THE ELECTRON MICROSCOPE

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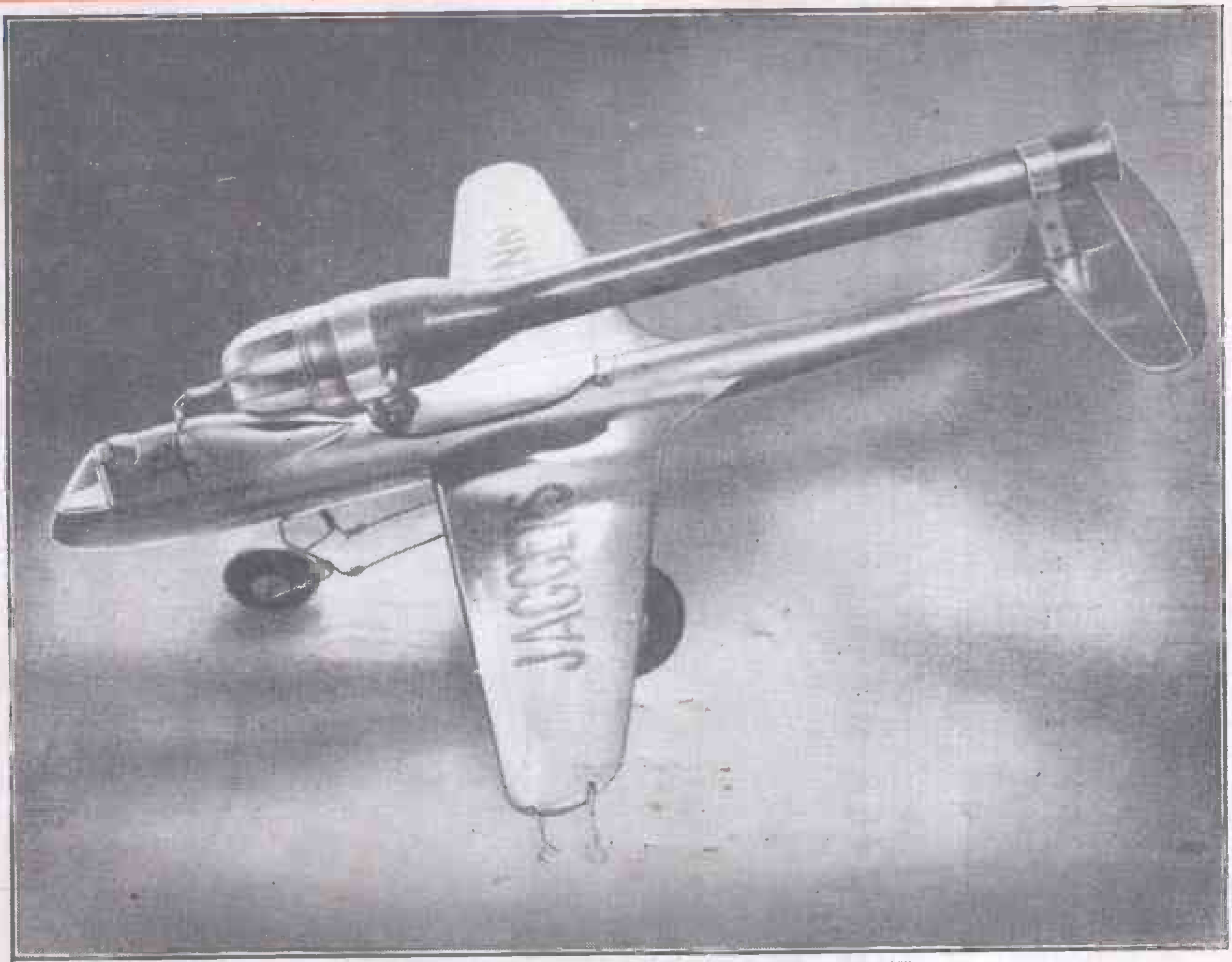


A RECORD-BREAKING JET-MODEL AIRCRAFT (SEE PAGE 27)

PRINCIPAL CONTENTS

Twenty Years from Now

Shall We Have Atomic Energy?

