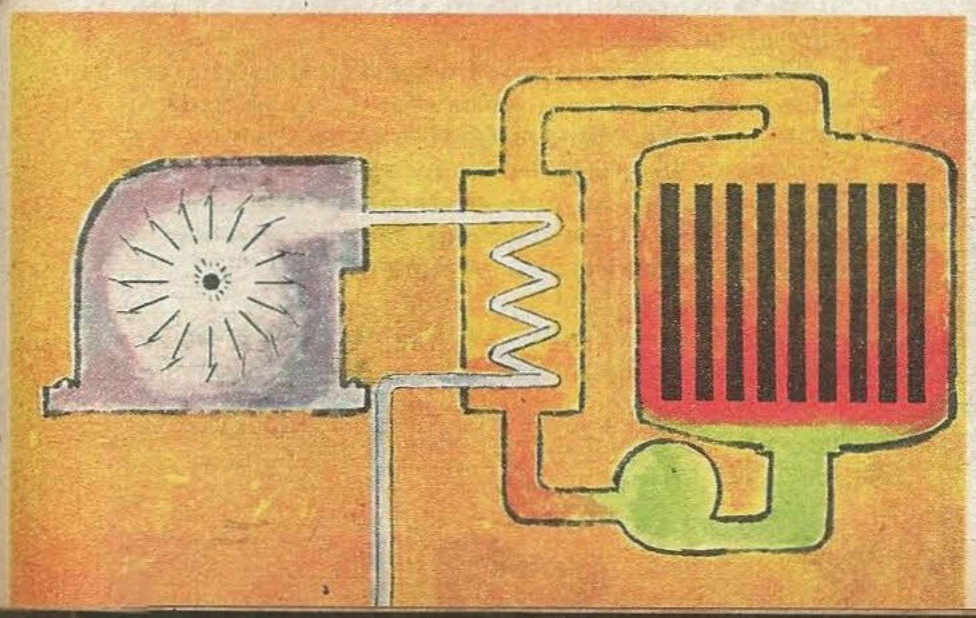
22. The British, American and Russian navies have submarines driven by nuclear power. This enables them to travel at high speed for long distances under water. Several nuclear-powered submarines have voyaged under the North Pole.

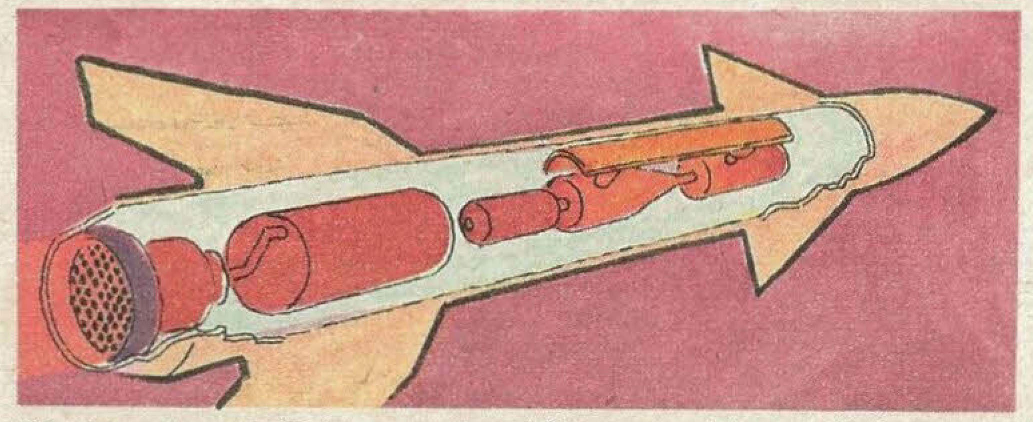




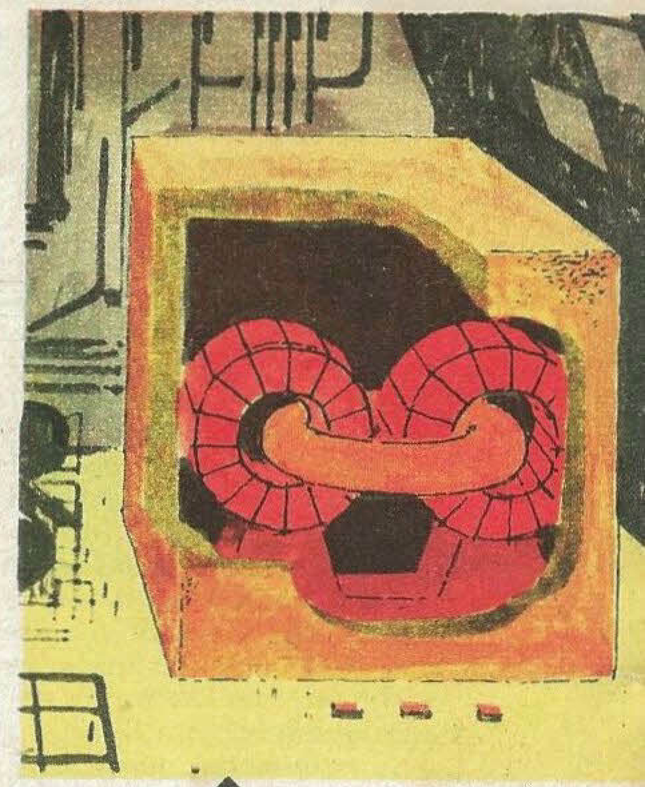
23. Several attempts have been made to design an atomic reactor small enough and light enough for aircraft. But none so far has been successful. An atomic-powered aircraft would be able to fly round the world several times without re-fuelling.

24. This is how an atomic furnace works. The heat produced by the splitting of the atoms in the reactor (right) is transferred to water flowing through the tube (centre). This water is turned into steam and the steam then drives turbines which in turn drive alternators that generate electricity.

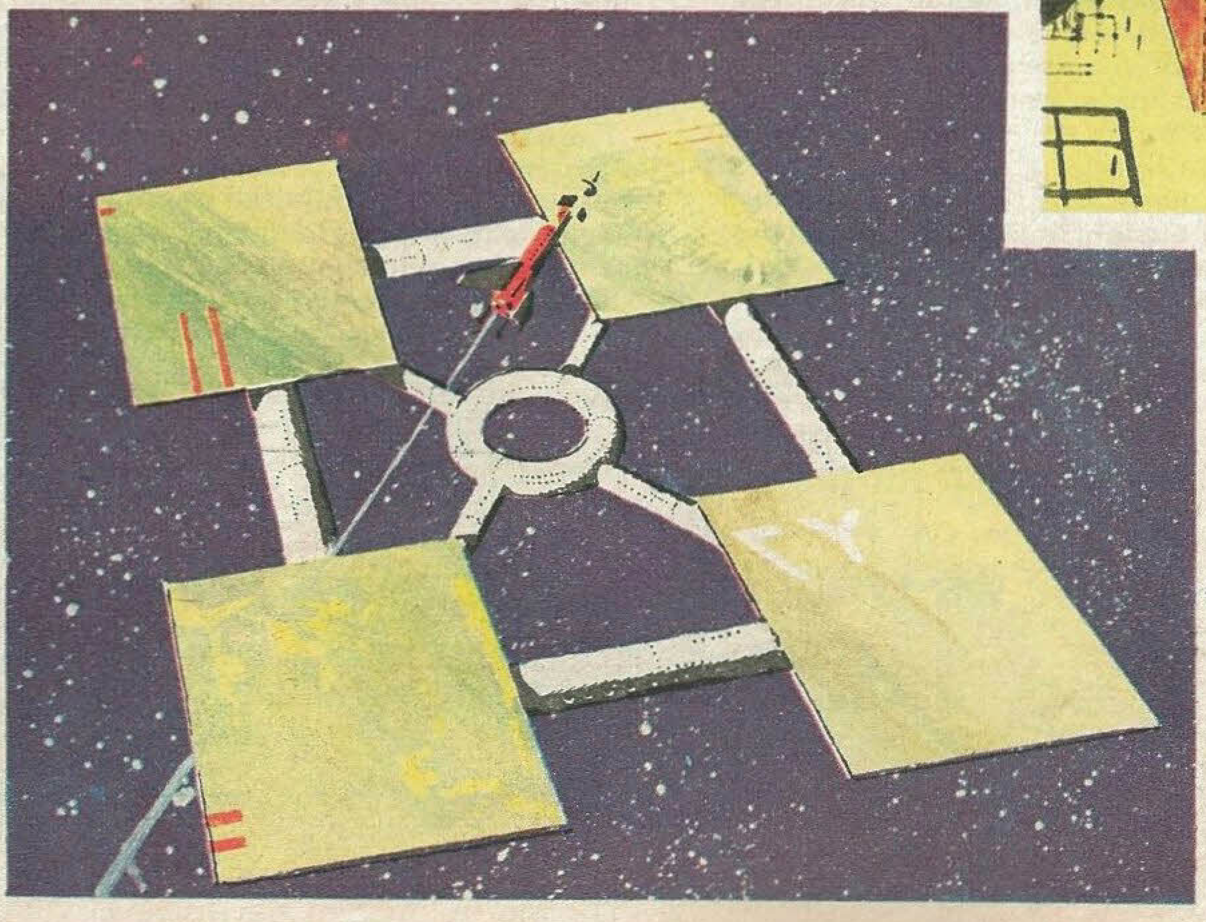




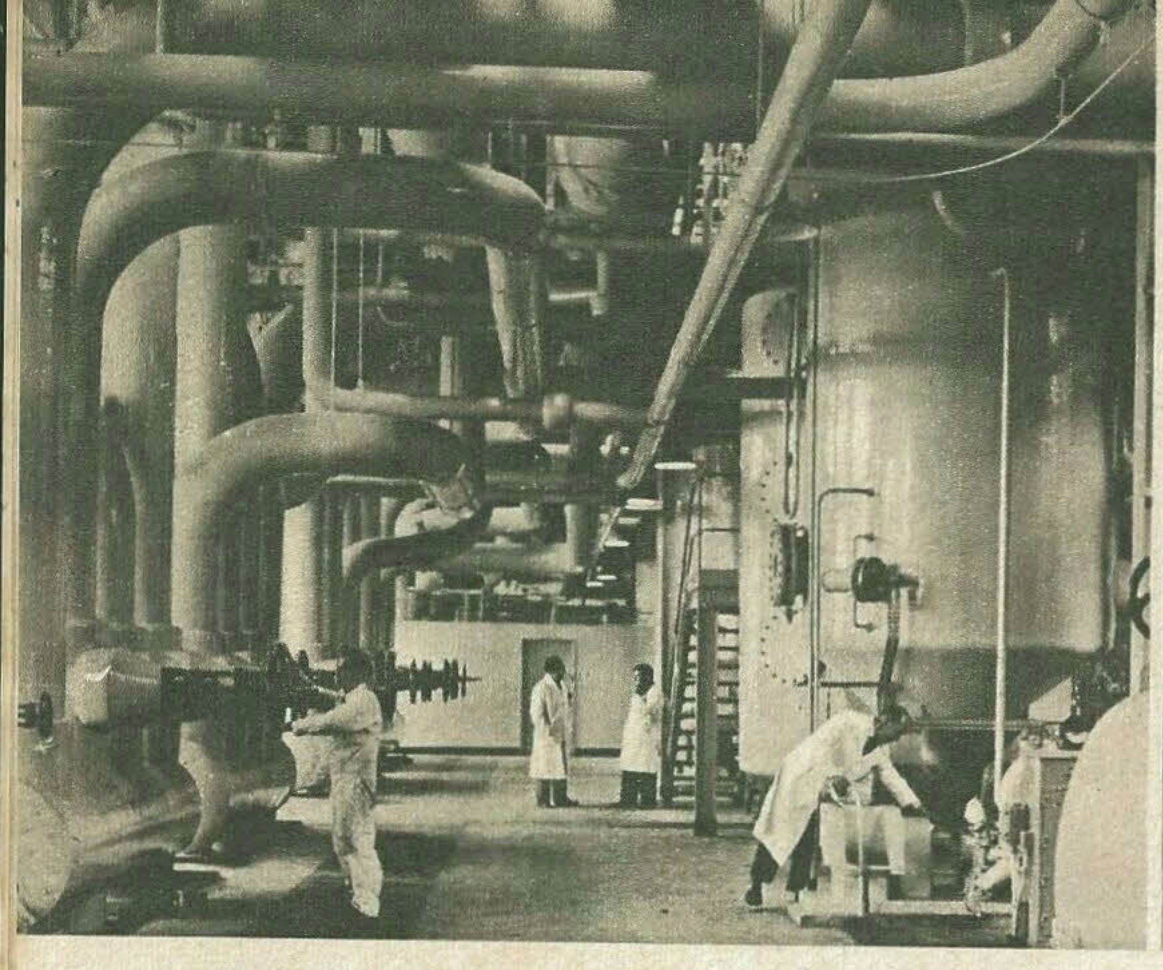
25. Atomic rockets may one day drive space ships on their journey to the planets. A nuclear reactor will heat hydrogen gas, which will expand and force its way through the rear of the rocket, so pushing the space ship forward on its flight.



26. Nuclear fusion, in which atoms are joined together to produce energy, has been attempted in a device called Zeta. But efforts have managed to produce only a fraction of a millionth of one horse-power of energy.



27. Scientists are thinking of harnessing an atomic particle called a "photon." A photon travels at the speed of light—186,411 miles per second. Here a photon-powered rocket leaves its space station to travel to the stars at the speed of light.



The heat exchanger room at Calder Hall Atomic-Power Station. On the left is the complicated system of piping that carry hot gas to the heat exchangers on the right and the steam away from the exchangers to the turbines.

If a worker at an atomic power-station is thought to have come into contact with dangerous radiation, he is wheeled away in his protective clothing to the decontamination centre for medical examination.

To protect himself against the deadly radiation, this technician is using robot fingers to handle radio-active material.

FOCUS on THE ATOM

CONTINUED FROM PAGE THREE

An electron is a very tiny particle of electricity indeed. It "weighs" much less than the lightest atom. One atom of hydrogen, for example, "weighs" as much as 1,840 electrons.

Although the nucleus or centre of an atom is much smaller than the atom it is the most solid part. In fact, the diameter of an atom is about 20,000 times more than its nucleus.

If you took away the nucleus of an atom and all the electrons whirling round it, the atom would be just empty space.

There is no ruler accurate enough to measure the fantastically small size of the electron. But scientists have been able to calculate that an electron is about one-hundred-thousandth smaller than its atom.

To get some idea of what this really means, imagine a bubble of hydrogen gas a quarter of an inch in diameter enlarged to the size of the earth, which has a diameter of 7,926 miles at the equator. On that scale, each of the millions of millions of hydrogen atoms would be enlarged to about four inches in diameter.

Now imagine one of the atoms on that scale enlarged to the size of St. Paul's. The electron of the hydrogen atom would then be the size of a pinpoint, while the nucleus would not be bigger than the full stop ending this sentence.

Mathematicians have worked out that an electron must whirl round its atom's nucleus at a speed of twenty thousand miles a second. And all in a space of one thousand-millionth of an inch in diameter.

That is as often as the blades of an electric fan would turn in five million years.

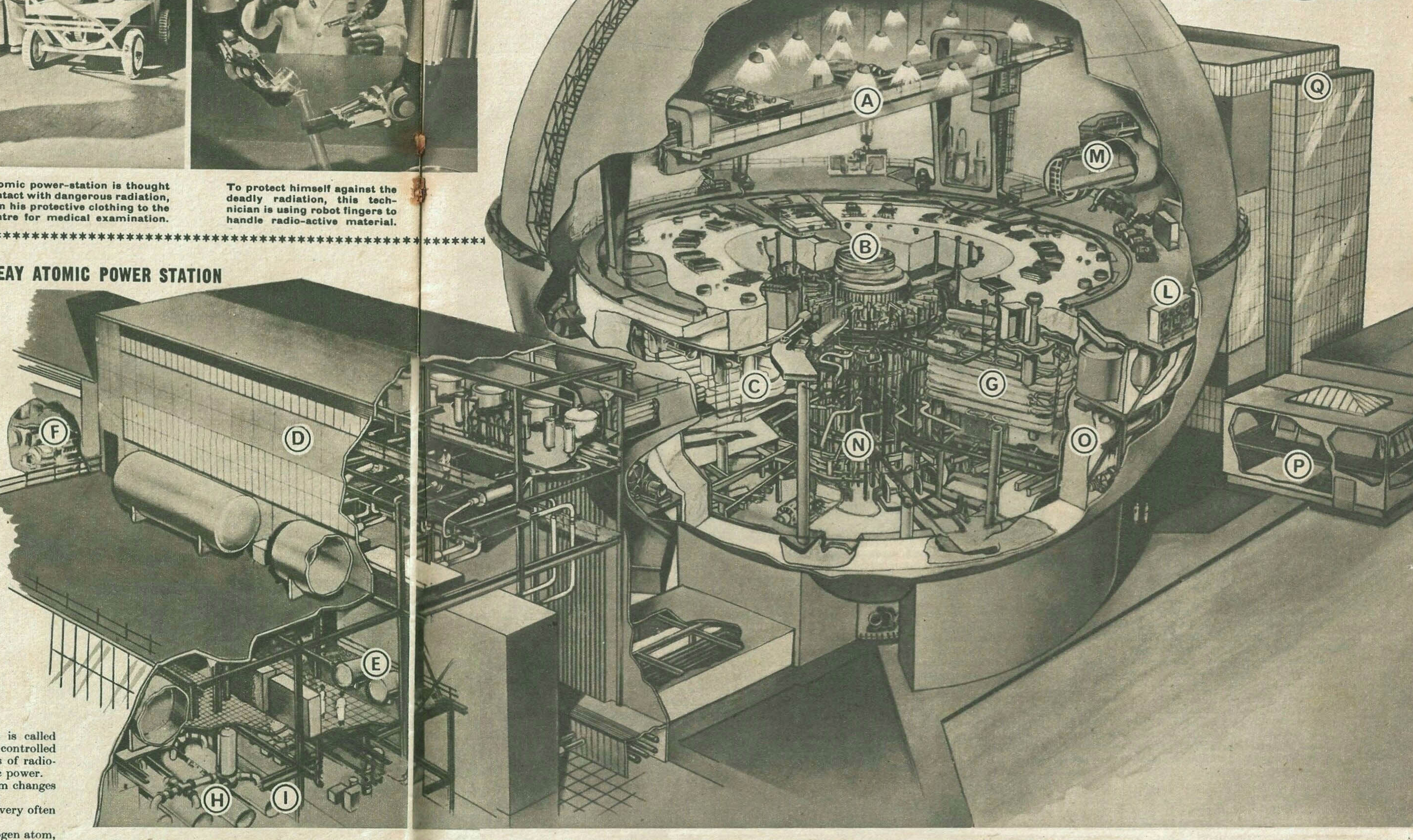
The electrons nearest to the nucleus are held to it fairly tightly. But electrons in the outer orbits are comparatively free and can move from one atom to another in an element.

Atoms from certain of the heavier elements give off from their nucleus what is called radio-activity.

Radium is a good example of this. The radium atom's radiation takes the form of light. That is why a watch with a luminous dial tells you the time in the dark. The hands and figures on the watch are coated with a paint containing radium.

A radio-active atom like that of radium has what is called an unstable nucleus. This means that it breaks up easily, and when it does so it releases particles of high energy.

WHAT HAPPENS AT DOUNREAY ATOMIC POWER STATION



Rods of atomic fuel are lowered by travelling crane (A) into the reactor (B). There the atoms are split and the intense heat generated is transferred to a mixture of liquid sodium and potassium passing through piping (C). The hot mixture then goes to a heat exchanger in the building (D). This turns water into steam which is stored in drums (E) from which it is led to turbines (F) which drive alternators to generate electricity. After it has turned the water into steam, the hot sodium and potassium is cooled by passing it through piping surrounded by water jackets (G). The cooling water is pumped from the sea through the pipe H. The water is then returned to the sea through the pipe J. The reactor and its equipment are enclosed in a huge steel dome (K), and their operation is controlled from the panel L. Technicians enter the dome through the door M. To prevent the escape of radiation, the reactor is surrounded by an inner shield (N) and an outer shield (O). The pumping system is controlled from a panel in the building P, and atomic fuel is stored in the building Q.

It was the development of what is called nuclear fission that speeded up and controlled the release of energy from the atoms of radio-active elements. That gave us atomic power.

Taking particles away from an atom changes what is called the mass of that atom.

Mass is a term which scientists use very often when talking about atoms.

For example, we say that the hydrogen atom, which is the lightest of all atoms, has a weight of exactly 1·0080, while the uranium atom, the heaviest of the atoms found in a natural element, has an exact weight of 238·07.

These figures really mean mass, although, strictly speaking, mass has nothing to do with the atom's size or weight. This mystery of mass and weight was explained in an article in the issue of LOOK AND LEARN for April 27, 1963.

When scientists talk about the weight of an atom they really mean the amount of material in it, not what it actually weighs. Indeed, an atom is so small that there are no scales delicate enough to weigh it.

That is why an atom's weight is simply given a kind of "mass number" and not any measuring unit such as a minute fraction of an ounce.

Mass is very important in atomic science. If the mass of an atom is changed by taking away one or more of its particles, energy is released. This taking away of a particle from an atom is called "fission."

An atom can also be made to give up its energy by adding a particle to it. This is called "fusion."

But it is much more difficult to create atomic energy by fusion than it is by fission.

Albert Einstein was the first scientist to realize the vast amount of energy locked in the atom, and he was the first to show how that energy could be released.

Atoms bombarded with nuclear particles such as protons may vanish, but they are not lost or destroyed. They have been changed into light, heat, or other forms of energy.

According to Einstein, matter and energy cannot be destroyed. If a given mass of matter or material is got rid of, energy takes its place.

When the force that binds together the neutrons in an atom's nucleus is broken, mass is lost and converted into energy.

In 1932 scientists at the Cavendish Laboratory, Cambridge, made nuclear history by splitting an atom for the first time.

Using an electric current at a pressure of 100,000 volts, the proton was "knocked" out of a hydrogen atom and fired at the nucleus of a lithium atom.

The lithium atom has a mass of 6·940 and its nucleus consists of four neutrons and three protons. The hydrogen atom has a mass of 1·0080 and its nucleus consists of a single proton.

After the collision between the hydrogen proton and the lithium nucleus a strange thing happened.

You would expect the hydrogen proton and the lithium nucleus to join together to form a single new nucleus of four protons and four neutrons, which would have a combined mass of 7·9840 (made up from the 1·0080 mass of the hydrogen atom plus the 6·940 mass of the lithium atom).

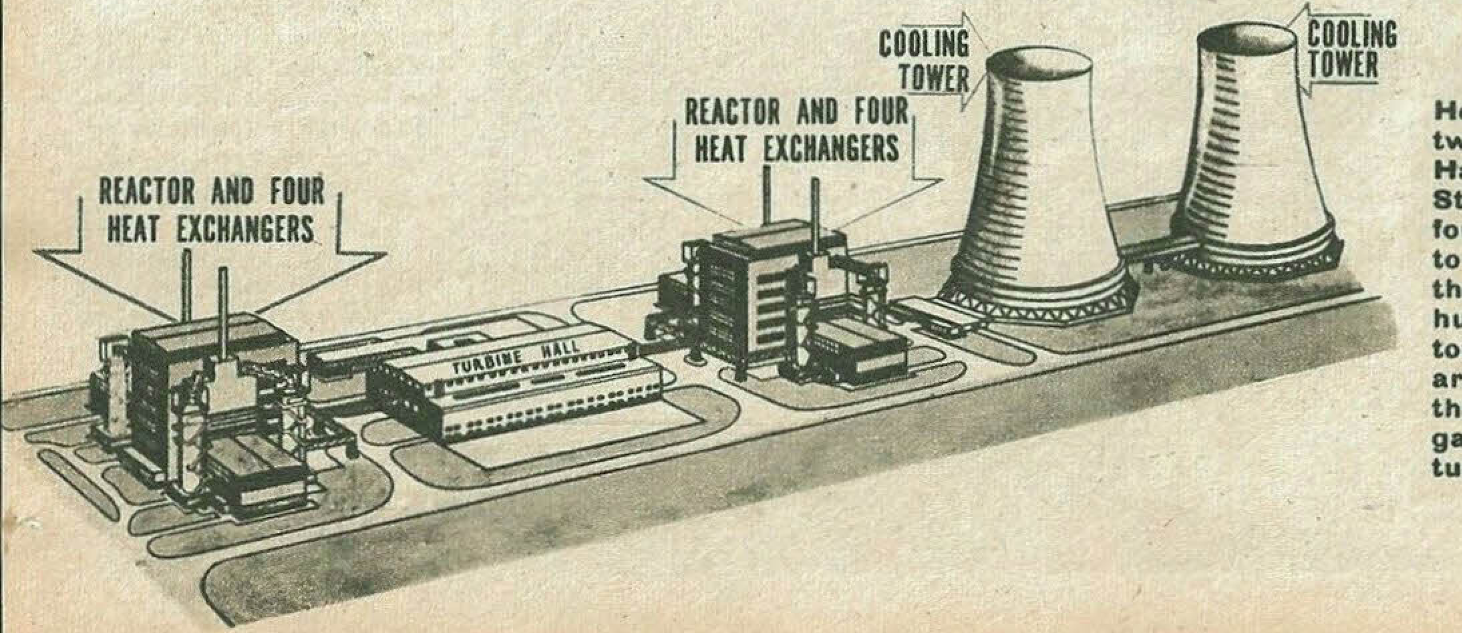
But nothing at all like that occurred. Instead, two nuclei of helium were formed each consisting of two protons and two neutrons—as an atom of helium should

As an atom of helium has a mass of 4·003, the two helium atoms formed by the collision should have had a total mass of 8·006. But the combined mass of the two helium atoms formed by the collision was only 7·9875.

A mass of 0·0185 was missing. The lost mass must have been turned into energy—just as Einstein had foretold.

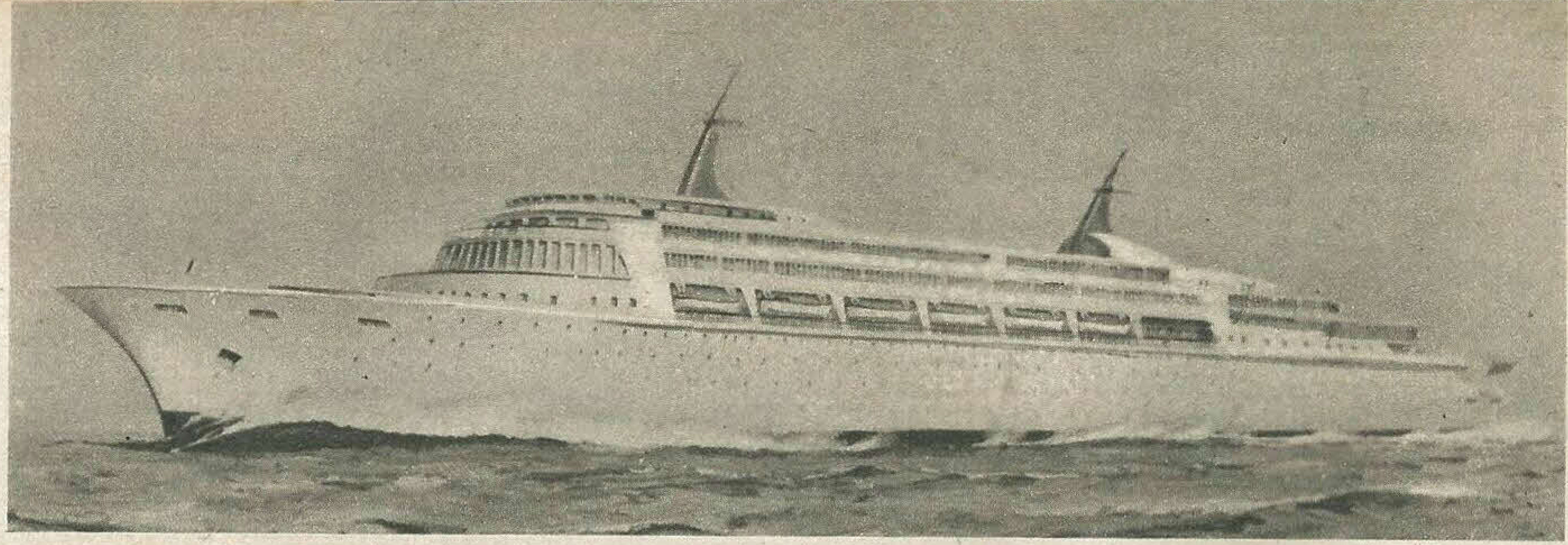
Atomic fission had been achieved. But releasing atomic energy in this way was fantastically costly. And the amount of energy obtained was out of all proportion to the enormous strength of the current needed to bring about fission.

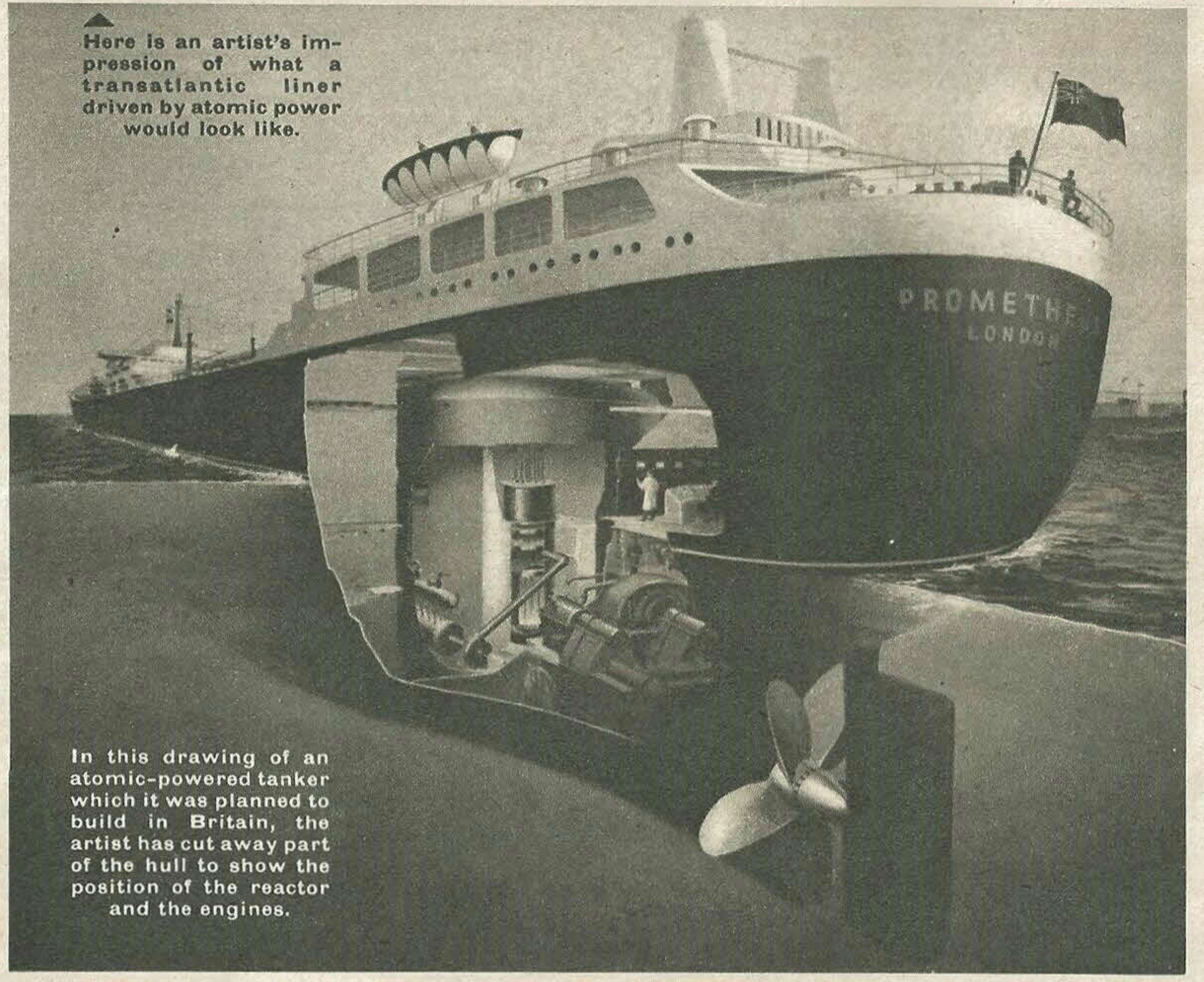
It was then decided that the problem of releasing atomic energy at a more reasonable cost could be solved by using as "bullets"



Here you see how the two reactors at Calder Hall Atomic-Power Station each supply four heat exchangers to provide steam for the turbines in one huge building. The towers on the right are for cooling water that cools the hot gases before they return to the reactors.

FOCUS on THE ATOM





Here is an artist's impression of what a transatlantic liner driven by atomic power would look like.

In this drawing of an atomic-powered tanker which it was planned to build in Britain, the artist has cut away part of the hull to show the position of the reactor and the engines.

neutrons separated from the nucleus of an atom that has a lot of neutrons. One such atom was that of a metal called uranium.

Uranium is the heaviest of all the natural atoms. Like all heavy atoms it has more neutrons in its nucleus than it has protons.

Therefore there are neutrons to spare if the atom of a heavy element like uranium is split to form atoms of two lighter elements.

If, for example, a uranium atom, which has a mass of 238, is split you will get an atom of krypton, which has a mass of 83, and an atom of barium, which has a mass of 56. The nuclei of the krypton and barium atoms so formed will then have a total mass of 139.

This combined mass of barium and krypton atoms is therefore ninety-nine less than the mass of the uranium atom before it is split. And the mass thus left over after splitting the uranium atom contains a lot of spare neutrons.

These free neutrons are then made to strike more uranium atoms. In doing so they release more energy from uranium atoms and free more neutrons.

Once a uranium atom has been split, the splitting of more uranium atoms becomes continuous and a steady flow of energy is released.

This goes on as long as there are neutrons as bullets and uranium atoms as targets for them. The continuous process is called a chain reaction.

The energy released by the splitting of the atom takes the form of heat, in the same way that the energy in coal is released by burning the coal.

In order to get heat from the atom on a big enough scale to produce useful power, millions of millions of atoms have to be split every second.

This is done in what is called a nuclear reactor.

The uranium atoms breaking up in the reactor are simply a form of fuel like oil or coal. Before atoms can do useful work they must be "burned" in a reactor to produce the heat that will turn water into steam to drive turbines.

The real power from the atoms in the reactor is the electric current generated by the dynamos or alternators driven by the turbines.

Although the amount of uranium fuel used at an atomic power-station is very small, uranium is one of the most expensive metals in the world. Also the equipment needed for releasing the atom's energy is very big and complicated and costs millions of pounds.

It is to reduce the enormous cost of atomic fuel that the breeder reactor has been designed.

A breeder reactor not only splits atoms to release heat, but it uses neutrons to turn atoms of other materials into atomic fuel.

Once the fission or splitting process has started in a reactor, the chain reaction continues automatically and is controlled by inserting into the reactor metal rods that have the property of being able to stop and absorb neutrons that strike against it.

Britain's first atomic power-station, which was also the first in the world, is at Calder Hall, Cumberland, and was opened on October 17, 1958.

Besides the huge atomic power stations on land, reactors have been made small enough for use in ships.

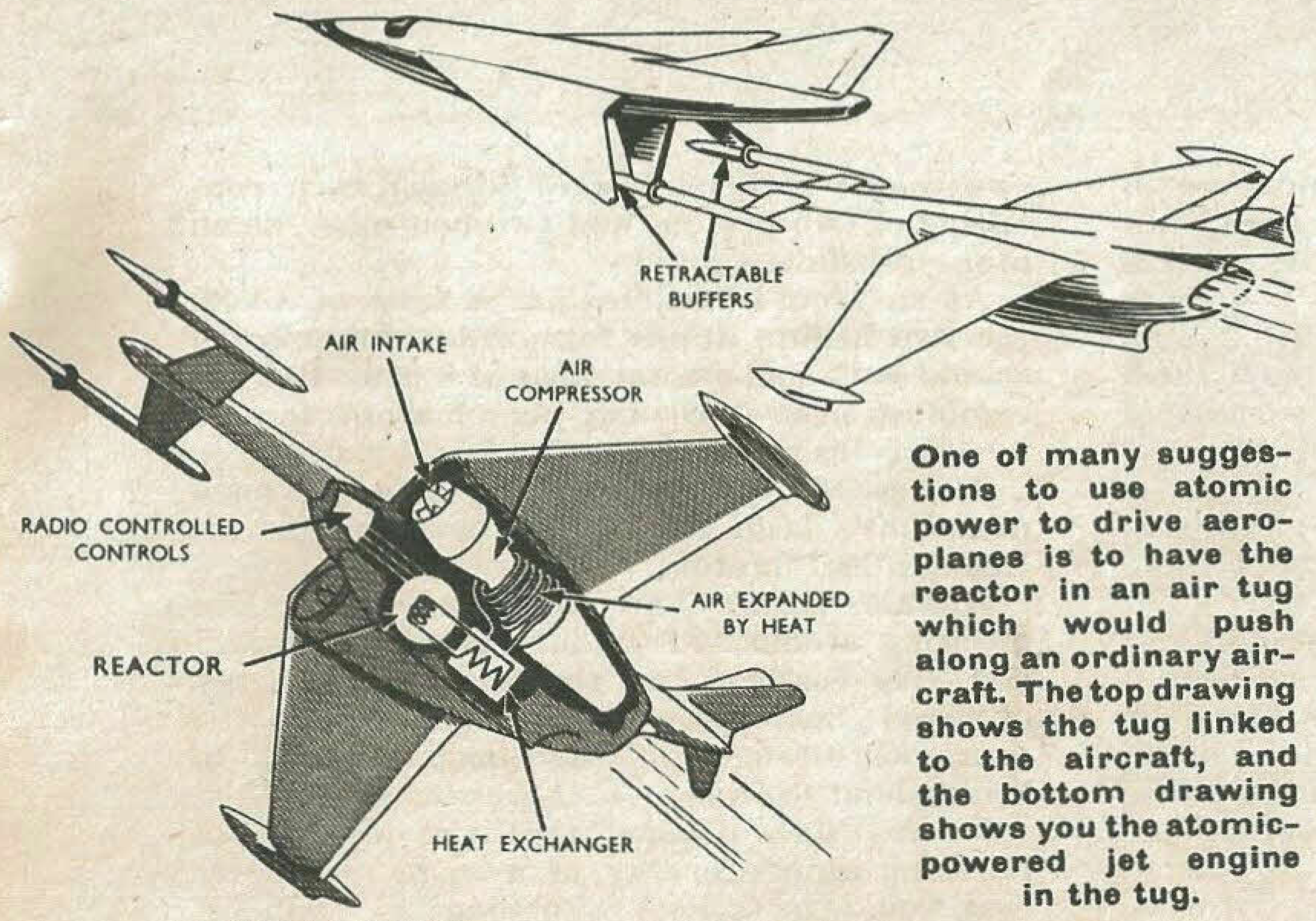
As yet, however, scientists have not been able to build atomic reactors small enough and light enough to drive railway locomotives, road vehicles or aircraft.

Besides their importance as a source of power, atoms have many other uses, particularly in industry and medicine. The atoms used for these purposes are called isotopes.

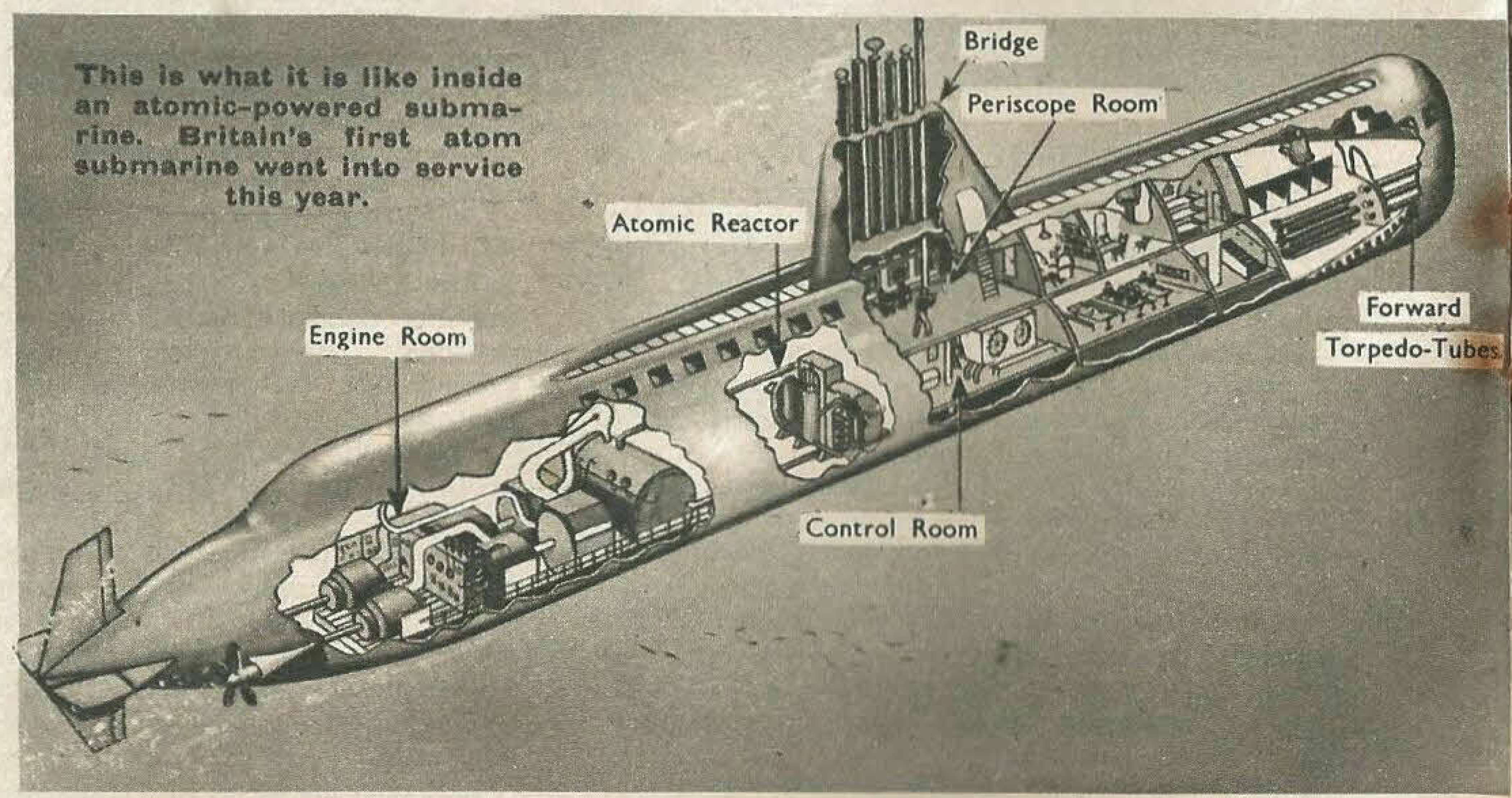
Most elements have several different kinds of atoms. They are all alike except for a difference in atomic weight. It is these different kinds of atom belonging to the same element that are called isotopes.

Some of these isotopes are naturally radio-active while others are not. But a non-radio-active isotope can be made radio-active by means of a reactor.

Radio-active isotopes, whether occurring naturally or produced in a reactor, are very useful because they give out radiation. This radiation can then be detected by means of an instrument called a Geiger counter.



One of many suggestions to use atomic power to drive aeroplanes is to have the reactor in an air tug which would push along an ordinary aircraft. The top drawing shows the tug linked to the aircraft, and the bottom drawing shows you the atomic-powered jet engine in the tug.



This is what it is like inside an atomic-powered submarine. Britain's first atom submarine went into service this year.

Part Four of WIKI THE DOLPHIN—Margaret Mackay's enchanting story about a boy's friendship with a deep-sea animal

TIDAL WAVE TERROR

Fishing boats ran amok, trees snapped like matchsticks, and the roads were flooded. Watching the havoc Kamuelo's thoughts turned to Wiki—alone somewhere in that raging sea

Kamuelo, a Hawaiian fisherman's son, and his friends, were thrilled when a baby dolphin appeared among the school of dolphins which used to swim offshore. As the children watched the baby grow, they christened her Wiki-Wiki, meaning Hurry-Hurry. Wiki soon decided that human beings were friendly, and she and Kamuelo often swam together. The boy soon realized that he had won Wiki's trust and affection, and Wiki proved this soon afterwards, when Kamuelo's father took his fishing-boat out one morning and was stranded. The engine had failed, and a storm was blowing up. Wiki stayed by the boat until help came, but she was injured when the craft struck her as it was being towed by the rescue ship. Later, to Kamuelo's delight, she returned to Calabash Cove wounded, but safe. But with this good luck came bad news: a great tidal wave was sweeping across the ocean!