By Prof. A. M. LOW

(*Continued from page 335, July issue.*)

UP to the moment the only tangible result of the great scientific achievement of atomic fissure has been entirely destructive. "Splitting the atom" has resulted in the deaths of thousands, in scaring hundreds of millions and in making the nations of the world suspicious of each other—not very creditable results for one of the great scientific triumphs of all time. But I think that when we look back in 20 years' time we may see the use of the atom bomb just as an incident in the history of atomic energy. Without being cynical, we may take the view that the explosion at Hiroshima was like an explosion in a high explosive works or a child cutting itself when learning to use a knife.

For in 20 years' time I believe that atomic energy will be "harnessed" and supplying us with millions of horse-power of energy a year. I do not rule out the possibility of it being used as a military explosive, but fully developed atomic energy could bring about an industrial revolution hardly less important than the harnessing of steam power.

Research Work

Britain is spending £30,000,000 simply on preliminary steps in research on atomic fission for "peaceful" purposes, and other nations are also spending vast sums. In 20 years we shall have the fruit of this research. In the House of Commons, Ministers have been at some pains to damp down the idea that atomic power could lead to the Utopia of a four-hour working day, but the reasons for this are probably psychological. Of course there are immense technical difficulties—that is why we are spending £30 millions. But if the result of overcoming these difficulties is not to be a supply of abundant cheap power, why trouble to tackle them?

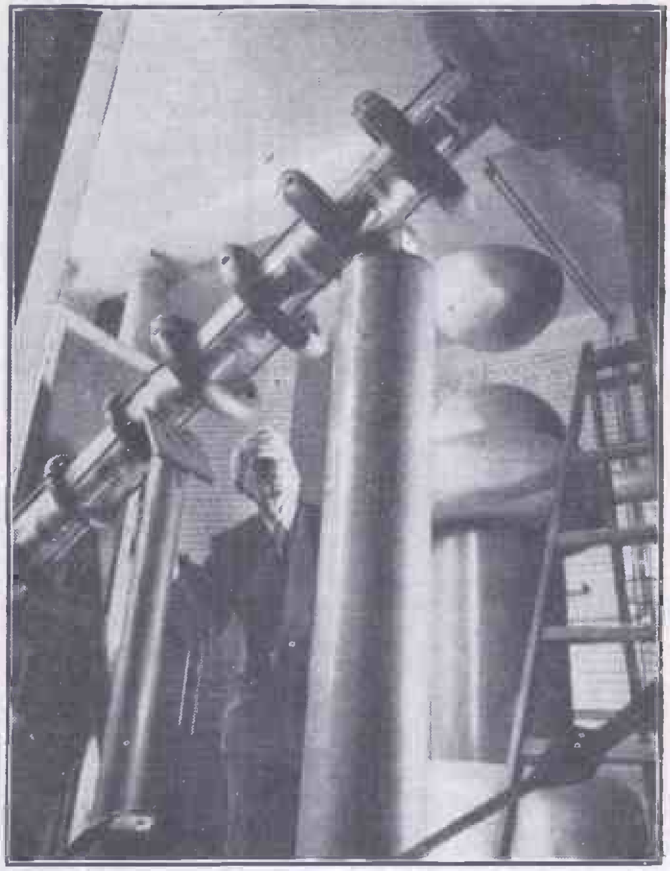
The principle by which it is assumed that atomic energy will be harnessed is that atomic piles will be made to run so that they heat water, which in turn will drive gas or steam turbines. Research may show that there are more direct methods by which the energy can be harnessed, just as it is likely to reveal methods of utilising the atomic energy of elements less expensive than uranium, which has hitherto been used.