The villagers hastily collected their belongings and made for the high ground.

IN the sultry heat Kamuelo was almost falling asleep. He was in his arithmetic class in the small school-house. Flies buzzed like the distant jet planes on the trans-Pacific air routes. The room smelled of chalk, which the teacher was using at the blackboard.

"If I have a hundred mangoes and I give you twenty-three, how many have I left? Kamuelo!"

Kamuelo jumped. His eyelids snapped open.

"Uh-uh-seventy-five!"

The others tittered, and he blushed.

He was saved by a heavy knock at the door. The teacher opened it. The pupils woke from their drowsiness when they saw a big brown Hawaiian policeman standing outside.

"Better send the kids home right away," they heard him say urgently. "We've just had a warning on the radio. A tidal wave is on its way across the ocean. It's expected to reach Hawaii in about four hours."

The class whispered with excitement.

Quickly they marched from the room, and then scrambled towards their own homes as fast as their horny bare feet could carry them.

Waiting

SEVERAL times in the lives of the older villagers a great tidal wave had swept in across the sea. It had moved so fast that it had covered several thousand miles in a few hours. In parts of the islands it had drowned people. It had washed away boats and houses near the shore, and destroyed miles of property and plantation crops.

"Maybe it won't be so bad this time," said Kamuelo.

But for once the easy-going faces of the grown-ups were very grave.

"I hope Wiki will be all right," murmured Kamuelo.

"Of course she will," said his father. "She can swim, can't she?"

The lazy hamlet was much busier than usual in the afternoon heat. Every household was getting ready for a possible flood. Like all their neighbours, Kamuelo's family rolled up their lauhala mats from the floor and piled everything movable on top of tables and cupboards. They made bundles of their treasures. They added some blankets and extra clothes, and packed a picnic basket with plenty of food. For word had come on the radio that all the houses along the shore must be evacuated, in case the tidal wave should rush beyond the beach.

So Kamuelo and his family, and Mary and her parents, and all the other neighbours, anxiously turned their backs on the little houses of Calabash Cove. With their bundles and baskets they prepared to trek uphill under the heavy sun—men, women, children, and babies, with dogs and cats, chickens squawking in the big baskets which the women had woven, and even some squealing pigs in the back of a pick-up truck.

A few families were in shiny new cars, some in old second-hand ones, and others on foot. Kamuelo's family piled into their rattletrap.

With anxious sighs the chattering procession started up the slope on a dirt road which led up the mountain. In a couple of hundred yards they felt sure they were high enough to be safe. They stopped beside a papaya orchard; the luscious fruit was ripening like melons on the scraggy branches. From here they could look over the roofs of the village and across the crescent of the beach, and out to sea in a sultry haze—out over watery space, from where the tidal wave would be coming.

Suddenly an old Portuguese Hawaiian fisherman called out. With his long sight he was used to looking over water.

"There it is!"

They all jumped up and shaded their eyes with their hands, to squint against the glare. They could hear each other breathing hoarsely. At first Kamuelo could see nothing. Then he made out a great glassy shelf of water moving forward where the sea met the sky. It stretched from one end of the horizon to the other. He could hear a hissing rumble.

Closer and closer came the tall tide, bearing down on the island, faster than an express train. The rolling mass loomed many feet higher than the surface of the ocean. Louder and louder it boomed. As it roared near the shore, where ridges of old lava and coral made bumps in its path, it broke up into a vast wall of spray. There was a mighty thunder. It pounced on the cove like some colossal monster. It sprang—and hurled itself against the beach with a deafening bellow. The land shook under Kamuelo's dusty feet.

Women screamed. Chickens cackled.

"Daddy! Daddy!" shrieked Pikaki, and hid her head against her father's bright flowered shirt.

Kamuelo could see the fishing-boats pitching at their moorings until they stood on end. Two or three broke away; they writhed as if they were in pain. Then they ran amok, this way and that, in the foam.

For a moment he wondered where Wiki was, under that seething cliff of water. He could imagine what a shock it must be for the young dolphin, alone without a school of friends. He hoped and prayed she was all right.

Miracle

OVER the beach dashed the deep mass of water and across the road. Only the tufts of the coconut-palms showed above it; underneath, it snapped off several of their trunks like matchsticks and whizzed them away.

The seafront looked like a stormy lake. The sea flung itself against the huge banyan-tree. A crowd of mynah birds fluttered up into the sky, chattering. It sprang on to the front doors of the poor little houses cowering among the foliage.

For an instant Kamuelo closed his eyes. He expected to see it swallow up his own house—smash it into timbers and carry it away on the flood like driftwood. He could picture his small white bed floating off like a tiny boat, shipwrecked.

He opened his eyes.

And then, to his astonishment, a miracle happened. The tidal wave had stopped at the front porches. It splashed the houses with a vast dousing of salt water, as if some giant window-cleaner were at work. Then, incredibly, it toppled back on itself in a huge fold; at its crash the spray exploded into the sky.

There was a groaning, tearing, wallowing sound. Sweeping, surging, the wide wave was sucked back towards the sea. It carried palm-fronds—chicken coops—petrol-tins—road-signs—stalks of bananas—coconuts—an outrigger canoe—hibiscus shrubs—an outhouse—a straw hat—garbage from the village dump—a dead rat—a fisherman's rubber boot—a tangle of leaves and sticks and roots and flowers—a scum of red earth and black lava.

Back, back, back it roared, as if the first range of the mountains were slipping into the ocean.

Back over the road it surged, and across the beach. In the cove it gave another enormous push to the fishing boats. Two more broke from their anchors. They spun around in a whirlpool, and staggered off to sea on a moving mountain of the wave.

On and on it billowed in a great hump. It was as if a sea-monster were at work like a mole to tunnel the ocean bed. Now, no doubt, the whole island—the whole chain of the Hawaiian Islands—would be enfolded in its octopus-grip. It would squeeze them all in its many tentacles, and then sweep on, on, on, wearing itself out across the open sea to California . . .

"*Ah, wei!*" sighed the people on the hillside. They felt flabby as jellyfish with relief. "It's *pau*—finished!"

"Thank God!" murmured the preacher.

"I want to go home!" piped Pikaki. "Can we go home now?"

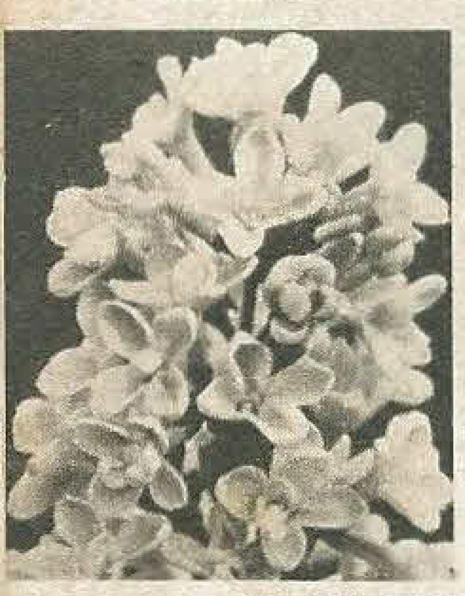
"Soon," said Kamuelo, trembling with exhaustion.

And he added, "I wonder how Wiki is."

NEXT WEEK: ORDEAL ON THE BEACH

CROSSWORD

CLUE TO 1 ACROSS



CLUE TO 12 ACROSS

CLUE TO 25 ACROSS

CLUE TO 3 DOWN

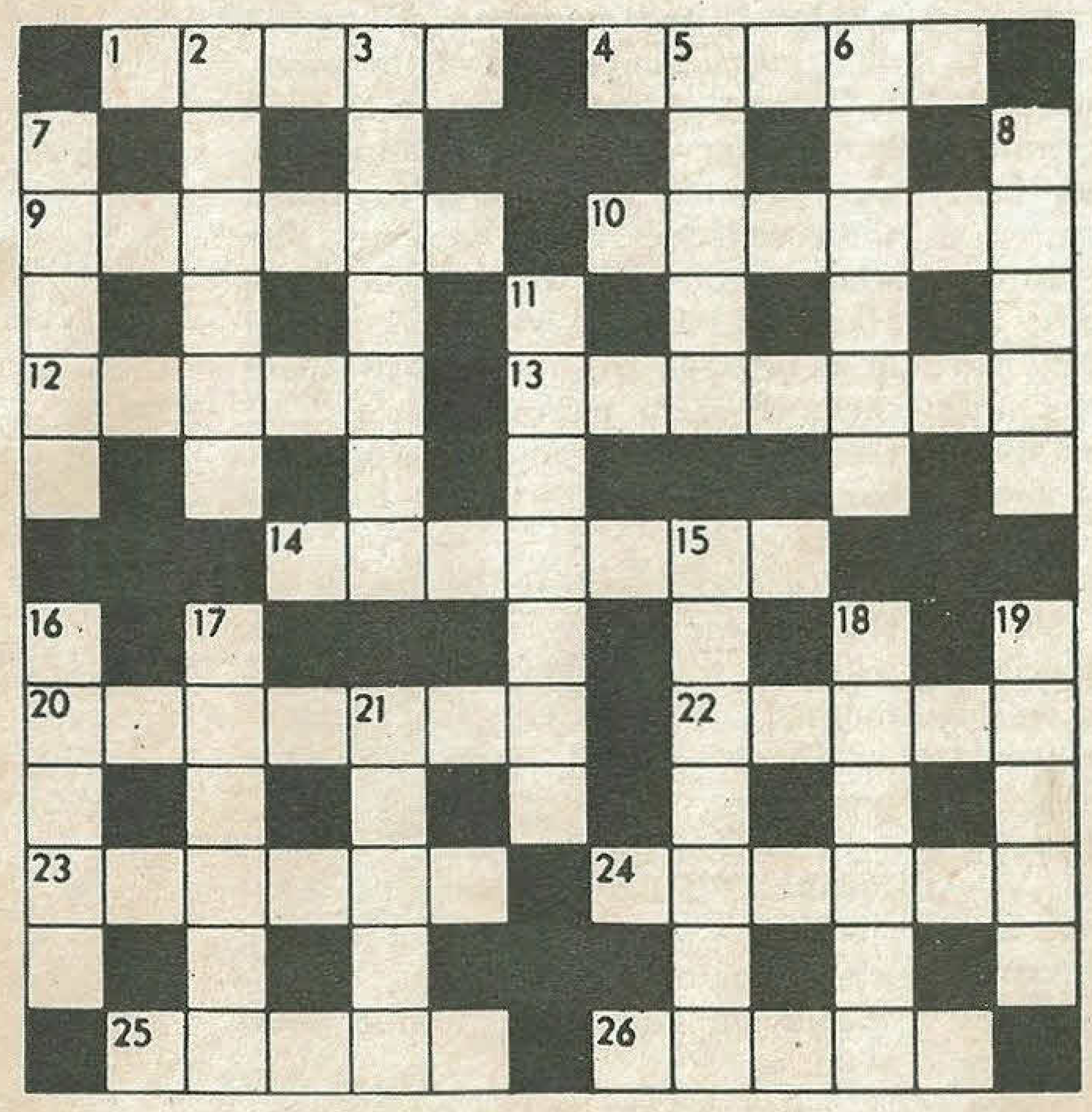
ACROSS

1. Head cooks in hotels. (5)
4. To treat with heat to extract metal from ore. (5)
9. The runways of an airport are covered with this, and it gives them this name. (6)
10. Dense tropical forest; Kipling wrote tales about it. (6)
12. Flowering shrub with white or light purple flowerheads. (5)
13. Having three leaves, like clover. (7)
14. Showed someone to their seat. (7)
20. Blind people can read this with their finger-tips. (7)
22. A small circle of rubber needed to mend a puncture. (5)
23. Surprisingly, the kingdom to which sponges belong. (6)
24. A water tobacco-pipe used by Arabs, Turks, etc. (6)
25. Member of the Sun's family that can be seen on rare occasions. (5)
26. Name of eight kings of England. (5)

DOWN

2. This king was killed at the Battle of Hastings. (6)
3. Christian name of Drake, who was knighted for his exploits. (7)
5. Small rodent—many children keep it as a pet. (5)
6. An ancient Roman army of three to six thousand soldiers. (6)
7. In the country, we climb over it to get from one field to another. (5)
8. A cockney is supposed to be born within sound of Bow ——. (5)
11. Guided a car or a ship. (7)
15. What brave men and adventurous children like to do. (7)
16. A seaman's word for "abreast." (5)
17. A cotton cloth first made at Calicut, in India. (6)
18. He looks after the furnace in the boiler-room. (6)
19. Rulers of Persia. (5)
21. A soldier hopes to get this at Christmas. (5)

SOLUTION ON PAGE 29



FRANCE

The Wine Country

1. It was from Boulogne that Julius Caesar set out on his conquest of Britain, and the port has handled much of the England-France traffic ever since. Boulogne has a modern harbour, and many new buildings, since the town was extensively damaged during the last war.

2. *The city of Lille, capital of the Nord dept. and fifth largest city in France, was until 1914 a front-line fortress. A city of wide, straight streets and shady squares, Lille's suburbs are highly industrial.*

3. Without a doubt, France is the world's leading wine-producer—and one of the most famous wines takes its name from the area in which the grapes grow: the Champagne. Centre of the Champagne industry is Reims (or Rheims), noted for its magnificent cathedral, which was founded in 1211.

4. *In the town of Rouen, on the River Seine, Joan of Arc was burnt at the stake. The city, one of the greatest ports of France, has many fine buildings, including the cathedral and the large sixteenth-century archway which has the Gros Horloge—an ornamental clock said to be five hundred years old. Rouen was the capital of ancient Normandy.*

5. On the vast beaches of Normandy the great D-Day landings took place in 1944. In one day 156,000 men were put ashore in German-occupied France.

6. *The great Palace of Versailles is known throughout the world for its splendour and magnificence. Louis XIII built a small château at Versailles in 1627, and Louis XIV built a gigantic palace round it forty years later.*

7. Paris, the City of Bridges, is symbolized by the Eiffel Tower, 985 ft. high. It is one of the most beautiful cities in the world, with wide, tree-lined boulevards, the banks of the Seine, and the colourful and picturesque cafés with tables cluttering the pavements. Paris has been the cultural capital of Europe for centuries.

8. *Strasbourg, capital of Alsace, lies only two miles from the German frontier. It is noted for its cathedral, whose spire is 465 ft. high, and for its university. Near the city ran the Maginot line, underground defences against Germany in World War Two.*

9. On the north coast of Brittany a granite islet rises out of the bay of St. Michel. On the rock, a quarter of a mile from the shore, stands the abbey of Mont St. Michel, founded in 708. Tides sweep up the bay with treacherous speed.

10. *The people of Brittany are fiercely proud of their traditions, and take great delight in dressing in the costume of the province. Breton men have been seamen for centuries, and one of the centres of the sardine fishing industry is at Quimper.*

11. To many people, the name Le Mans means one thing only—fast cars. Here is held the famous twenty-four-hour race.

12. *At Vézelay the founding of a Benedictine abbey in the ninth century caused the village to become a place of pilgrimage. The Second Crusade was begun here by Louis VII.*

13. Besançon has had a varied career. Once capital of the old province of Franche-Comté, it became a free German city in 1184, and belonged to Spain for thirty years in the seventeenth century. It is now the centre of the thriving French clock and watch-making industry.

14. *One of the most beautiful parts of France is the valley of the river Loire with its magnificent châteaux, such as this one at Brissac. Tourists flock to the Loire Valley to see the breath-taking "Son et Lumière" (sound and light) performances, where the châteaux are floodlit, and their history is brought to life by actors.*

15. Vichy is one of the best-known health spas in Europe, particularly famous for its mineral water. After the defeat of France in the Second World War, territory unoccupied by the Germans was ruled by a government set up here by Marshal Pétain.

16. *France is not only a summer-holiday country—winter sports in the French Alps brings visitors from many countries to the resorts to ski.*

17. Lyon, capital of the Rhône department, is one of the largest cities in France. It has great importance as a railway centre and as a university town. It is also one of the largest industrial cities of France, with a famous silk industry, established for over 500 years.

18. *The town of Le Puy takes its name from the curious tall rocks, or puys, formed from volcanic material, which are found in the highlands of the Massif Central, in Central France. A church crowns this one at Le Puy.*

19. In 1940 four boys were walking in the Lascaux woods when they lost their dog through a fissure in the rocks. In their search for the dog the boys stumbled on a great cavern whose walls were decorated with prehistoric art, preserved over thousands of years.

20. *Bordeaux is the centre of a thriving wine industry, and the city gives its name to the particular wine produced in the area. To the south of Bordeaux lies an infertile tract of land, sandy and marshy, known as the Landes, which may bring new prosperity to the area as a result of test drillings for oil.*

21. A song has made the old bridge at Avignon famous throughout the world. The city, once the seat of Pope Clement V, is still surrounded by medieval fortifications.

22. *Of all the holiday resorts on the continent of Europe, the French Riviera is probably the most popular. The warm climate and clear water of the Mediterranean attract holiday-makers from all over the world.*

23. Carcassonne is another walled city, whose fortifications date from the twelfth or thirteenth century, although traces of Roman defences have been found. The city within the walls is one of narrow, twisting streets, but a newer city stands outside the walls.

24. *In 1858 a girl at Lourdes claimed to have seen a vision of the Virgin Mary. The news spread quickly, and soon many pilgrims were flocking to the town. A natural spring close to the spot where the Virgin appeared is said to have miraculous healing properties.*

25. Corsica has been a French possession for nearly 200 years, and is famous as the birth-place of Napoleon. The island is gaining rapidly in popularity as a holiday resort.


LONDON
BOULOGNE
LILLE
ENGLISH CHANNEL
ROUEN
REIMS
VERSAILLES
PARIS
LE MONT ST. MICHEL
STRASBOURG
MAGINOT LINE
QUIMPER
LE MANS
BASEL
VEZELAY
BESANÇON
VICHY
LYON
CHAMONIX
LE PUY
BORDEAUX
THE LANDES
AVIGNON
CARCASSONNE
LOURDES
RIVIERA
MEDITERRANEAN
CORSICA
SAYNOR
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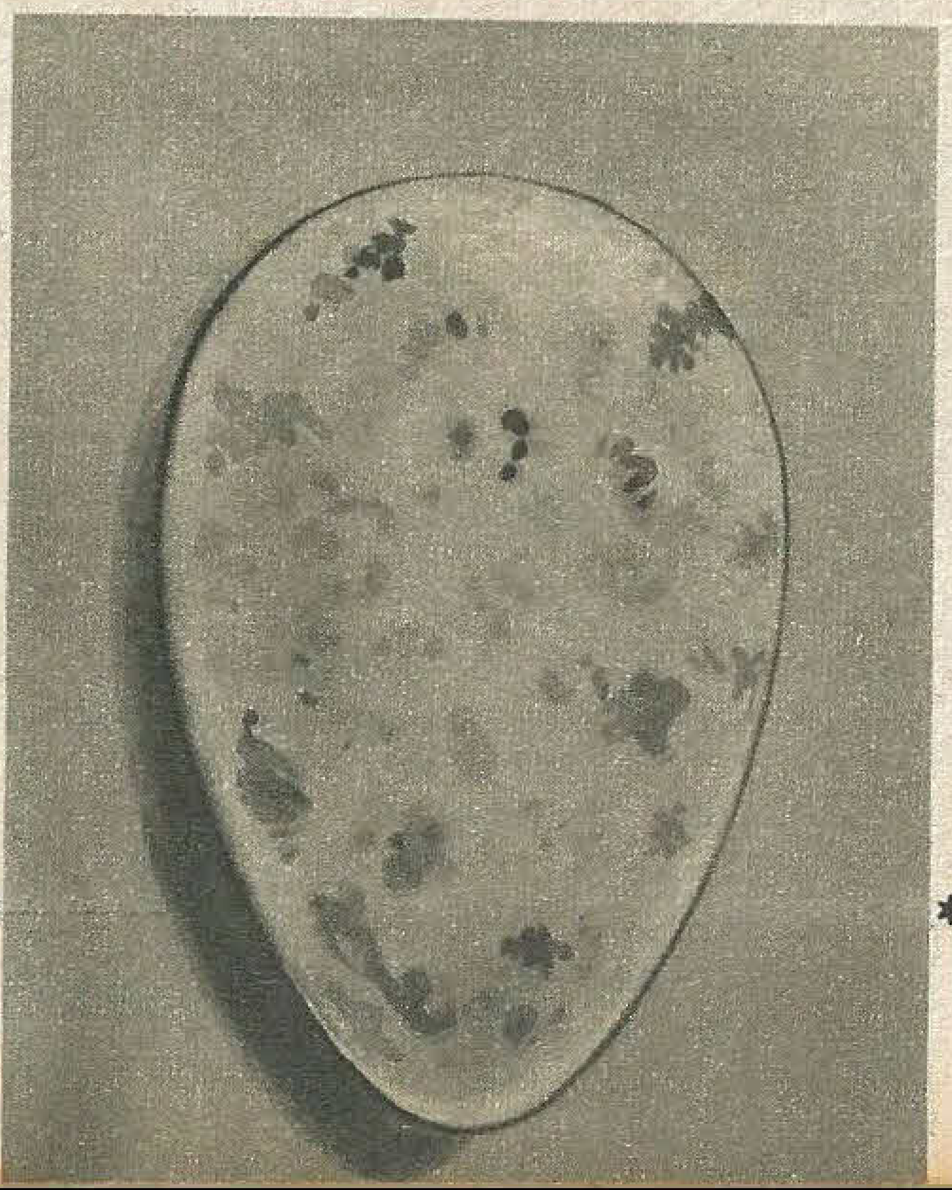
ROOKS LIKE A CROWD!

▲ The rook is a glossy, purple-black, with a bare patch round its beak. It belongs to the *Corvidae* family of the crow, magpie, raven and jackdaw.

Eggs are greenish, mottled with olive brown. They are usually laid in March—as many as six by one rook—in treetop nests. ▶



The farmer scares the flock of rooks from his fields—but in some ways these birds can help him, for they eat harmful grubs and insects as well as corn

THE cawing of rooks settling drowsily in the high branches of a clump of elm trees is one of the most typical sounds of a summer evening in Britain.

These socially-minded birds like to do everything in a crowd. They fly in a flock, feed together, and even live in a "rookery," or collection of nests in the treetops of elms or other tall trees.

Although rooks are a nuisance to the farmer because they eat up newly-planted grain or seed, they are also of great value in another way. They eat many harmful grubs and insects, like leatherjackets and wireworms, which damage crops.

The rooks do, however, damage root crops like turnips, frequently tearing up thousands of newly-planted seedlings in their search for grubs.

There is an old East Anglian saying:

"Plant four seeds in a row,
One for the rook, one for the crow,
One to rot and one to grow."

Same Nest

ROOKS build nests of sticks and dried mud lined with grass or wool, which they repair or rebuild each March when the nesting season begins. Sometimes there are as many as thirty of these nests to one tree, over thirty feet up from the ground.

You can easily distinguish the rook's nest from those of its cousins the magpie and the crow, because the crow builds lower down the tree and the magpie builds a solitary nest high up.

Both mother and father rook will sit on their eggs until they hatch. Later the baby rook joins the flock and feeds with it.

Bare Faces

THE young rook leaves its nest after thirty days. Early on it loses the feathers from its face, leaving a patch of bare, whitish skin round the base of the bill, distinguishing it from the crow, which retains short feathers here.

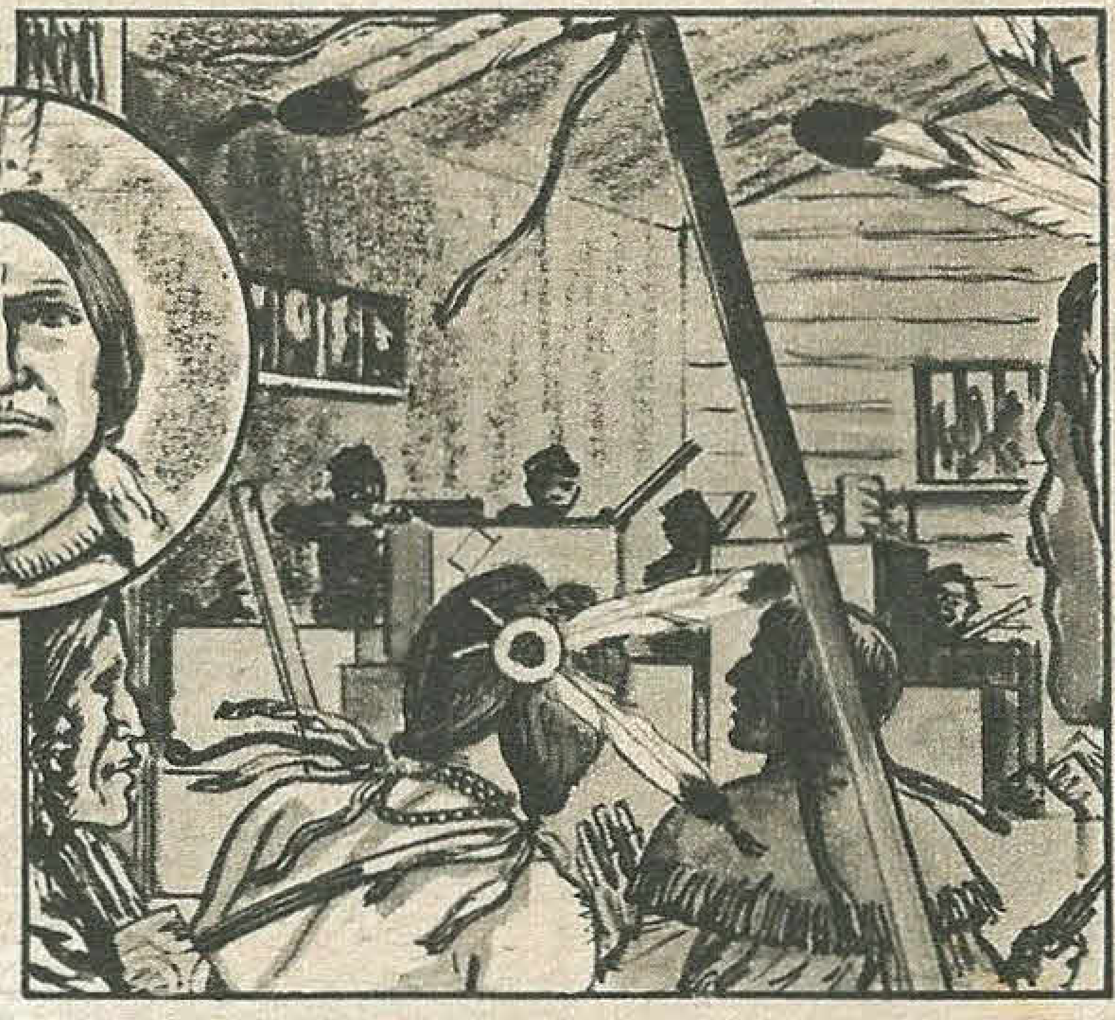
The rook can also be distinguished by the purple gloss of its plumage, particularly on the head and neck. It is about eighteen inches long—a bit smaller than the crow.

Although they do not always take kindly to captivity, rooks can become lively and affectionate pets.

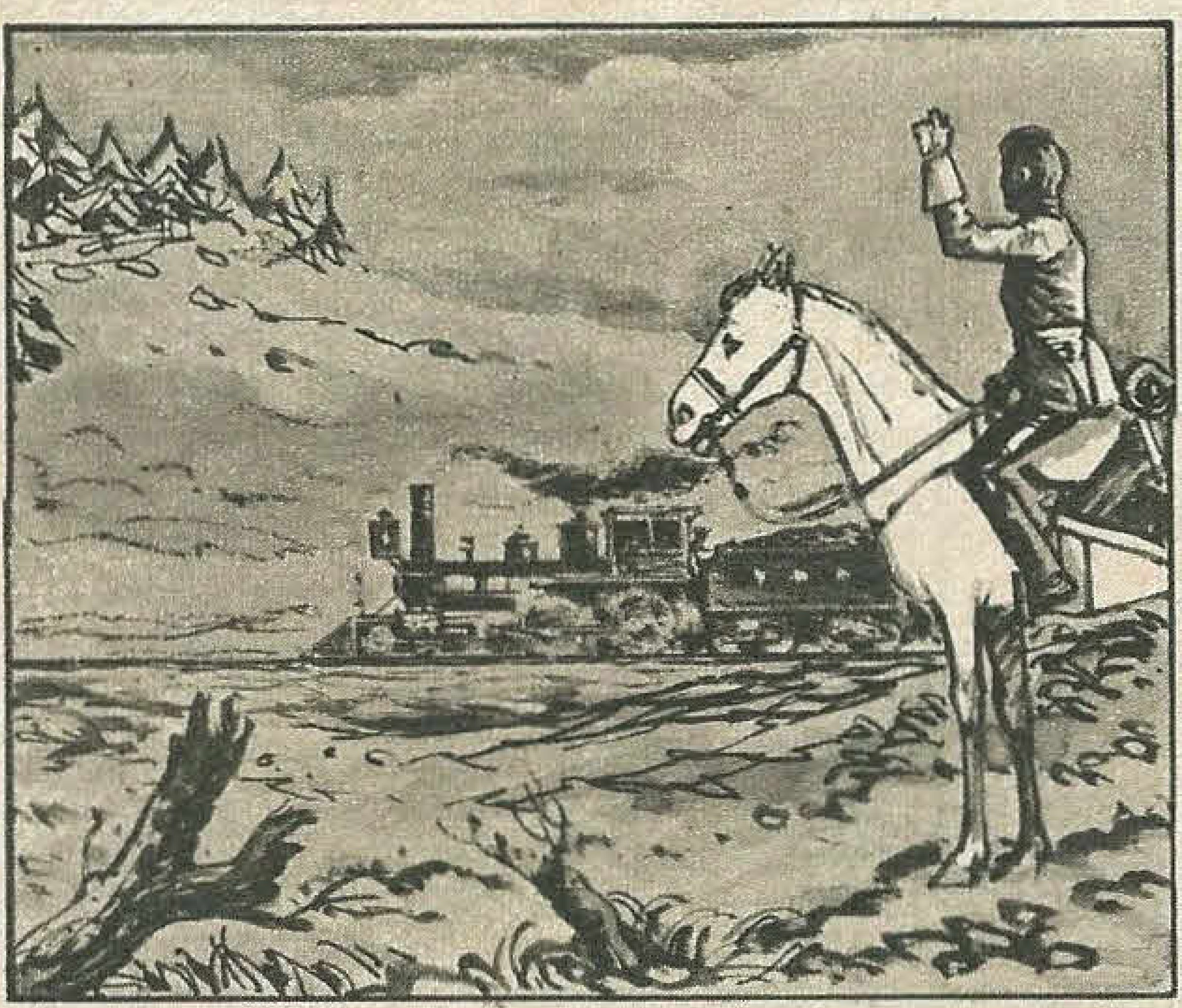
THEY ALWAYS GET THEIR MAN

1. The first scarlet-coated Canadian "Mounties" rode out of Stone Fort in 1874 to prevent the illegal sale of alcohol to Cree Indians. The North West Mounted Police had begun their work of keeping law and order among the traders and Indians of remote Canadian regions, near Lake Winnipeg.

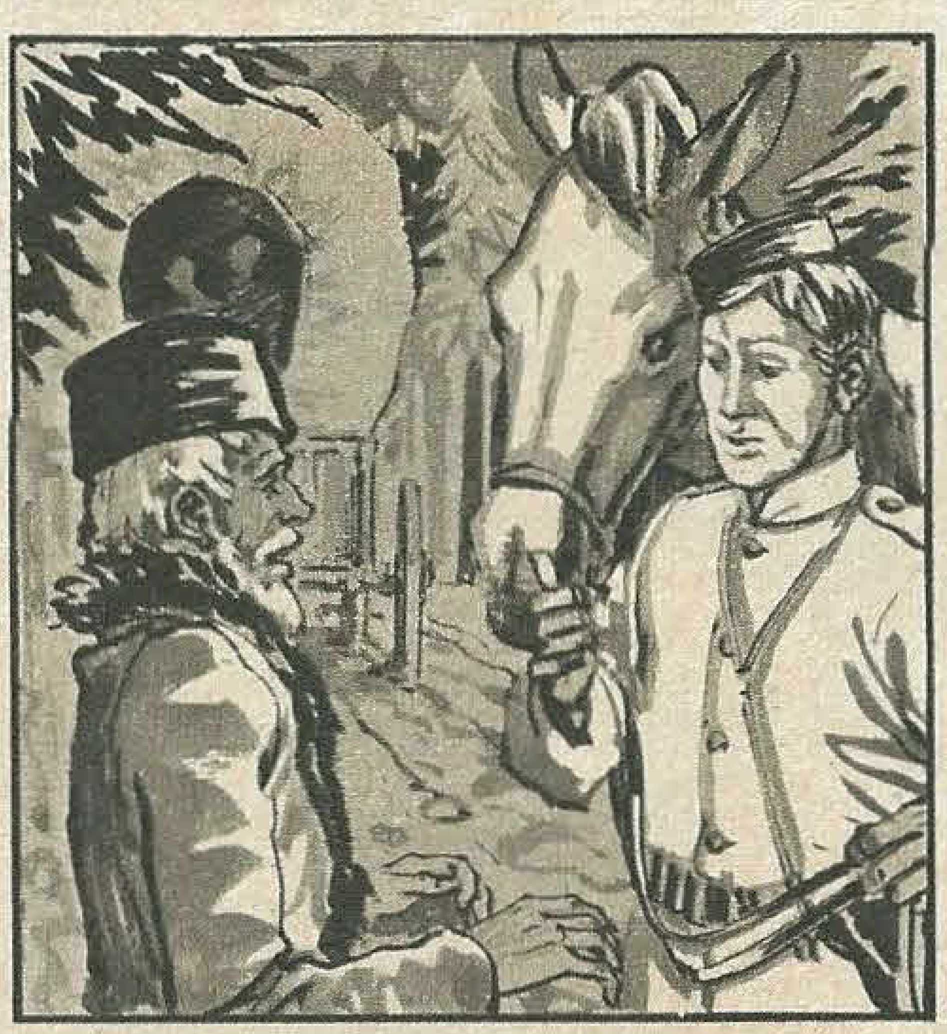
2. In 1875 Sioux Indians invaded new headquarters at Fort Walsh, believing the Mounties building it to be disguised American soldiers. But when they saw the Union Jack flying the Indians were finally convinced that the policemen were British and in time came to accept their laws.



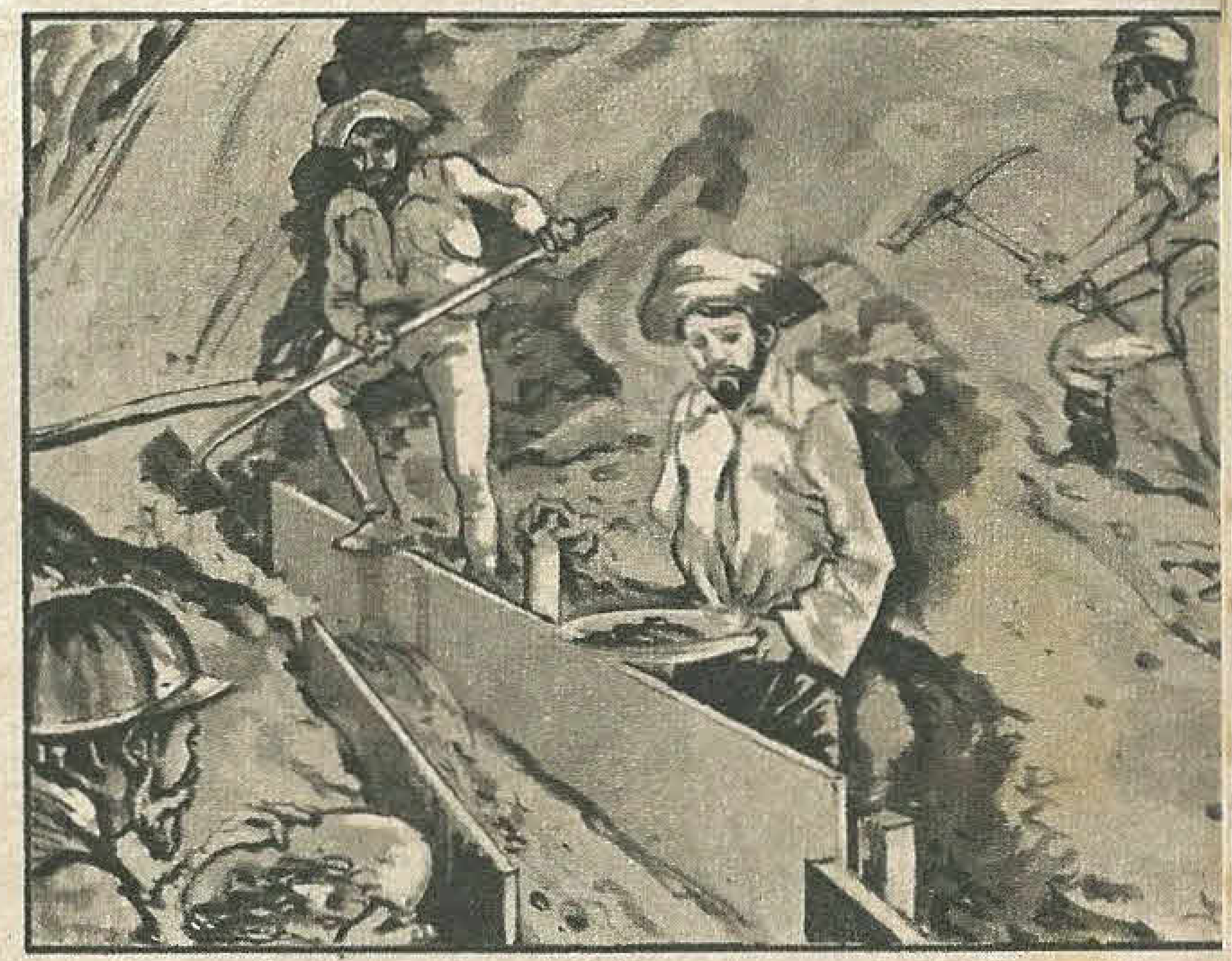
3. But Chief Sitting Bull (inset) who had fled from America after General Custer's death, tried to persuade other tribes to turn against the Mounties. He even made an unsuccessful raid on their ammunition store at Wood Mountain before he was finally defeated and agreed to return to America.



4. Gradually the Mounties established peace with the Indians, who came to respect the skill and honesty of the white men. The force increased in size, and its duties included guarding trains travelling across the vast wild lands. As crime diminished farmers and traders began to realize that the Mounties always got their man.



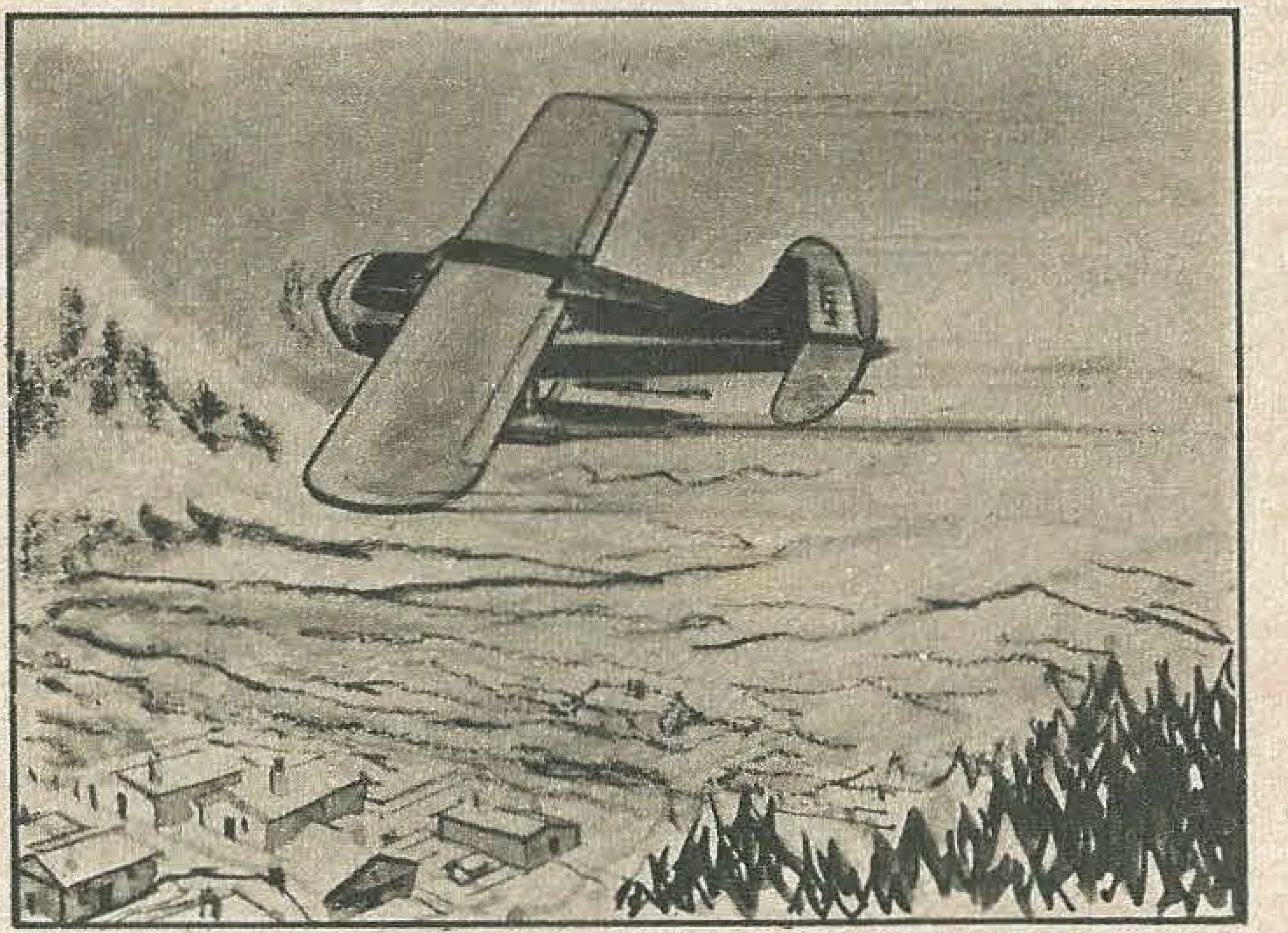
5. The Mounties also helped to stop smuggling. They held up suspected traders and searched their cargoes for illicit alcohol or guns smuggled over the border from America. Penalties for smuggling included fines, hard labour and confiscation of property.



6. In 1895 the British Empire's most northern police station was built in the Yukon—the "roof of the world." Next year the Klondyke gold rush began, and the Mounties had to keep order among the tough trappers and miners who flooded into the area, hungry for fortunes. The Mounties had to work in blizzards at below-zero temperatures.