In the light of our present knowledge the disadvantages of atomic power are: the very high cost of the plant and "fuel"; the fact that an atomic pile must be large and, thirdly, the poisonous gases and by-products of atomic fission which have to be disposed of. The last two disadvantages are taken to mean that it will never be possible to utilise atomic power for transport—the energy generator would be too large except, perhaps, for a ship, and the impossibility of disposing of the dangerous by-products would make it impossible to use atomic power in street vehicles or even trains.

Controlled Atomic Power

But it would be wrong to assume that this disadvantage will always exist. Just as we may find cheaper atomic "fuel," so we may find methods of utilising atomic energy indirectly, turning it into a synthetic fuel that could be used by comparatively small power units and with no danger from by-products. You will not, in 20 years, stop at a garage and fill up your car with uranium—radioactive materials are too dangerous to use in densely populated places even when they are in "foolproof" containers. But you may fill up with a fuel whose potential energy has been derived from an atomic power generator.

The first practical use of controlled atomic power is, paradoxical as this may sound, likely to be in countries which are not greatly industrialised. With our present methods atomic power is rather more expensive than power derived from coal. Research will undoubtedly bring down the cost so that atomic power becomes much cheaper than power from coal. But the fundamental fact remains that in this generation of electricity and the manufacture of goods, the cost of power is only one item. Fuel accounts only for about 40 per cent. of the cost of our electricity—as against 60 per cent. for distribution and administration: In many manufactures the expenditure on fuel represents only about 10 per cent. of the total cost.



Professor Sir George Thomson, F.R.S., looks at the accelerating tube of a Van de Graaff generator in the Imperial College of Science laboratory. This type of machine produces deep-penetrating X-rays which are of great help in experiments for the treatment of cancer.

It will be seen, therefore, that even if we could get atomic power for nothing, it would not make such an enormous difference. The importance of atomic energy, in my view, lies in the fact that we can look forward to obtaining it in quantities inconceivable for coal or oil-derived power, and that the fuel is comparatively light and easily transported. This means that we shall undertake gigantic engineering feats that would be impossible with our present sources of power, and that we shall be able to obtain power cheaply in places remote from present industrial centres. For instance, with atomic power it is possible to consider great irrigation pumping plants in the heart of deserts, where the cost of transporting fuel would at the moment make the use of power pumps quite uneconomic. In the arid regions of Australia and Africa there is water if the boring is deep. Atomic power offers the possibility of getting it.

Gigantic Engineering Feats

We shall be able to contemplate gigantic engineering feats which may change the climate and even the weather. Twenty years ago the idea of removing—or making—mountains in order to change the rainfall seemed ridiculous. Using the power of atomic fissure it becomes a practical possibility. We can contemplate melting polar ice or warming the soil over hundreds of square miles. The Americans have already talked, even if only half seriously, of diverting the Gulf Stream so that it gave them more warmth. That may become a real possibility. It is in such ways, perhaps, rather than in replacing coal and oil as fuels, that atomic power will be used.

Atomic power may prove to be the key to inter-planetary flight of which I have written in my first article. A few tons of atomic "fuel" will provide more energy than thousands of tons of oil. We may even discover methods of renewing the fuel by making use of the atomic fragments—cosmic rays—which we know are abundant in space.

The difficulties of the dangerous radiation will, I believe, be overcome more quickly than anticipated, and the present tremendous concrete walls may seem as clumsy as mediæval armour in twenty years. It is worth noting that in the short history of atomic energy the experts have constantly had to revise their ideas of the future. After Hiroshima they were at pains to say we could expect no peaceful developments for twenty years. Then they began to talk about ten years. Now they admit that the first "pilot" commercial atomic piles are ready to begin work and that we can expect practical results in five years.

Plentiful and cheap power is not the only benefit from atomic energy we shall be getting in twenty years. Medicine will benefit very greatly as atomic fissure makes it possible to obtain great quantities of radioactive substances for tracers and medical purposes, so that we can think of "radium treatment" in a new way. In less than twenty years' time the cost and shortage of radium which handicapped surgeons will have disappeared.