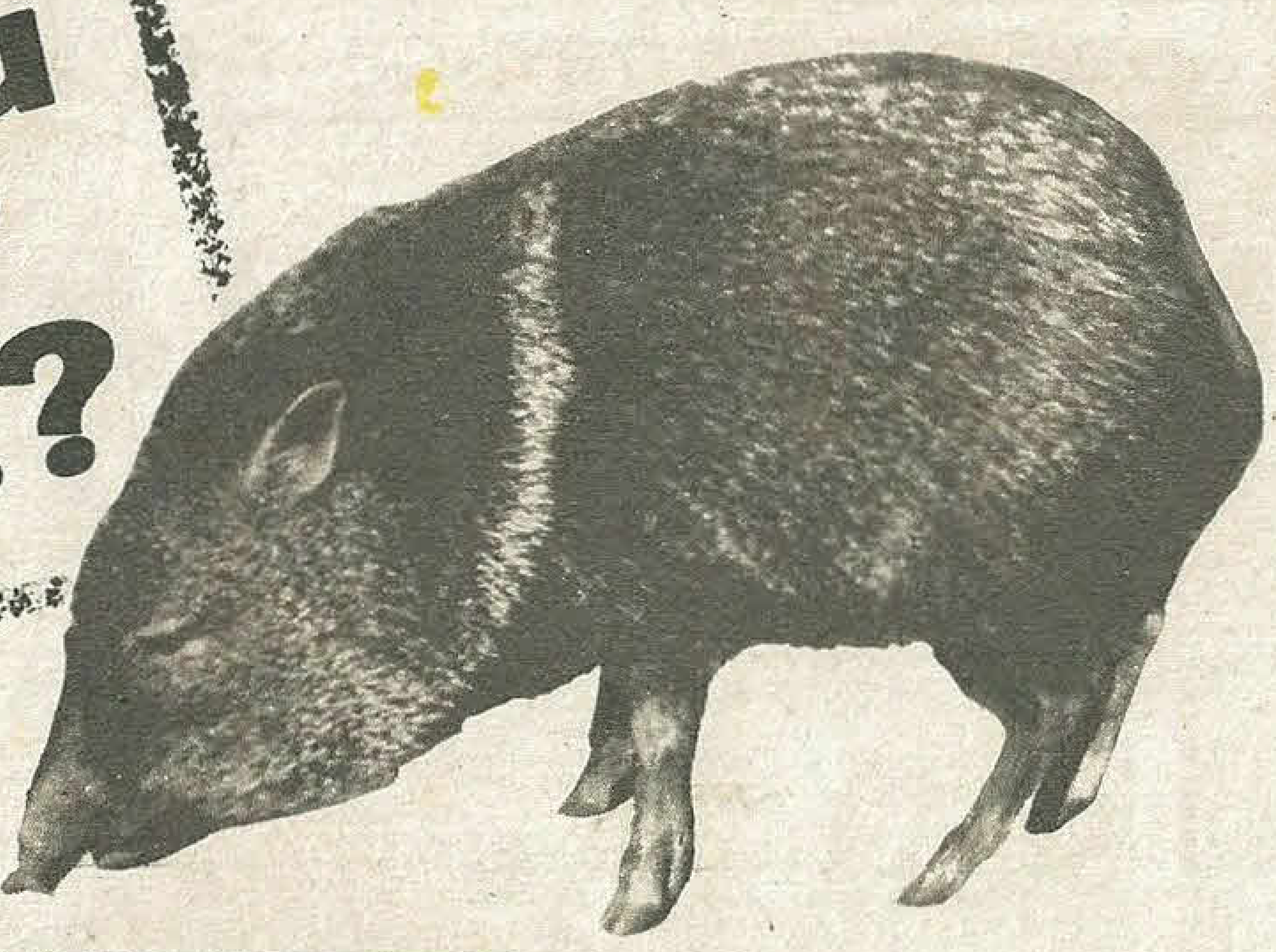
7. They also had to protect government money being transferred from the Yukon by ship. Not a dollar was lost, despite gangs which lay in wait at docks. Mountie patrols often carried mail to outlying mining camps.

8. In 1904 Edward VII (inset) granted the Mounties the right to call themselves the Royal North West Mounted Police. In 1916 numbers dwindled, however, when many men left to join the army and fight against Germany in Europe.



9. Today the modern Mounties use aeroplanes for difficult patrol work and for communications. They have a marine division for coastguard and rescue work, detective and Special Branches and police dogs. The old pill-box hats have been replaced by broad-brimmed stetsons.

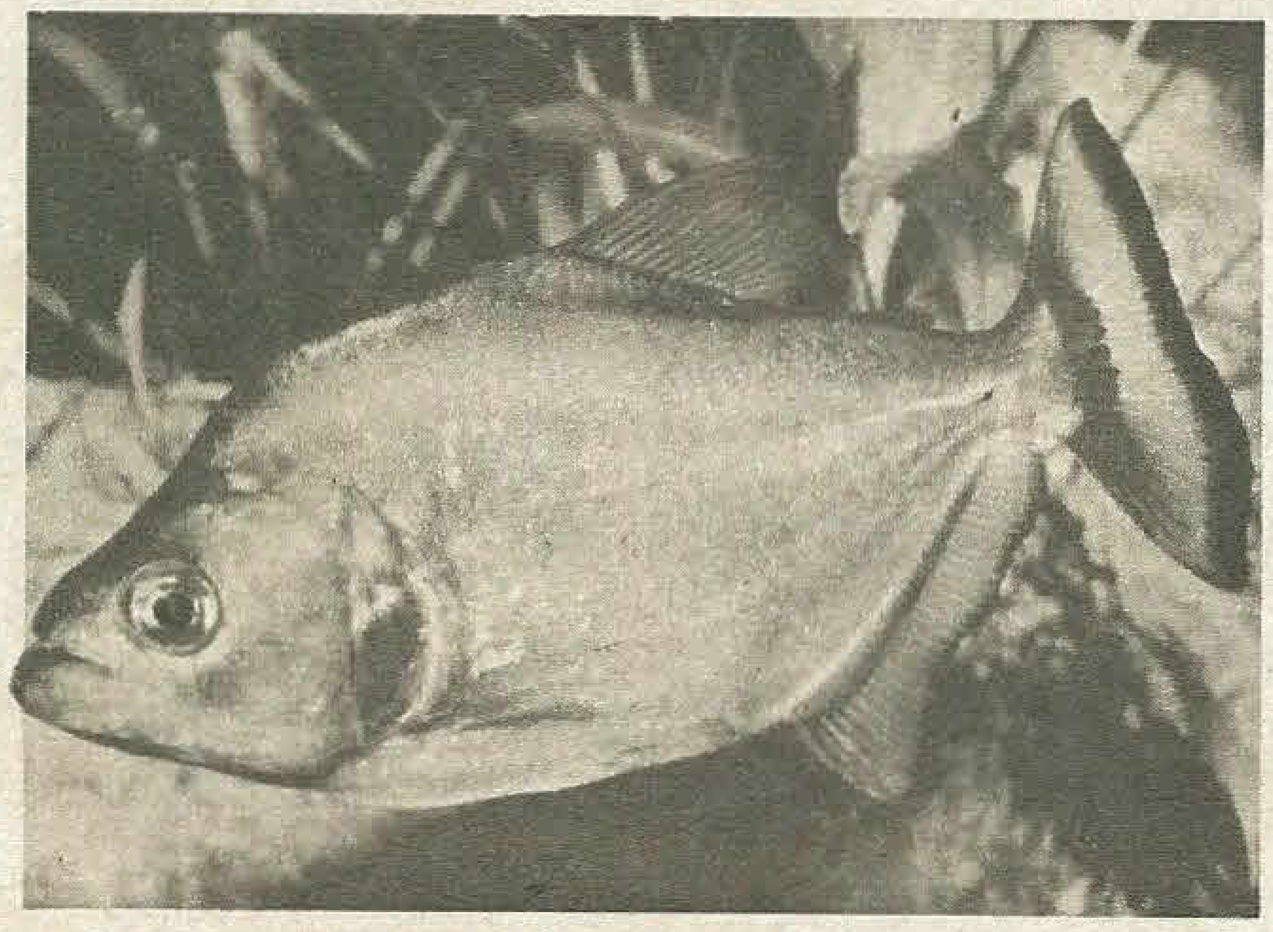
Did You Know That...?



. . . although the animal in our picture may look strange to you it is, in fact, a member of the pig family. It is the collared peccary, the only wild pig in North America and is so named because of the white stripe on each shoulder. This animal makes numerous holes in the ground in order to obtain water from the roots of cacti and other plants. The peccary is about 3 ft. long, and lives in small herds of 8 to 10.

WHO IS THIS? See page 29

. . . one of the cheapest and most easily obtained goods of today used to be the most precious in ancient times. It is salt, which played a great part in the history of many countries, as those which could produce it were in a very advantageous position for trading. Roman soldiers received part of their pay in the form of salt, and this was known as "salt money," or *salarium*. From this Latin word we get "salary," which means wages. The only salt mine left in Great Britain is in Cheshire, and you can see it being worked in the picture above.



. . . although this fish may look like one from your goldfish bowl, this species has probably killed more people than sharks. It is the notorious Piraya or Tiger Fish. Found in great numbers in South American rivers and streams, the largest growing to twenty inches long, these fish are sent into a frenzy by the smell of blood in the water. They have been known to strip all the flesh from a 400 lb. pig in less than ten minutes.

. . . in most European countries people put their money into a bank for safety, but in Santa Cruz, S. America, a whole family's fortune may consist of the feathers of the honey bird, which are worth a great deal. People who have wealth in this form do not put it in a bank, but plait the feathers into a coil of rope such as the one you can see on the left.

COLLECTORS' CORNER

APPLES ON STAMPS

APPLES have appeared on the stamps of Argentine and New Zealand in 1936; Latvia 1939; Hungary 1954; and Bulgaria and New Zealand (shown here) in 1956.

During the apple's history, research, grafting and budding have produced thousands of varieties, though only a small proportion of these have gone into cultivation. Apart from desert, and cooking apples, large numbers of special varieties are grown for cider brewing.

In New Zealand, apples are a major crop, and form part of the country's exports to Britain. The apple-growing industry there is very advanced and as highly developed as anywhere in the world.

JIGSAW THAT

MIDNIGHT, black as pitch. The North Sea—and the worst storm in living memory. For weeks winds of hurricane force had swept down from the icy north. But tonight, it seemed, they had reached their climax.

The larger vessels—the liners and the mailboats—had sought shelter in British and Dutch ports. Yet even in the comparative shelter provided by the landmasses they dragged at their anchors and were in danger.

Only the little motor vessel Amethyst was out at sea, and she was in trouble. Her motors had broken down, her radio was out of action and despite the joint strength of two men at the wheel she had been swept south almost to the English Channel. A solitary look-out had lashed himself to the bows, watching for the warning flash of the Westhinder lightship.

Below deck the engineers fought to keep their balance on the heaving decks as they struggled to repair their engines.

Hours later the speaking tube in the charthouse whistled shrilly. "Engines repaired, sir," the engineers reported.

The captain turned to the first officer.

"Start her up, Mr. Mate . . . half ahead both . . . full ahead both, . . ."

As the engines turned and the screws bit again into the water the strain on the wheel relaxed. The captain smiled at them. He spoke again, as if to himself:

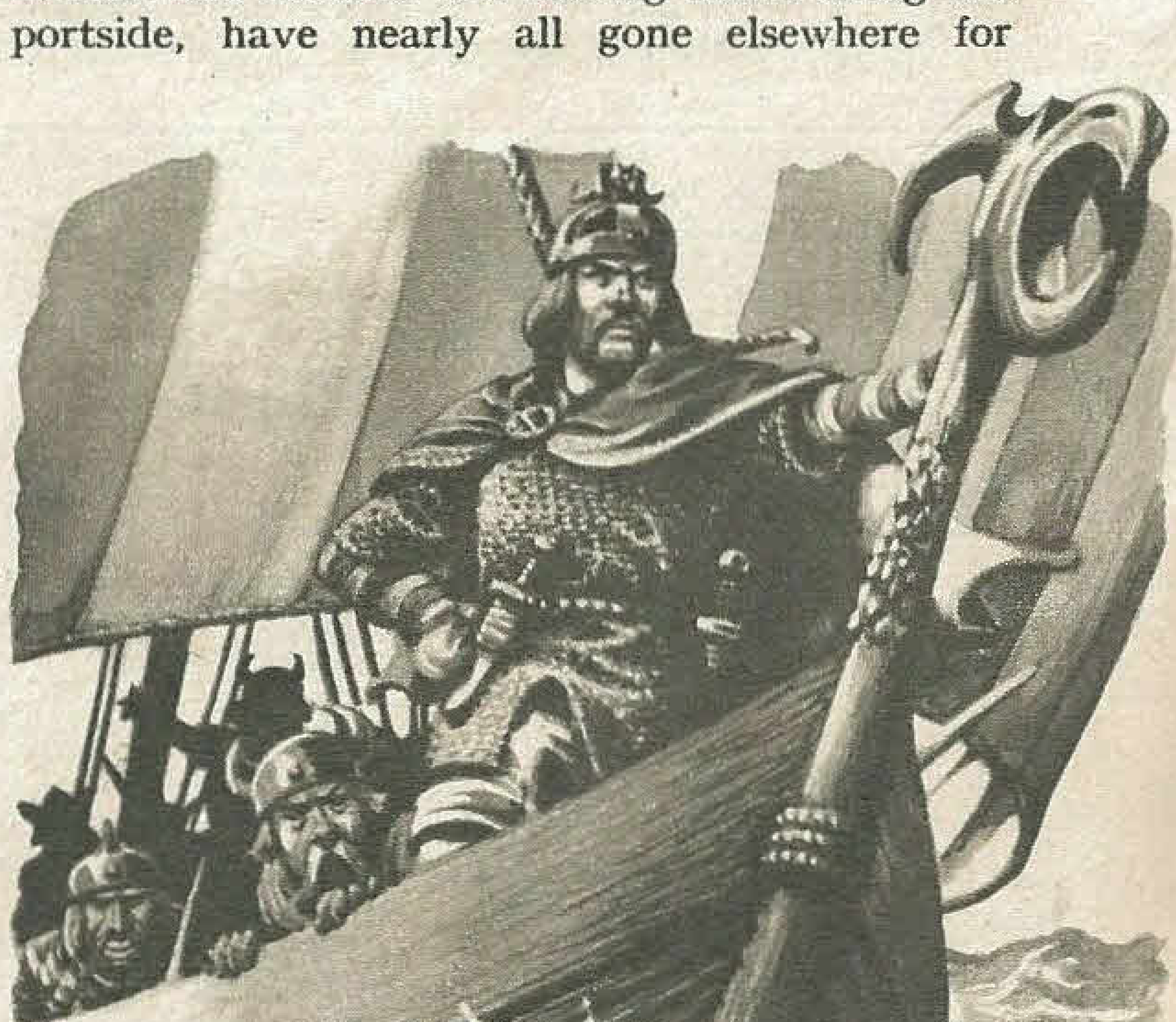
"Great men these . . . they're from Stornoway. The greatest sailors in the world. . . ."

Early Pirates

STORNOWAY men! They are respected wherever ships sail. Stornoway is the biggest town of Lewis-with-Harris, known locally as the Long Island and the largest of the Western Isles. The northern part of the island, Lewis, is part of the mainland county of Ross and Cromarty. The town has been renowned for its seamen almost as long as men have put to sea in ships. Its fishing fleets were the greatest in Europe, its sailors the hardiest in the world.

This, perhaps, is to be expected from island dwellers. But these men have something special about them—something that they have, perhaps, inherited from the Norse pirates who dominated Lewis for hundreds of years until a treaty signed in 1266 gave the island back to Scotland.

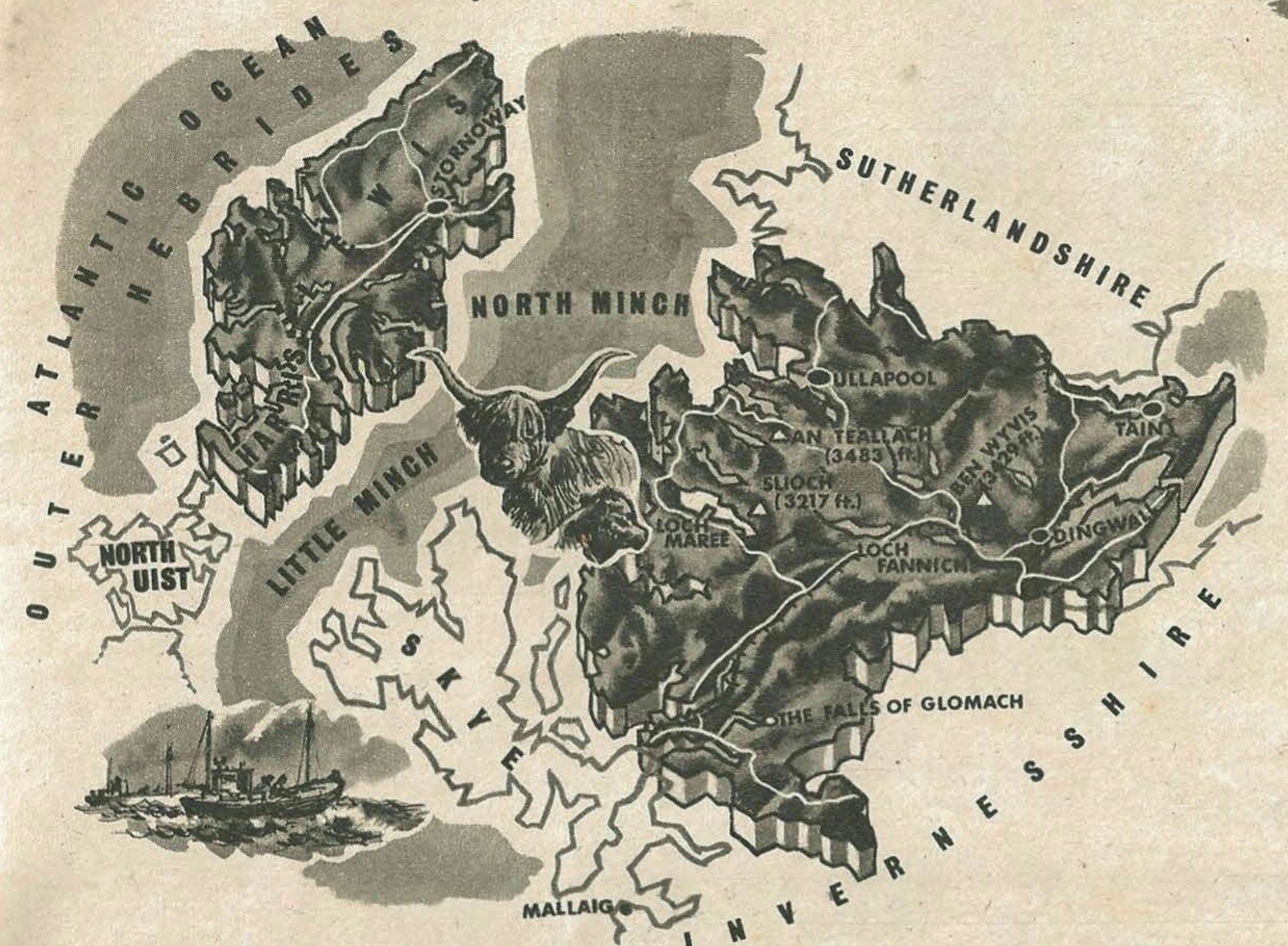
Today the fishing industry has declined and the bustling fishing ports are almost silent. The sturdy Scotswomen, clad in their blue jerseys, scaley aprons and Wellington boots, as they filleted and cleaned the herring catch along the portside, have nearly all gone elsewhere for



The keen eyes of Stornoway men still scan the seas as the Norse pirates of Lewis did a thousand years ago.

WHERE THE WORLD WAS BORN

That is how the mountain folk of Ross and Cromarty describe their beautiful county. Here, on the seashore, you can find the oldest known rock in the world



employment. Frozen fish from Europe and Scandinavia is ruining the greatest fishing industry in the islands.

Even as their fishing fleets were reduced the men of Stornoway have turned to the merchant marines of the world—there is hardly a nation with merchant ships on the seas today that does not boast its quota of Stornoway sailors.

Fortunately for Lewis a new prosperity is coming—a prosperity based on the age-old industry of Harris tweed. And though this prosperity is still small, by the old standards, it is growing greater each year.

Originally the weaving of this world-famous tweed was a small crofters' home craft. It began in the southern part of the island, hence its name "Harris tweed." But now it has moved north and has been modernized. Chemical dyes have taken the place of home produced vegetable dyes; the yarn is now machine spun but the finished cloth is still handwoven. And the quality is higher than ever.

Sheer Grandeur

With modern marketing methods hundreds of miles of the cloth is shipped all over the world and still production cannot keep up with demand.

While Lewis has found a new industry, a new beginning to prosperity, what of the mainland county of which it forms a part?

Ross and Cromarty stretches from the Atlantic in the west to the North Sea in the east; it includes the northern islands of the Outer Hebrides, and that means that it includes the Lewis part of the Long Island.

For sheer grandeur there is not another part of Britain that can even approach Ross and Cromarty.

Its southern border, with Inverness-shire, is a magnificent rampart of peaks all between 3,400 and 3,900 feet high. In fact only a very small part of southern and western Ross is under 1,000 feet.

In the Liathac mountain group there are peaks of 3,456 and 3,358 feet; famous Ben Slioch rises 3,217 feet above Loch Maree which, incidentally, is the largest fresh water loch in Britain. In the Fannich group there are at least six mountains over 3,000 feet; in the northwest, the Teallach mountains throw peaks 3,483 and 3,474 feet into the air.

However, Ross and Cromarty is famed even more for its tremendous collection of lochs and bays which stretch the whole length of its shore. And the deepest waterfall in Britain is to be found here: the Falls of Glomach which drop a sheer 370 feet.

Good roads are few and communications difficult. Only 60,000 people live in this area of more than 3,000 square miles. They are mostly farmers, with farms that are really smallholdings. Most of them are of five acres or less and the average for the whole of the county is a mere 18 acres.

Salmon Fisheries

In Britain today the county is perhaps best known for the earl who bears its name—the Earl of Ross. The present earl is married to the mother of Lord Snowdon, Princess Margaret's husband. His title goes back to the twelfth century, when the earldom was created by King Malcolm IV of Scotland.

Comparatively little is known of the early history of this region. It is known that, from the first days of the A.D. era, the area was peopled by Gaelic Picts. They were converted to Christianity by Saint Columba.

For three hundred years, from the seventh to the tenth centuries, the coastal regions were under continual attack from the Norse pirates. They have left reminders of their presence in the names of many towns and villages—such as Dingwall and Tain.

The county of Ross was split from the Province of Moray and became a separate entity in 1661. Cromarty was created as a county in 1685. They were consolidated as Ross and Cromarty only in 1889.

The finest of all salmon fishing is to be found here. In fact the salmon fisheries are part of the county's economy and when salmon is out of season, the fisheries turn to off-shore catches, such as herring, ling and cod.

Only 800,000 acres of the mountainous country are arable land—and this includes the land of the island of Lewis. The people are fiercely independent and proud—proud of their heritage, proud of their land.

You too can share in this pride. If ever you go to Lewis for a holiday, go down to the shore and chip away a piece of the rock you find there.

Keep it, for Lewisian Gneiss as the rock is called, is the oldest rock in the world. Some scientists say that it is even as old as the world itself.

And, somehow, this ancient ruggedness, this kinship, as it were, with the earth's creation, has become part of the character of this proud people.

The mountain folk of Ross and Cromarty will take you by the hand and lead you to the top of a peak. In the distance, almost on the horizon, you will see the hard outline of the Long Island.

"There," they will tell you, pointing, "was the world born."

The cloth woven on the Long Island has won fame throughout the world as "Harris Tweed."

SEARCH FOR THE RUNAWAYS

On a day in the early nineteenth century a crowd of people gathered on the quayside in New York as a boat from Europe approached her moorings. When they were within hailing distance, the waiting people sent up a cry to those on deck: "Is she dead?"

The answer came back in sad tones. "Yes," and some of the waiting people wept at the news.

Who was dead? Why were there such anxious inquiries?

It was Little Nell who had died, the heroine of Charles Dickens's story, *The Old Curiosity Shop*, running as a serial in a magazine. The last instalment to arrive in America had left little Nell at death's door. On board the ship were copies of the next instalment and the faithful American readers of Dickens could not wait for them to be unloaded to hear the news they feared.

Yes, Little Nell was dead, killed by exposure to the weather as she journeyed around the countryside with her grandfather, the original owner of the Old Curiosity Shop, which he had lost to Quilp, the rascally financier, because of gambling debts.

They had run away together, with no clear idea of where they were going, and the first real sign of friendship they met came from Mrs. Jarley, a large lady who lived in a caravan and toured with Jarley's Wax Works. Nell learned how to lecture to those who paid to see the show, but her grandfather still gambled, though he tried hard to give it up.

To get him away from such influences, Nell persuaded him to leave, and on they went through heavy rains to the village of Tong, where they were given shelter. But Nell was already ailing. . . .

Through the novel pass many characters, well drawn by the master pen—the faithful young Kit Nubbles who sets out with Mr. Garland, brother of the grandfather, to search for the runaways; Dick Swiveller, who originally planned to marry Nell when he believed her grandfather was rich.

Casting a shadow of villainy throughout the whole story is Quilp, the dwarf, whose shady dealings put the police on his trail. In a dramatic scene where he tries to escape them he falls into the river and is drowned.

Originally, the story concerned only the Old Curiosity Shop itself, but Dickens lengthened and developed the tale with the travels of the two runaways.

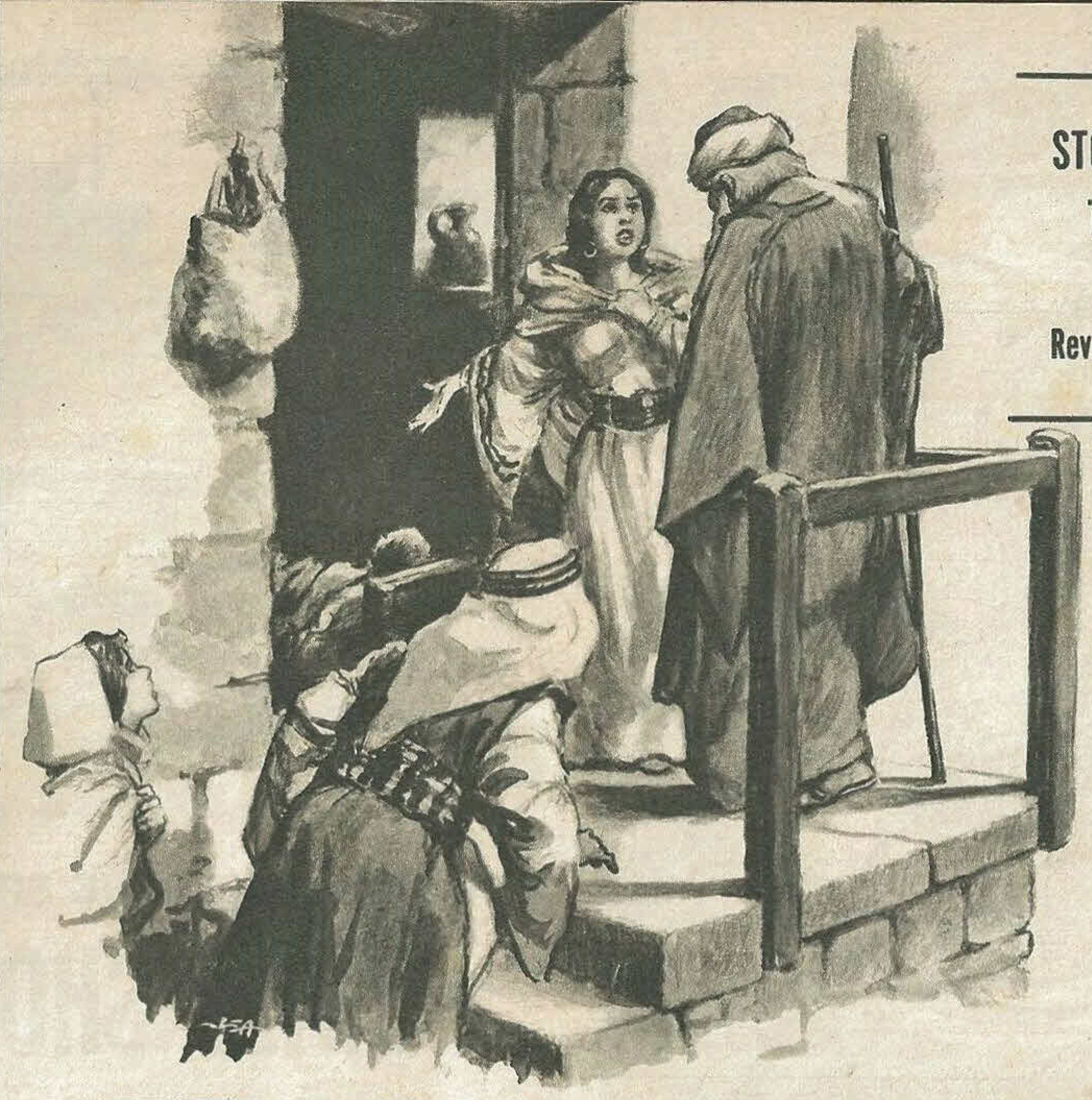
Dickens was so fond of the characters he had created that he was reluctant to bring the story to a close. He finished the story at four o'clock on the morning of January 17, 1841.

"It makes me melancholy," he said afterwards, "to think that all these people are lost to me for ever and I feel as if I never should become attached to another set of characters."

But the great novelist was still to create many more—the characters who peopled such novels as *Martin Chuzzlewit, A Christmas Carol, Dombey and Son, David Copperfield, A Tale of Two Cities* and *Our Mutual Friend.*

◀ As Nell and her grandfather approached the caravan Mrs. Jarley, proprietor of the travelling show called Jarley's Wax Works, was about to have her tea. She gazed at the travel-stained couple and said to Nell, "Come nearer, child. Are you hungry?"

STORIES FROM THE BIBLE
by the
Rev. JAMES M. ROE



"What sort of prophecy was this?" asked the mother. "Did you promise me a son only to bring me sorrow?"

THE MIRACLE AT SHUNEM

A MAN called Elisha became the chief prophet in Israel after Elijah, and among the stories told of him is one concerning a little Hebrew boy.

We do not know the boy's name, but we do know that Elisha was a great friend of his parents. At their home in Shunem a special room was kept ready for the prophet. It was while staying at this house some years before that Elisha had prophesied the birth of a son to his friends, who were delighted when this promise came true.

But one day a messenger rode in haste to the door of another home many miles away, where Elisha was staying.

"I've come from Shunem," he gasped. "It's the boy—he was out in the fields with his father when he suddenly became ill. Said he had pains in his head. We thought it was sunstroke, but he died soon after we'd carried him home. His mother wants you to come!"

Servant's Mission

Elisha set off at once, and on the way met the child's mother, who had come to meet him. "What sort of prophecy was this?" she cried. "Did you promise me a son only to bring me sorrow?"

Seeing her distress, Elisha called Gehazi, his servant, and said, "Run ahead as fast as you can. Don't stop for anything, and when you reach the child lay my staff against his face."

Gehazi set off swiftly, while Elisha and the mother followed at their best pace. But as they neared the house Gehazi met them and said to Elisha, "I did as you asked, but it's no good. There's not a sign of life. See for yourself; they've taken him to your own room."

Elisha climbed quickly up to the little room which he knew so well. There was the boy, stretched out on the prophet's own bed, but lifeless and still. Elisha closed the door, knelt at the bedside, and prayed earnestly that God would restore life to the child whom they all loved so much.

Kiss of Life?

Then Elisha did a strange thing. Lying on the bed, he placed his strong, warm hands upon those of the lifeless child. Then he touched the child's eyes with his own, as if to give his own sight to them; finally he pressed his own mouth close to that of the child.

Many people say that Elisha revived the boy by the "Kiss of Life" which is well-known today as a means of re-starting the breathing of an apparently dead person. This is possible, but by no means certain. Elisha's acts were intended as signs of his power as a prophet of God rather than as any form of "artificial respiration."

But whatever actually took place, the little boy began to breathe again, and, as the Bible rather strangely records, "sneezed seven times" before opening his eyes!

The thankful mother fell at Elisha's feet in gratitude for the son whose coming he had promised so long ago, and whom God had now restored to her care.

ANSWERS from page 2

Literature
(1) (c) *novelist.* (2) *Hugh Walpole.* (3) *The missing word is Walrus, and the author is Lewis Carroll.*

People
(1) *Both were geographers and both made maps.* (2) *Dwight D. Eisenhower.* (3) *Viscount Linley.*

Music
(1) *Four.* (2) *Deafness* (3) *Puccini.*

Geography
(1) (b) *350 miles.* (2) *Holland, Luxembourg, France, Switzerland, Italy, Austria, Czechoslovakia, Poland.* (3) *Pacific Ocean.*

Legend
(1) *Wolf.* (2) *Guinevere.* (3) *Hercules.*

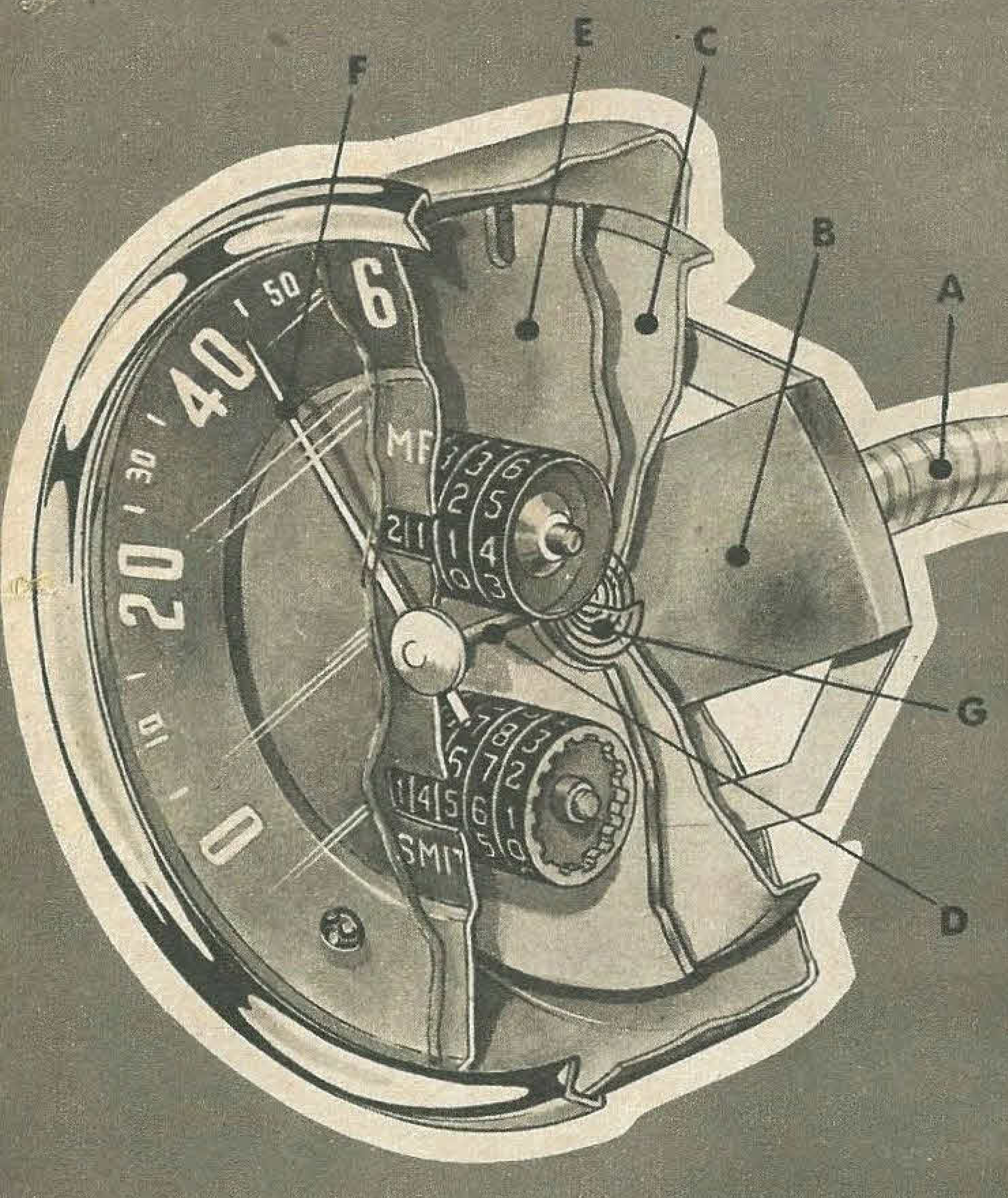
Natural History
(1) (*a*) *An animal.* (2) *Metazoa.* (3) *Lily.*

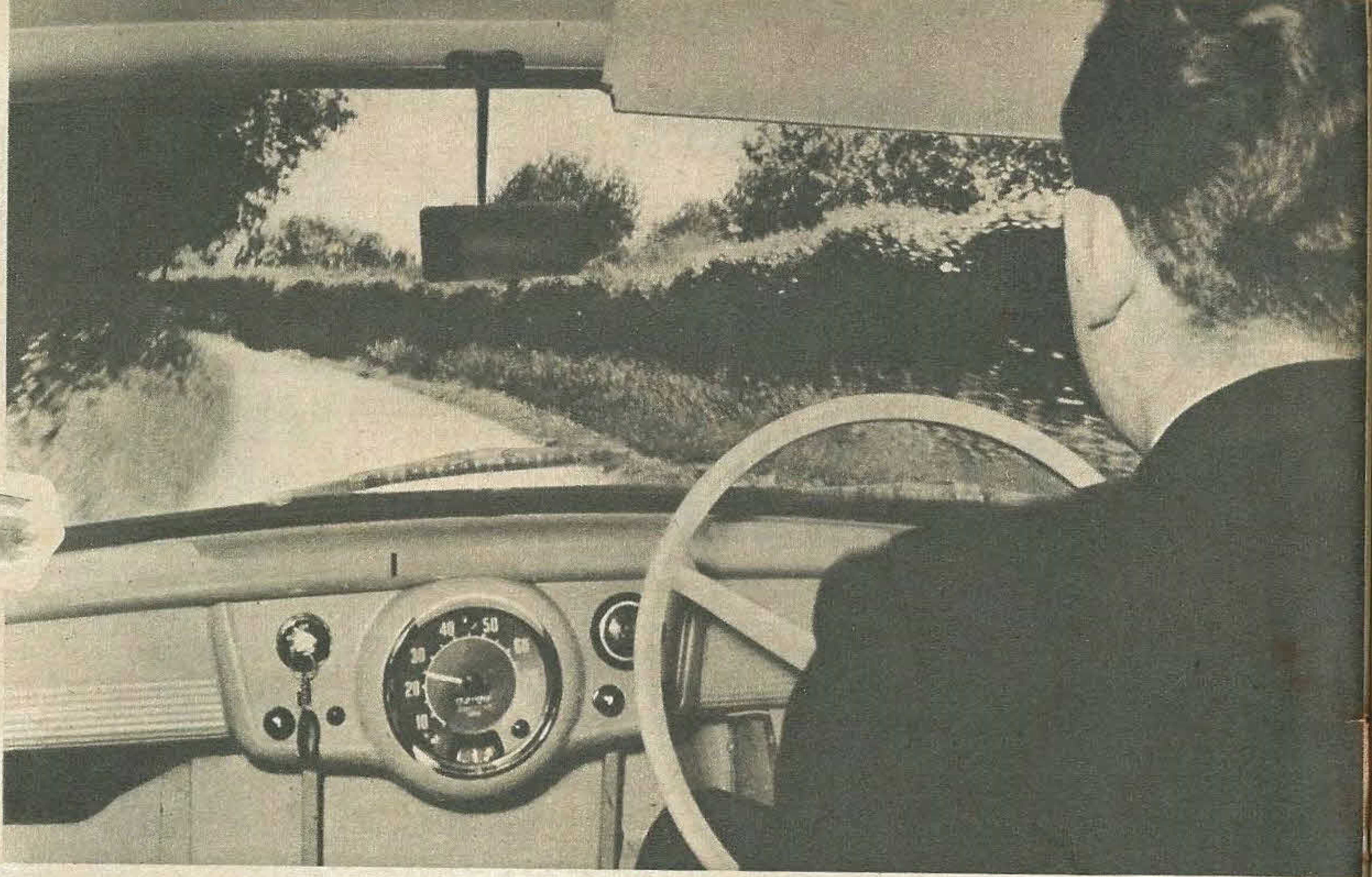
History
(1) *An Emperor of Rome.* (2) *Richard Cromwell, Oliver's son.* (3) *The Houses of York and Lancaster.*

Art
(1) *Romanticist.* (2) *Dutch.* (3) *Pieter the Younger and Jan Brueghel.*

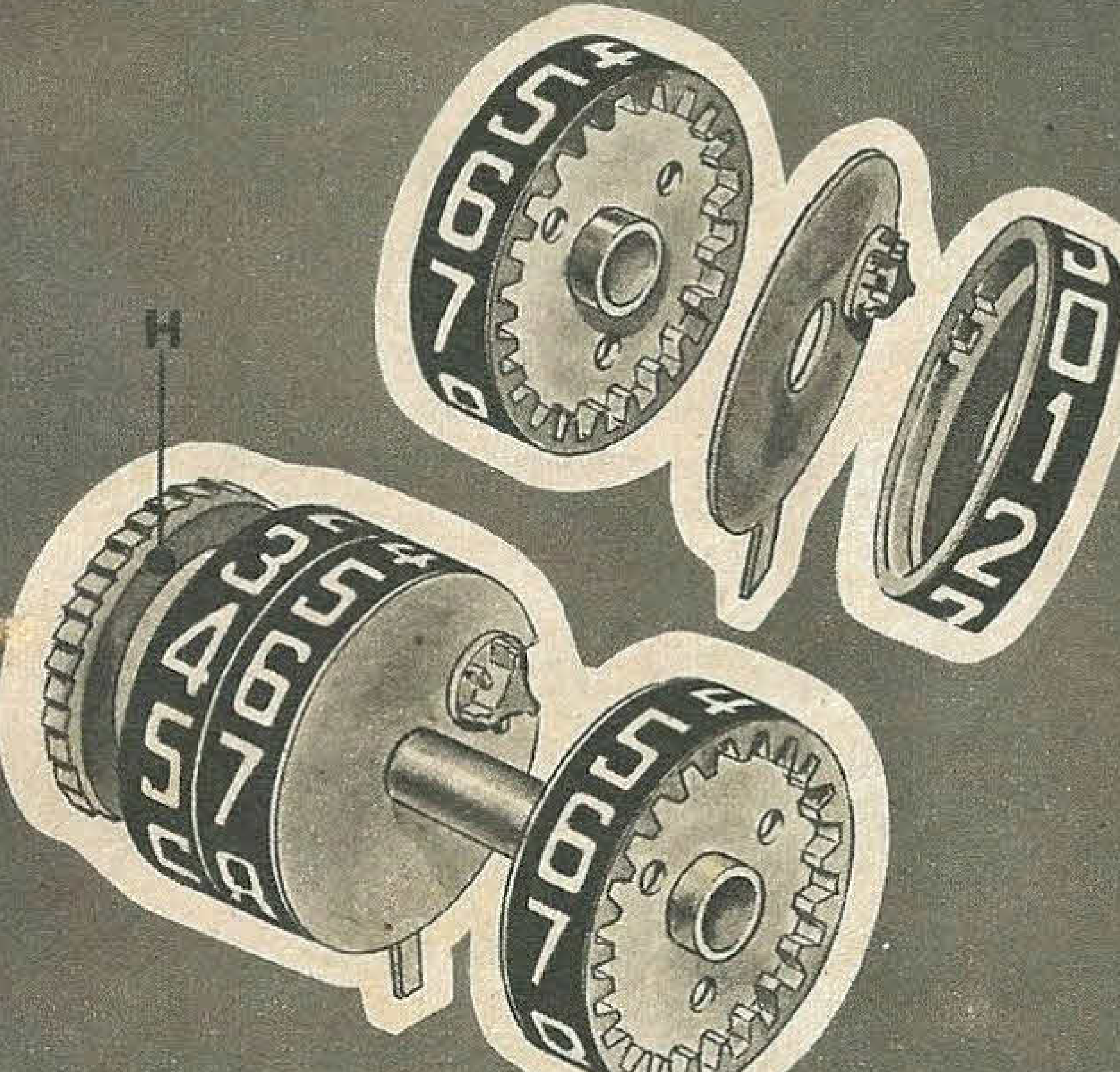
SOLUTION TO CROSSWORD (from page 22)
ACROSS: 1. Chefs; 4. Smelt; 9. Tarmac; 10. Jungle; 12. Lilac; 13. Trefoil; 14. Ushered; 20. Braille; 22. Patch; 23. Animal; 24. Hookah; 25. Comet; 26. Henry.
DOWN: 2. Harold; 3. Francis; 5. Mouse; 6. Legion; 7. Stile; 8. Bells; 11. Steered; 15. Explore; 16. Abeam; 17. Calico; 18. Stoker; 19. Shahs; 21. Leave.