Radioactive Elements

In addition, atomic fissure enables us to create radioactive elements and compounds, like "heavy water," in which the ordinary hydrogen of plain water is replaced by a special form. A whole new field opens up for chemistry. The number of possible substances is immensely multiplied. We have not yet had time even to contemplate what some of these new "materials" may be like, or what magic we can perform with them. But already a number are being used for medical research and treatment, offering new possibilities of cures in hitherto incurable diseases. These radioactive elements could, in many cases, be made before atomic fissure, but only in minute quantities at immense expense. Now they are mere by-products of atomic piles and should become plentiful.

In twenty years the results of research based on these new substances should be apparent. They may be very far-reaching. Consider one piece of research alone that may be made possible with the aid of atomic pile by-products. Scientists have never been able to unravel the process by which plants, with the aid of sunshine, turn water, carbon-dioxide and mineral substances into living tissue. Before twenty years are passed, with "activated" materials the mystery may be solved. In twenty years we may be setting up food factories in which starches and sugars are really synthetised on the same principles as plants work. The effect would be revolutionary. It would mean the end of the danger of famine anywhere in the world. And this is only one of the possibilities that emerge from research based on atomic fissure.

Atomic energy will bring new responsibilities which are not limited to its use as an explosive. If we obtain energy to change climate and weather, we shall be forced to work in co-operation with other nations to avoid disaster. Warming the polar regions, for instance, might have far-reaching effects on the weather in the rest of the world.

Many people say it would have been better if the scientist had failed in his effort to "split the atom," and that the world would have been a happier place. Myself, I like to think that this great achievement is the beginning of an adventure, perhaps the greatest adventure on which the human race has ever embarked. For the first time man can contemplate changing his environment, really being master of his own condition. Whether the adventure ends in disaster or in triumph may well be decided in the next twenty years. Disaster will come through failure to realise our responsibilities. But triumph cannot come simply by negative action. Research for the exploitation of the atom is as necessary as avoiding its use for destructive purposes.

Letters from Readers

Exhaust Gas Analyser

SIR,—In the July issue of PRACTICAL MECHANICS you published a letter describing an exhaust gas analyser as used on certain American aircraft during the war. Here are a few more details of such an instrument which may be of further interest to readers.

As stated in the letter referred to, the composition of the exhaust gases depends on the original mixture strength. Rich mixtures form more carbon monoxide, whereas weak mixtures mean that more carbon dioxide and excess oxygen are found in the exhaust. Water vapour is present in any case.

As the composition of the exhaust gas varies so does its thermal qualities, i.e., specific heat and thermal conductivity. If these thermal qualities can be measured, then the composition of the exhaust gas, and so the original mixture strength, can also be estimated.

The apparatus consists of a Wheatstone Bridge. The bridge has two standard arms "a" and "b" and two others "c" and "d" (Fig. 1). These latter are enclosed in two chambers separated from each other by a thin metallic wall (Fig. 2). Resistance "c" is surrounded by a standard gas (atmospheric air saturated with water vapour by means of wick) and resistance "d" is surrounded by the exhaust gas to be analysed.

Current passing through the bridge heats both wires "c" and "d" to a temperature higher than that of their surrounding gases. The arm "c" is cooled (by conduction and convection) through the standard gas and settles down at a steady temperature and resistance; "d" is cooled by the exhaust gas and settles down at a temperature dependent upon the heat-removing properties of the exhaust gas which, once again, varies with the mixture strength. The difference in temperature between "c" and "d" upsets the balance of the Wheatstone Bridge giving a reading of the galvanometer. This reading varies according to the mixture strength in use. The galvanometer is calibrated to read mixture strength direct.

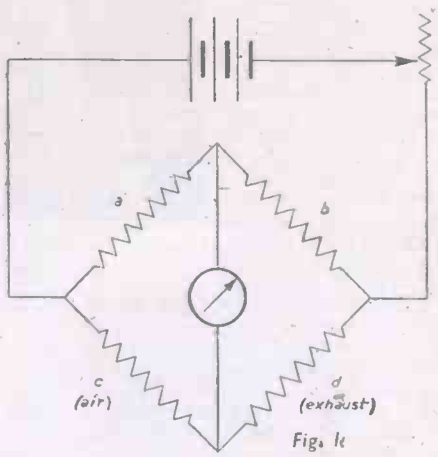
For greater sensitivity all four arms of the bridge could be placed in the two gas chambers, "b" and "c" in the standard chamber and "a" and "d" in the exhaust chamber.

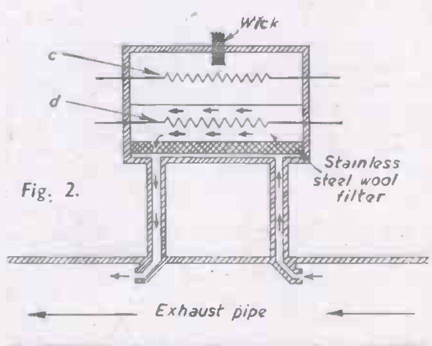
The temperature of the exhaust gas plays no part in the operation since the hot exhaust also heats up the standard air chamber via the thin metal wall which has a high conductivity. After a short period of running, both chambers have the same temperature so that both resistances "c" and "d" are affected to the same extent. In any case, the wires are warmer than the surrounding gases and are "cooled" by the same.

The resistances are usually of platinum or stainless iron.

The stainless steel wool in the exhaust chamber needs to be washed occasionally in petrol and then thoroughly dried out before replacing. Soap should not be used since it tends to leave a "scum" behind. This scum is fatty and under working conditions it may, for quite a long time, give off a vapour which affects the accuracy of the instrument.

As your previous correspondent remarked: although not extremely accurate, the analyser provides a very useful check on the mixture strength in use.—H. S. PERRY (Beeston).





Circuit diagram and sectional view of an exhaust gas analyser.

Detecting Refrigerant Leakages

SIR,—Referring to an enquiry in the July issue of PRACTICAL MECHANICS regarding leak detection of methyl chloride refrigerant, it may be interesting to this reader to mention that our official organ "Modern Refrigeration" (June issue) contains an article which explains a red colour tracer for leak detection.

Another test is the moistening of absorbent wool with a test solution containing 3 grains of alpha-naphthylamine and sulphanilic acid. If this moist wool is placed for a few minutes near the suspected leak, a red spot will appear on the wool. (Moyer & Fitty).—JAMES PARTINGTON, A.M.Inst.R. (Bolton).

Cellulose Lacquers

SIR,—We were very pleased to see your reference to our name as a source of supply for cellulose lacquers and for paint materials generally under "Queries and Enquiries."

During the recent war our old premises at Cornwall Road, S.E.1, were completely destroyed by enemy action and, as a result, the activities of the company have been transferred entirely to its subsidiary factory, which has now been greatly enlarged, and the address of which is Woodbridge Works, Kingston Road, Leatherhead. We feel sure you would wish to know that as one of the oldest established manufacturers of paints and varnishes and allied products in the country, we are continuing our activities at this address. —NOBLES & HOARE, LTD. (Leatherhead).

Re-cellulosing a Car

SIR,—With reference to the reply given to reader J. Jacklin (Grimsby) in the July issue of PRACTICAL MECHANICS on how to re-cellulose his car.

As a coach-painter, I cannot agree with the method suggested.

I should like to outline a procedure to be followed by an amateur on a repaint. This may be of some value to other readers.

(1) In the first place I do not advise any beginner to strip a car completely. This is very difficult and very often disastrous because the rough spots on a car body are usually camouflaged with very thick layers of putty, and the surface will have to be built up again if this putty is stripped off.

A simple test can be made to find out if the original paint will carry new cellulose. Take a small piece of thin cloth, roughly 2in. square, and soak in cellulose thinners. Lay on a horizontal surface and allow to dry (10 minutes). If the cloth can be lifted off without pulling any paint, the cellulose can be applied safely.

I have found that only one car in fifty need be stripped completely.

The first operation is to remove all traces