ANSWER TO MYSTERY PICTURE (from page 26): HAILÉ SELASSIÉ

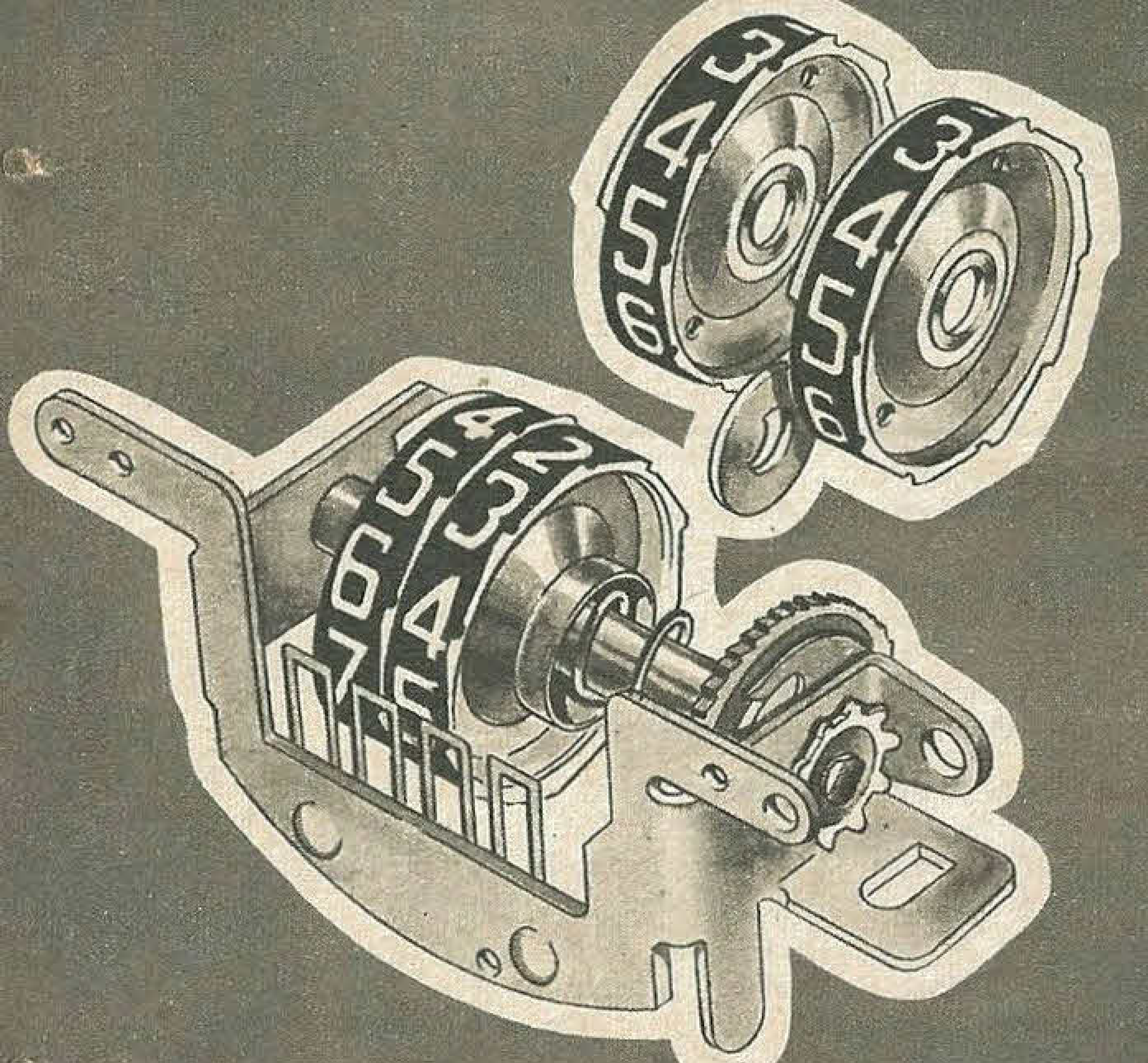




TOTAL MILEAGE INDICATOR



TRIP MILEAGE INDICATOR



HOW IT WORKS—THE SPEEDOMETER

DIALS SHOW THE MILES

There are three things the driver wants to know—how fast he is going, how many miles the car has travelled, and the mileage of each individual trip. One glance at the dashboard tells him

EVERY day millions of vehicles travel on the roads. Some use motorways, where high speed is compulsory, and others move in built-up areas where there are speed-limits. To both types of motorist, the speedometer is a vital instrument.

The diagram at top left shows an exploded view of a magnetic type speedometer used in most cars and light vehicles. It is driven by a flexible drive from the gearbox.

The flexible drive (A) rotates a bar magnet (B) positioned close to a shallow aluminium dish or drag cup (C) which is fixed to a spindle (D). The spindle passes through a support disc (E) called a stator, and carries the speedometer pointer (F) on the dial face.

The drag cup is anchored to the stator by a very delicately balanced hairspring (G).

Spinning Magnet

As the magnet spins round it produces electro-magnetic currents which turn the drag cup, and move the pointer on the dial. But because the drag cup is held back by the pull of the hairspring its movement is restricted.

The faster the vehicle travels, the faster the magnet spins and the greater the pull on the drag cup against the hairspring. This means that the needle moves farther on the dial.

So you can see the basis of the working of a speedometer. More speed, more magnetic power created, more movement of the needle on the dial, and therefore a greater miles-per-hour shown. The whole installation is carefully "calibrated" or worked out in detail so far as that particular car is concerned. Only in this way can a true speed reading be given on the dial.

The total mileage and trip mileage indicators (shown on the left) are driven by a ratchet wheel (H) turned by an extension of the flexible drive that rotates the magnet.

The total mileage indicator consists of five counters, each numbered 0-9 and fitted between geared friction plates.

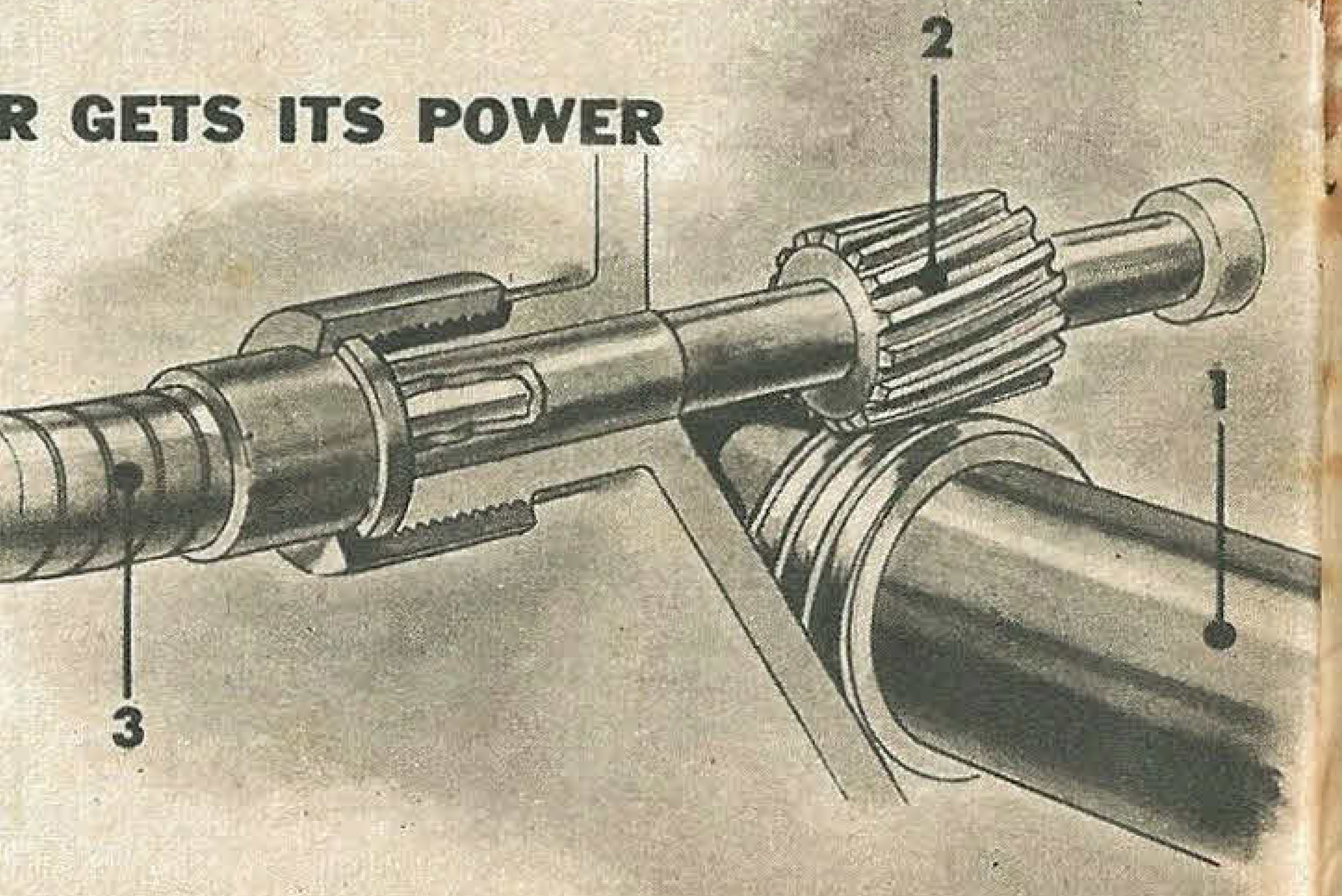
One complete revolution of the ratchet wheel is equal to one unit on the counter—one mile. The counters are so geared that every time the first counter records nine miles, the "score" is passed on to the second counter which registers one unit for every ten miles. The third counter registers one unit for every 100 miles and the last two counters one unit for every 1,000 miles. In turn each counter passes the score on to the next counter until the maximum of 99,999 miles has been recorded. When this happens the counters reset to zero and start again.

The trip mileage, which has four instead of five counters, works in the same way, but its first counter registers tenths of a mile at a time. It can give a reading up to 999 miles and nine-tenths of a mile.

In order to show different types of mechanism, we have illustrated a Total Mileage Indicator worked by toothed gears, and a Trip Mileage Indicator worked by friction drive between the cylinders carrying the numbers.

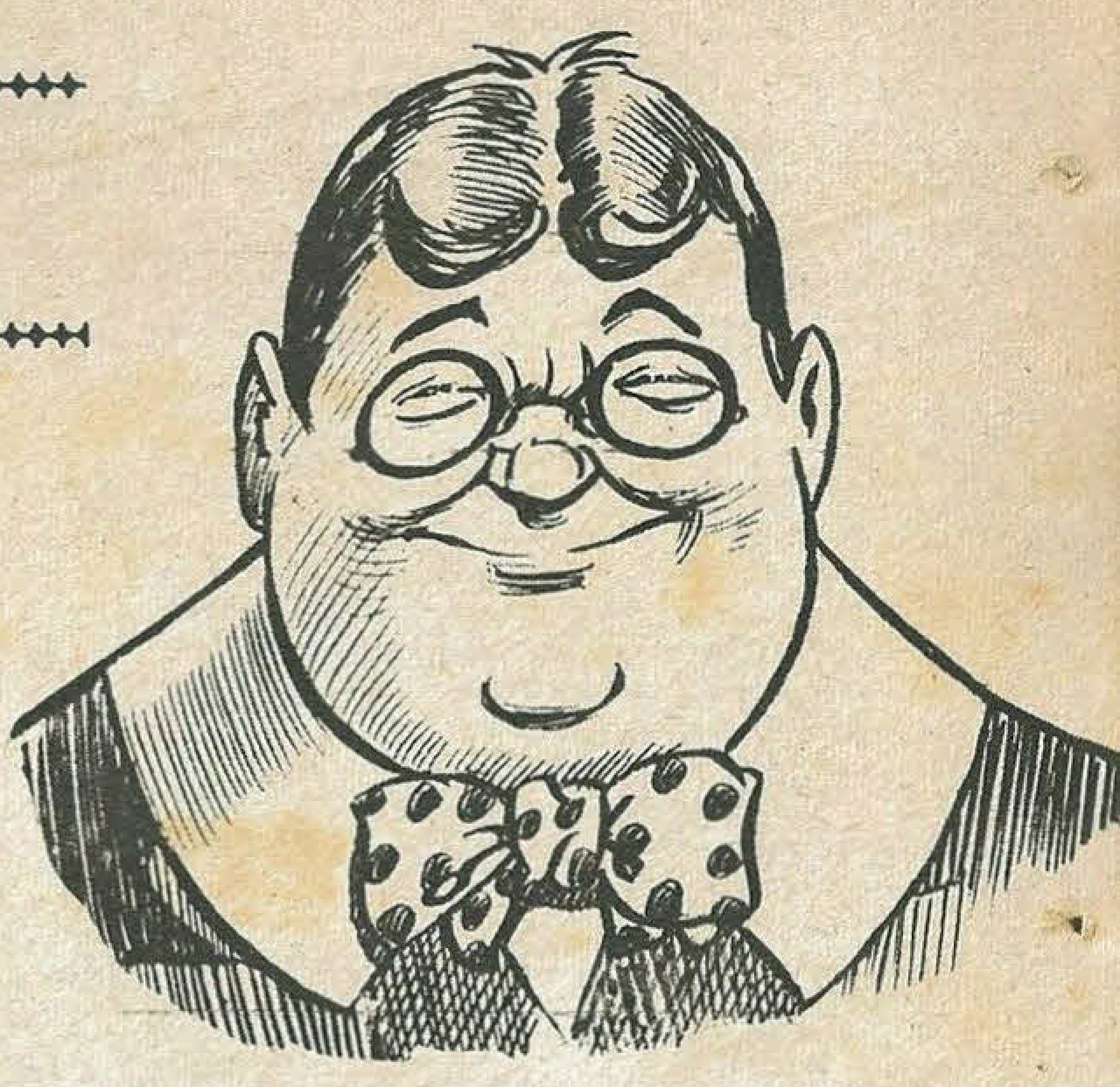
WHERE THE SPEEDOMETER GETS ITS POWER

It is explained above how the reading on the speedometer dial is controlled by a revolving bar magnet. Here is the source of the power which drives it. Attached to the drive shaft from the gearbox (1) are two cogs known as a worm gear (2). They transmit the power to the flexible drive (3). This is a cable which revolves inside a tube with a continuous spring-like covering. It is the other end of this drive which is attached to the bar speedometer magnet.



By courtesy of S. Smith & Sons (England) Ltd.

Continuing the original adventures of the world's most famous schoolboy



THE STORY SO FAR

Bunter plays a trick on Mr. Quelch, master of the Remove form at Greyfriars, and is told to write out a thousand "lines" as punishment. When he delivers the first instalment the master's study is empty, and on the desk is the manuscript of the latest chapters of Mr. Quelch's History of Greyfriars School. A local paper offers a prize of 10 guineas for an essay on the history of the district, and Bunter decides to take the manuscript and enter for the competition. He leaves the study and encounters two form mates, Skinner and Bolsover, who are his enemies. They seize his "lines" and throw them on the fire. Bunter pretends that the papers they have burnt are actually Mr. Quelch's manuscript.

BILLY BUNTER of Greyfriars School

by FRANK RICHARDS

SKINNER and Bolsover stared at the Owl of the Remove in alarm.

"Do you mean that we've chucked some of Quelchy's History on the fire?" gasped Bolsover at last.

Bunter nodded.

"Oh, the fat fool's lying as usual, I expect," said Skinner.

"Oh really, Skinner! If you doubt my word——"

Billy Bunter was looking quite indignant for a moment. The fact that Mr. Quelch's manuscript was still in his pocket did not lessen the indignation of the Owl of the Remove at having his word doubted.

"Still, it's funny for the fat brute to think out such a weird yarn," remarked Bolsover. "Why did you pinch the papers, you fat cuckoo?"

"As a matter of fact, I thought I'd hide them from the beast for a week or two just to annoy him."

"Oh, crikey, is that really the truth?" asked Bolsover, with a searching look at Bunter. "I believe it is. It's just the idiotic kind of thing he would do!"

Bunter blinked at his companions rather scornfully. Now that he had succeeded in convincing them he was beginning to regain his confidence.

"I say, you fellows, there's no need to get the wind up, you know," he said with a sniff. "Be like me—brave as a lion! A little incident like this is all in the day's work to me!"

"Why, you fat porpoise," gasped Bolsover. "I'll pulverise you! I'll—I'll——"

"Stow it!" snapped Skinner. "We want to settle this business right away. What we want from you, Bunter, is a solemn promise that you're going to keep this really dark."

Bunter nodded. "You can rely on me, you chaps." He rolled towards the door, convinced that they would now let him go. He was right. Bunter returned to his own study and dived a fat hand eagerly into his pocket, triumphantly producing the manuscript that weighed so heavily on the conscience of Skinner and Bolsover.

"And now for that competition!" he muttered. "If Quelchy's piffle ain't good enough to win it, I'll eat my blessed hat!"

THE THIRD CHAPTER

A Serious Matter!

"QUELCHY wants you!"

"Blow Quelchy!" said Harry Wharton crossly.

As head boy of the Remove, Wharton had many little responsibilities which did not fall to the lot of the rank and file of the form. He was often required by Mr. Quelch at the most inconvenient times, and no time could have been more inconvenient than the beginning of a fine Saturday afternoon.

It was just five minutes before the time fixed for the kick-off in the football practice match and Wharton was anxious to see how his men were shaping in view of an important fixture with Rookwood School.

"Why couldn't he have put it off until after the practice?" demanded Wharton. "Did he say what he wanted?"

"No, but he looked in a fearful wax," grinned Snoop.

Harry Wharton put a coat over his football kit and sprinted off towards the School House.

He thought that Mr. Quelch's "Come in!" was a little sharper than usual and was not surprised to find that the master's lips were compressed into a straight line that boded ill for somebody.

"I have sent for you, Wharton, because I want your assistance in recovering some papers of great importance which I have lost."

"Yes, sir!" said Wharton, rather surprised.

"Doubtless you are already aware that I am engaged in writing a book on the history of Greyfriars. For several months I have been investigating the events that occurred here during the reign of Henry the Eighth, and the results of my investigations are assembled in two chapters which I have just completed. But the papers containing those two chapters, together with all my rough notes, have disappeared from this room, Wharton. You will appreciate that the loss is a most serious one from my point of view, and I am exceedingly anxious that all the papers should be recovered at once."

"I can quite understand that, sir," said Wharton sympathetically.

"I suspect that the papers were taken from my room yesterday evening. I am hopeful that it is just a foolish prank on the part of some junior, and that you will be able to find out where they are."

"If I were able to do that, sir, I'm afraid I couldn't very well sneak about it."

"Rest assured, Wharton, that I shall not ask you to divulge any names," said Mr. Quelch quickly. "In the event of your recovering the missing manuscript I shall be willing to accept it back without inquiring further into the matter."

He made a gesture of dismissal, and Wharton quitted the room.

THE FOURTH CHAPTER

Searching Skinner's Study

THE practice match was in full swing by the time Harry Wharton reached Little Side again.

"Hallo, hallo, hallo! Everything all right?" called out Bob Cherry from the middle of the field.

"Come and show these slackers how to play, Harry!" yelled Johnny Bull. "We're one down already!"

Harry dumped his coat in the pavilion and joined in the game. Nothing much could be done before teatime, anyway.

"Well, what did the beak want?" Bob Cherry asked when the game ended.

"Our wishfulness to know the wants of the esteemed beak is terrific," said Hurree Singh, in his weird and wonderful English.

Wharton told them about the missing papers.

"Well, I'm dashed! Poor old Quelchy!" said Nugent when Harry had finished, and there was a chorus of sympathy from the others.

"Perhaps that ass Skinner is up to his larks again," suggested Johnny Bull. "You know what a feud there's been lately between him and Quelch. What about turning out Skinner's study when we get back to the House?"

"Good egg!"

Harold Skinner was sitting alone in his study when the raiders entered and he looked quite alarmed at the number of his unexpected visitors.

"What do you want?" he snarled.

"Don't trouble to offer us a seat, Skinner," grinned Bob Cherry. "We haven't come to stay, you know!"

The others laughed, but Wharton said seriously: "Quelchy has lost some chapters of his History of Greyfriars and we've come here to see if you know anything about it. I know we all get Quelchy's back up from time to time, but pinching his papers is a rotten thing to do."

"And he's put the goody-goody Wharton in charge of the investigation!" said Skinner scornfully. "Don't start preaching to me, Wharton. Like as not it's one of your own pals who's pinched the papers!"

A howl of indignation went up from the juniors, and what was intended to be a search of the study turned rapidly into something more—into a full-blooded rag.

Johnny Bull started turning out the contents of the coal scuttle on the study carpet.

"Well, the papers aren't there!" he said solemnly, surveying his handiwork with a critical air."

"See if they're hidden at the bottom of that jam jar," Squiff suggested.

"Who knows?" said Bob Cherry gravely, emptying the jam over the fender.

"Don't miss the chimney—that's a well-known hiding place!" said Nugent.

"Not likely!"

Squiff seized a shovel and began ladling soot out of the chimney. Skinner danced around the study in rage, but he could do nothing to stop the rag.

When it was over the raiders tramped out again, leaving the luckless Skinner to clear up the mess—and to wish that he had not made the sneering remarks which began it all.

In the days that followed it became obvious that Mr. Quelch did not intend to drop the search, and for Bolsover and Skinner it was a nerve-racking time.

"Next thing they'll do," muttered Skinner, "is to question everybody in turn."

"They won't get anything out of us!" Bolsover asserted.

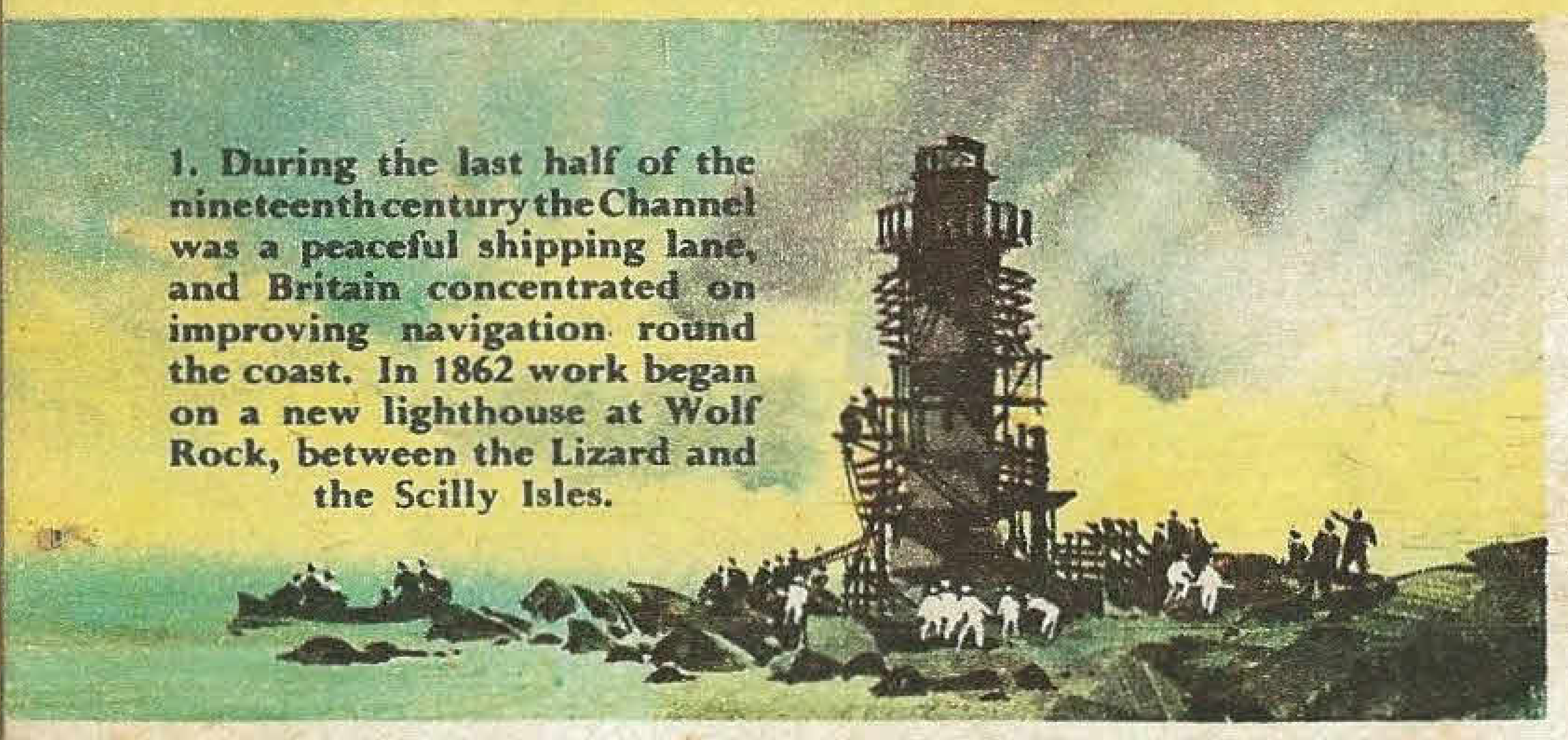
"I know they won't," Skinner responded. "But what if they question Bunter? You know how that fat chump blathers and gives the game away. If he does——"

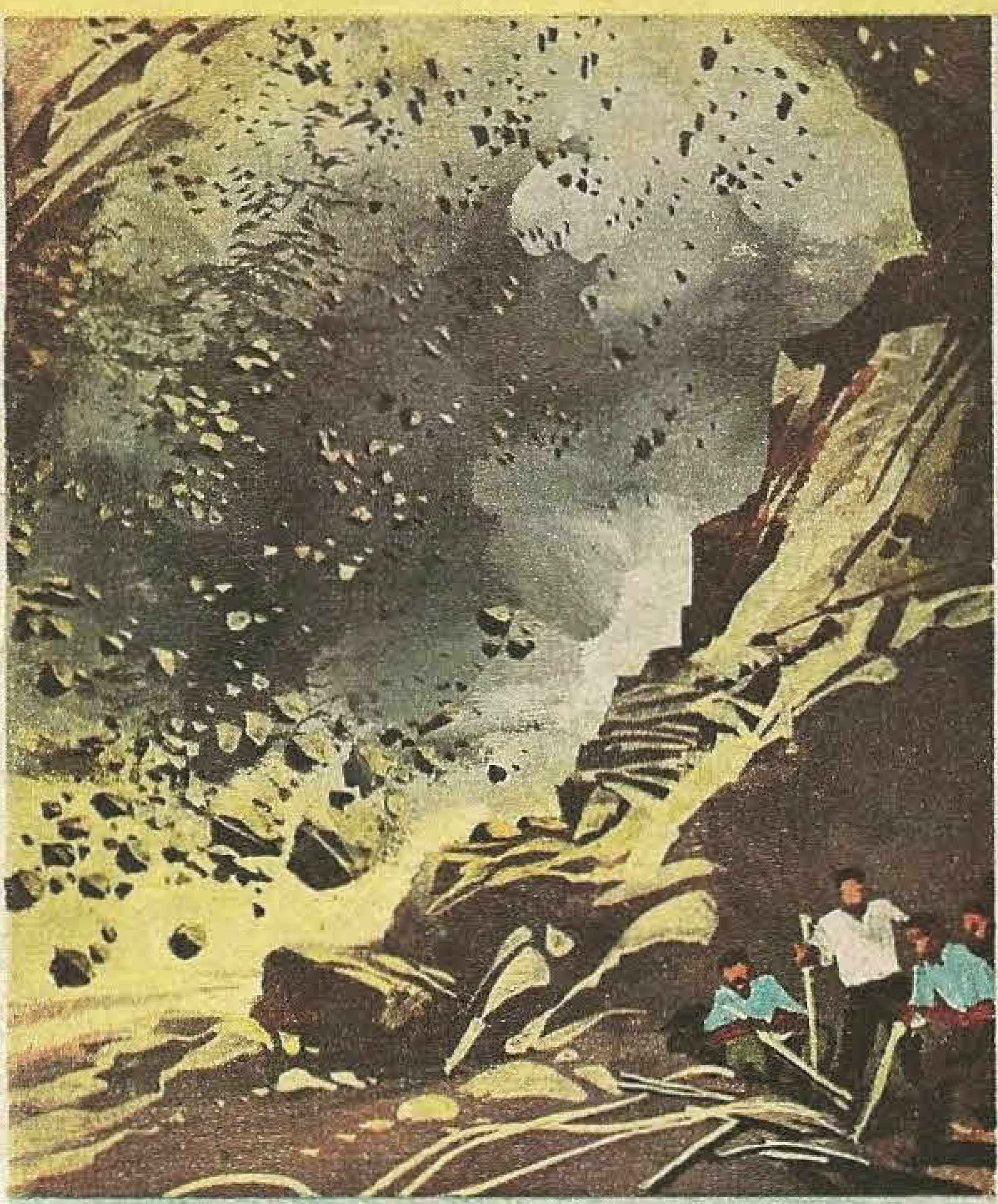
"If he does," finished Bolsover. "We're done for! We might be sacked from Greyfriars!"

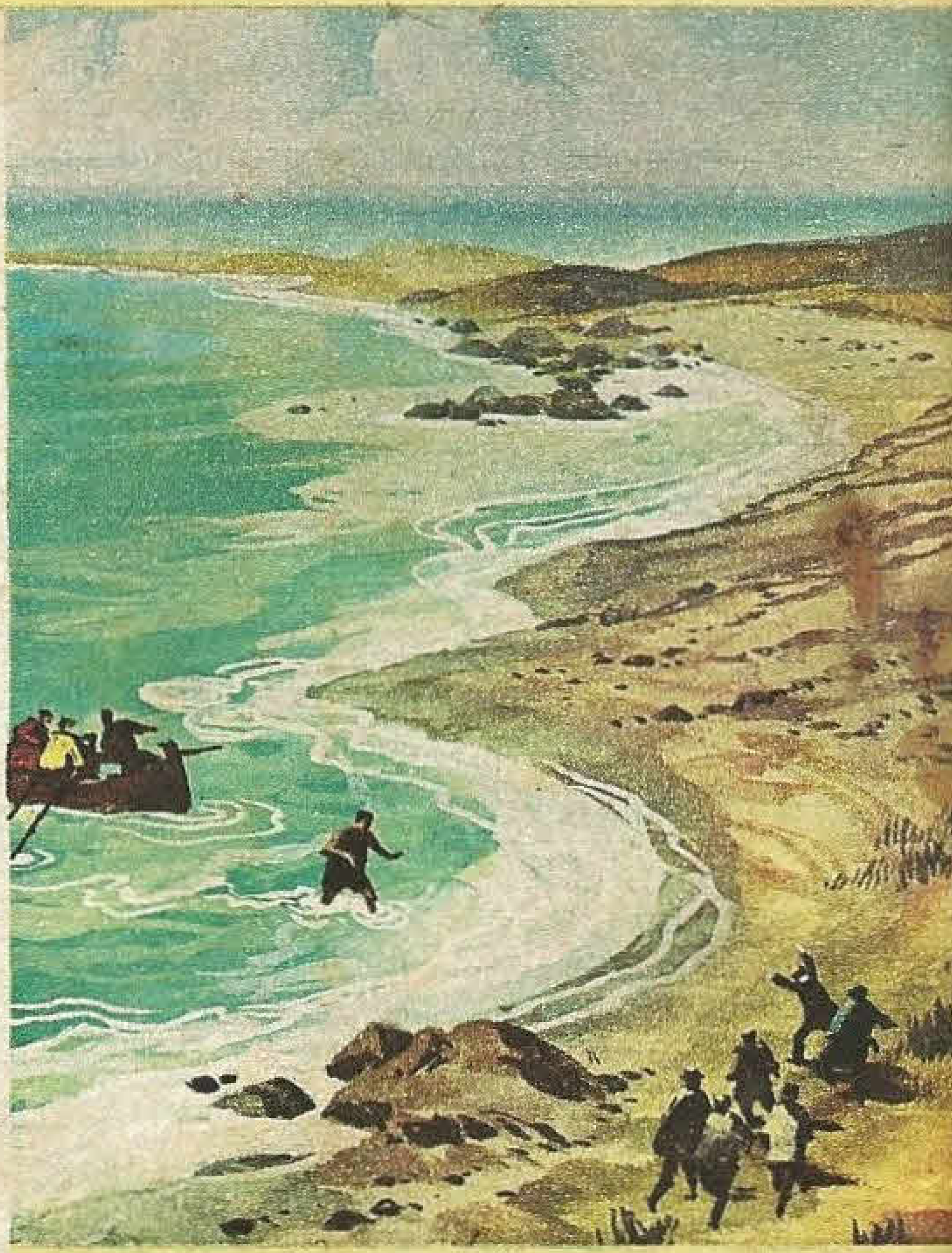
CONTINUED NEXT WEEK

The search of Skinner's study was on with a vengeance! Johnny Bull started by turning out the coal scuttle, while Squiff ladled soot from the chimney. Skinner fairly danced with rage. "Get out of my study!" he yelled.

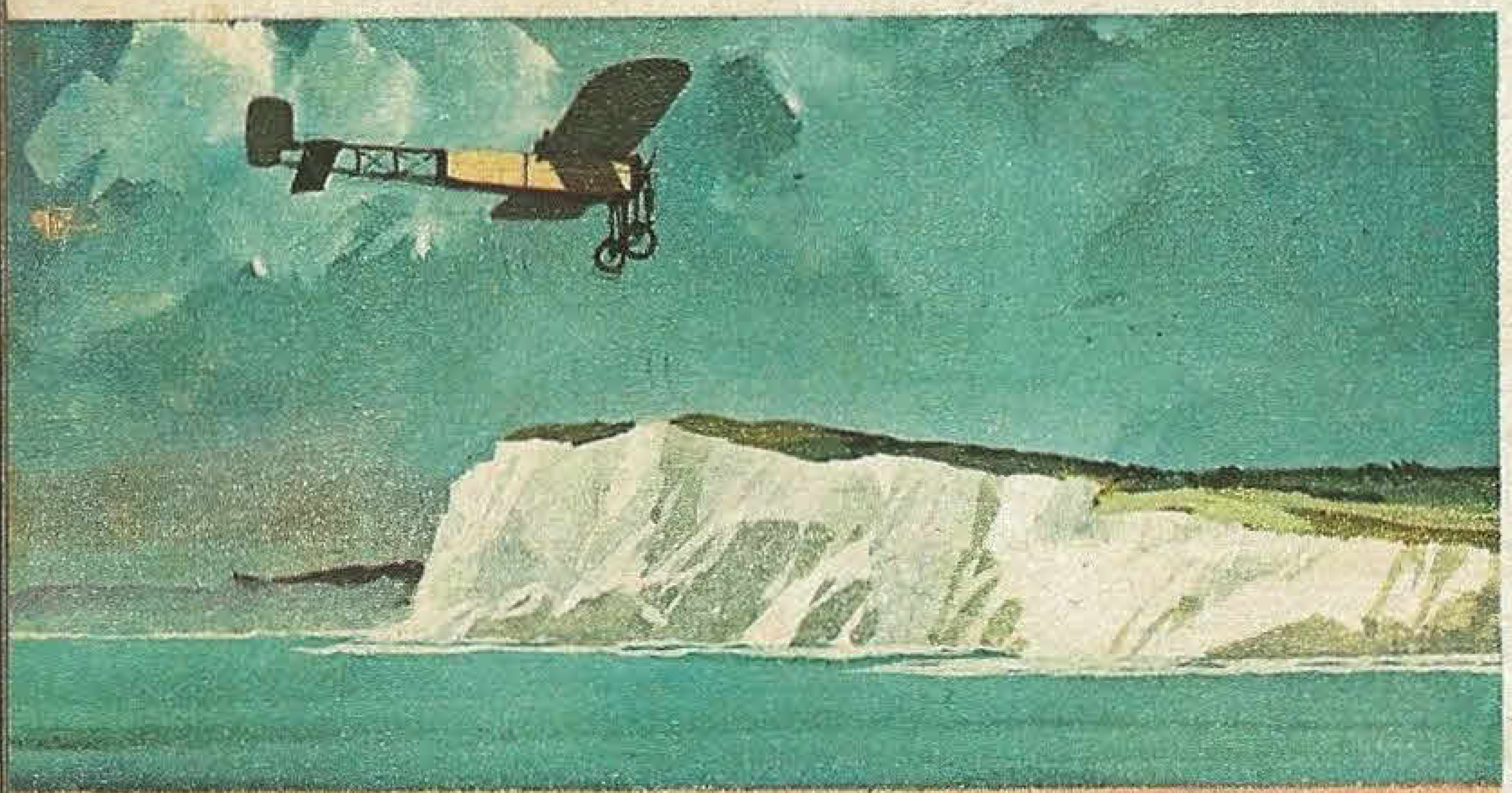
A 'MOAT' AGAINST INVASION

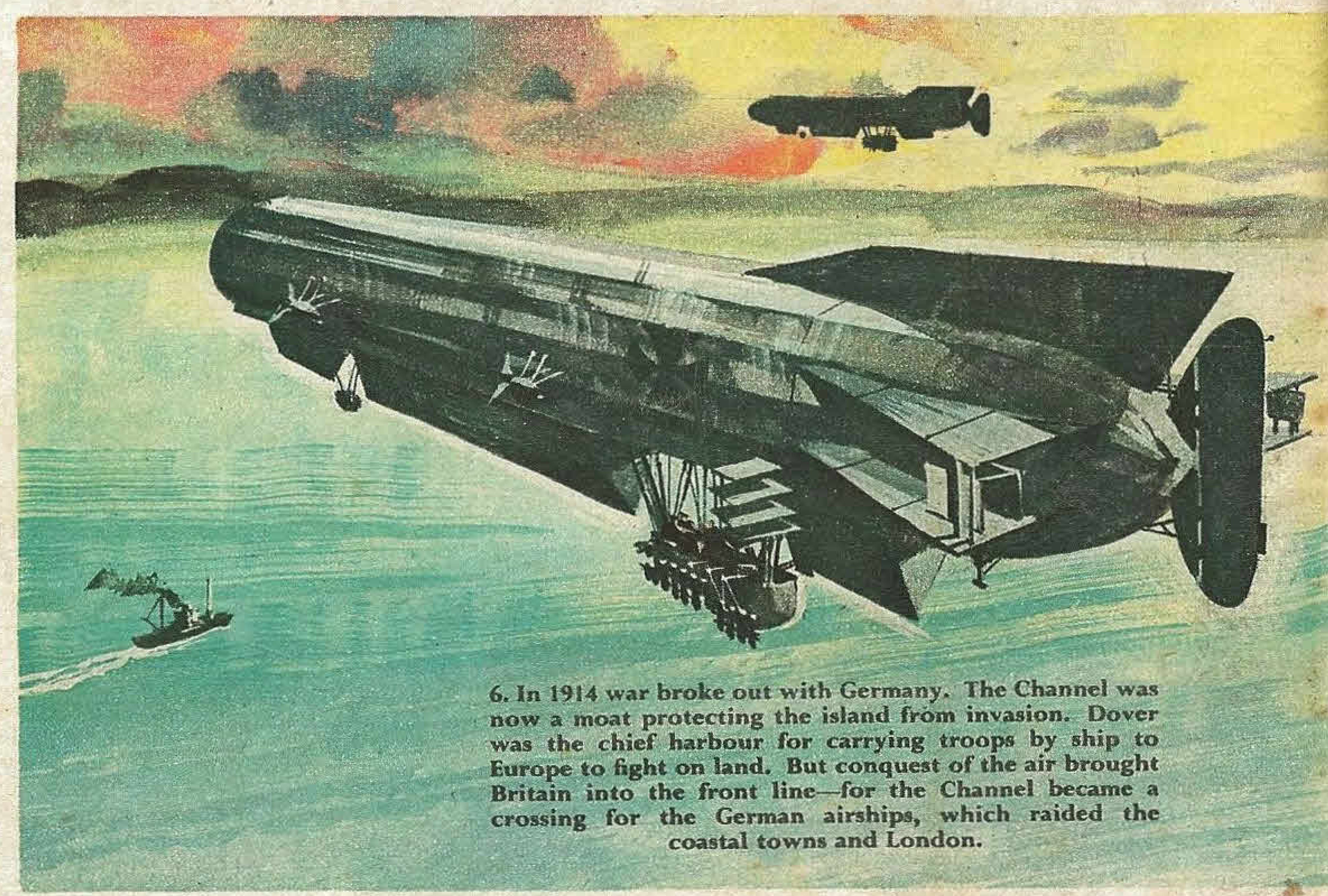

1. During the last half of the nineteenth century the Channel was a peaceful shipping lane, and Britain concentrated on improving navigation round the coast. In 1862 work began on a new lighthouse at Wolf Rock, between the Lizard and the Scilly Isles.

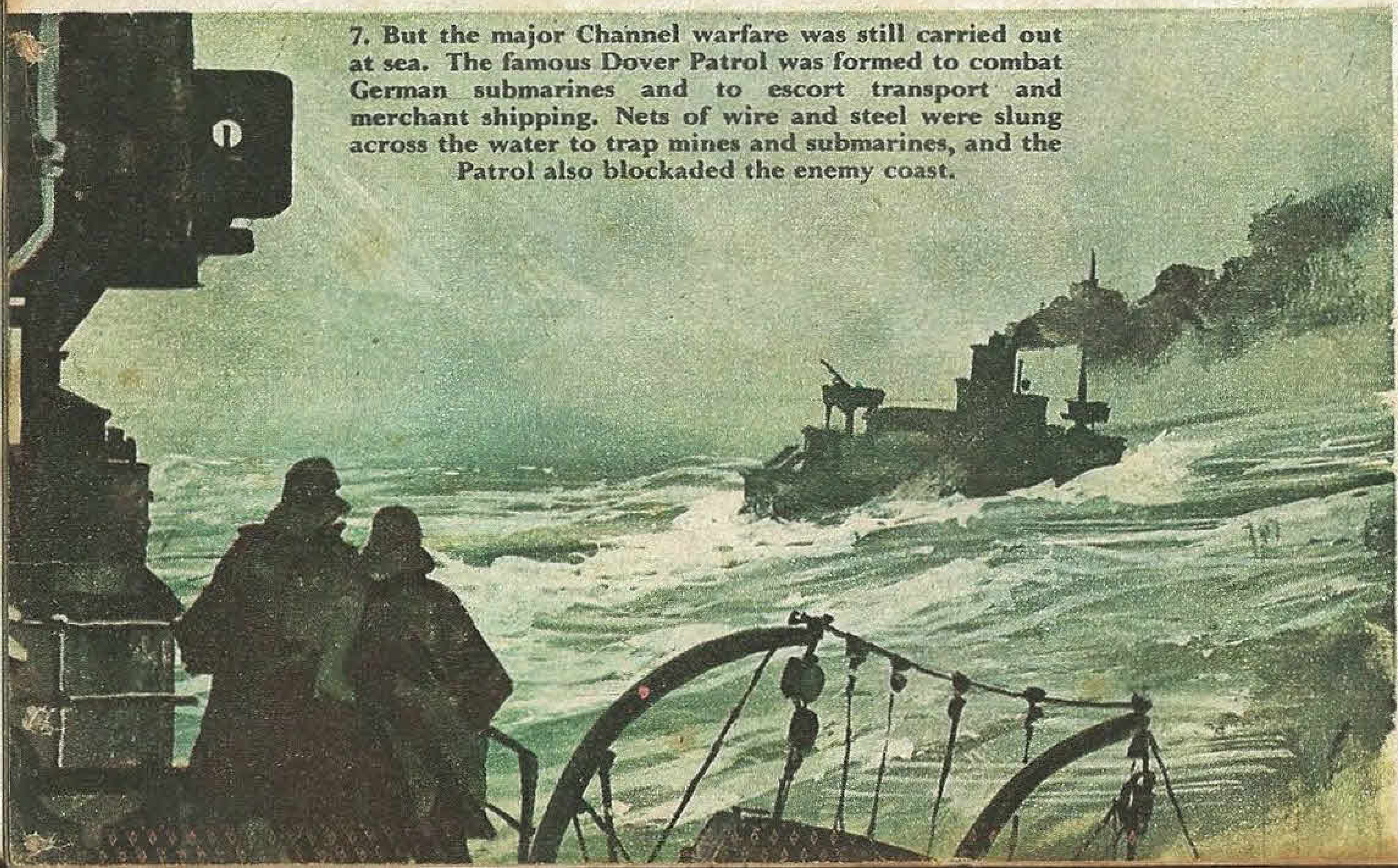

2. In 1875 both England and France agreed to the experimental boring of tunnels beneath the Channel to connect the two countries. The tunnels were blasted for 2,000 yards at Dover and Calais, but lack of funds stopped work.


3. One man, however, found his own way to cross the Straits of Dover. In August, 1875, "Captain" M. Webb swam from Dover to Calais, being the first man to do so. He made the journey in nearly 22 hours.


4. A new enemy was growing across the Channel—Germany. This mighty country was building up a great fleet, and Britain strengthened her sea defences. The fleet was enlarged, and a new enclosed harbour built at Dover. Finished in 1907, it was to be a valuable part of the coastal defences.


5. The tunnel question was raised several times over the years, but each time it was shelved. In 1909 the Frenchman Louis Bleriot flew from Calais to Dover. His pioneer flight was the forerunner of modern air-passenger systems, and of aerial warfare.


6. In 1914 war broke out with Germany. The Channel was now a moat protecting the island from invasion. Dover was the chief harbour for carrying troops by ship to Europe to fight on land. But conquest of the air brought Britain into the front line—for the Channel became a crossing for the German airships, which raided the coastal towns and London.


7. But the major Channel warfare was still carried out at sea. The famous Dover Patrol was formed to combat German submarines and to escort transport and merchant shipping. Nets of wire and steel were slung across the water to trap mines and submarines, and the Patrol also blockaded the enemy coast.


8. Train ferries were built on both sides of the Channel to carry troops across to France. Vast numbers of troops, tanks, trucks and guns were shipped by this method to war areas, and by 1918 more than 700 guns could be shipped within forty-eight hours to keep the armies supplied.

NEXT WEEK: FROM RETREAT TO VICTORY