HIGH SPEED AIRCRAFT - *What is the Limit?*

NEWNES

# PRACTICAL MECHANICS

APRIL

6D

EDITED BY F. J. CAMM

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# PRACTICAL MECHANICS

VOL. V. APRIL, 1938 No. 55.

## Fair Comment

### By The Editor

**Free Blueprint Next Month**

READERS will remember the National Contest for Petrol-driven Model Aircraft which I inaugurated last year. This year I propose to give rubber-driven model enthusiasts a chance, and next month I shall present with every copy of this journal a blueprint of a flying model of the Hawker Hurricane—the machine which recently flew from Edinburgh to London at the amazing speed of 408 miles an hour. I have reason to believe that the actual speed was nearer 450 miles per hour. As most readers know, the Hawker Hurricane is the R.A.F.'s latest and fastest fighter, and a flying model of it will I am sure be popular. In connection with this model I shall run a flying contest with many valuable prizes, and I hope that every interested reader will compete. Full instructions will, of course, be given in next month's issue together with photographs of the model. I give here some brief facts concerning the full-size prototype. The machine is of 44 ft. span, 30 ft. 3 in. length and 11 ft. 3 in. high. Its take-off power is 1,050 h.p., normal power 900 b.h.p. at 1,200 ft., its dry weight 1,318 lbs.

Those are as many details as I am permitted to give, as other details are secret. Order your copy of next month's issue now and make sure of your FREE BLUEPRINT OF THE FLYING MODEL "HAWKER HURRICANE."

**Producing Newspapers in the Home**

SEVERAL American broadcasting stations are making experimental transmissions for the production of facsimile illustrations and newsprint in the home. These transmissions are taking place between midnight and 6 a.m. so that they do not interfere with normal broadcasts. The apparatus in use is provided with a time switch, so that it may switch itself on at midnight and off when the transmission stops. It is expected that the transmissions will be in the form of a newspaper, so that those who possess the necessary apparatus will be able first thing in the morning to read the latest news as delivered to them by their own wireless set.

An ordinary type of wireless receiver is used, and the reproducing apparatus is connected to the output, replacing the loudspeaker. This system is not new, for the Fultograph was successfully used in this country in 1928. The mechanism of the new device differs from the Fultograph in many important details. For example, the material which it is desired to transmit is scanned by a beam of light, and the reflected light impinges upon a photo-electric cell which provides the necessary variations in the current. I understand that the scanning speed is approximately 100 lines a minute, this corresponding to an inch in depth, whilst the width of the type line is 4 in. It takes 6 hours to transmit 30 ft. of material. The general principle is that a recording stylus moves across a roll of paper in synchronism with the transmitter.

Perhaps in 50 years' time we shall produce PRACTICAL MECHANICS that way! Scientific developments are so rapid nowadays that almost anything seems possible. What seems ridiculous to-day is an actuality to-morrow. We are living in a most interesting period of scientific development in which we are making up for the delay of past centuries; or rather, we are collecting together and making use of the basic principles discovered for us by the early philosophers.

**The Model Railway Club Exhibition**

THE Model Railway Club Exhibition for 1938 takes place from April 19th to 23rd at the Central Hall, Westminster. The same space has been booked as last year—the whole of the ground floor of the Central Hall and the basement. The non-working exhibits, passenger-carrying track (free rides for all), and trade stands, will be staged on the ground floor, whilst the many working track layouts and the cinema will be found in the basement, together with the lounge and refreshments. There will be a greater number of working track layouts of various scales than last year, and the Maybank railway will appear in a new form. Many of the exhibits are produced by members who had no technical training, and in many cases with only a few tools. In spite of these handicaps most of the work shows a high degree of skill. I recommend all my readers interested in locomotives to visit this very interesting exhibition.

**Presentation Book Offer Next Month**

IN addition to the free blueprint referred to in the first paragraph, next month's issue will contain details of a most interesting book offer available to regular readers of the journal. This book, which will be fully described next month, is one which every reader of this journal ought to have, and will certainly want to possess. The conditions of the offer are such that every reader may possess a copy.

**Indexes**

I HOPE those readers who have not yet done so will obtain one of our indexes. We produce them specially for the readers' benefit, and it is felt that with a copy of the index and the back issues they will be able to locate at once the piece of information they require. I mention this matter because I continue to receive queries which have been answered many times before in this journal. Readers often want to know if we have published an article on a particular subject. An index would enable them to locate the issue and order it straight away.

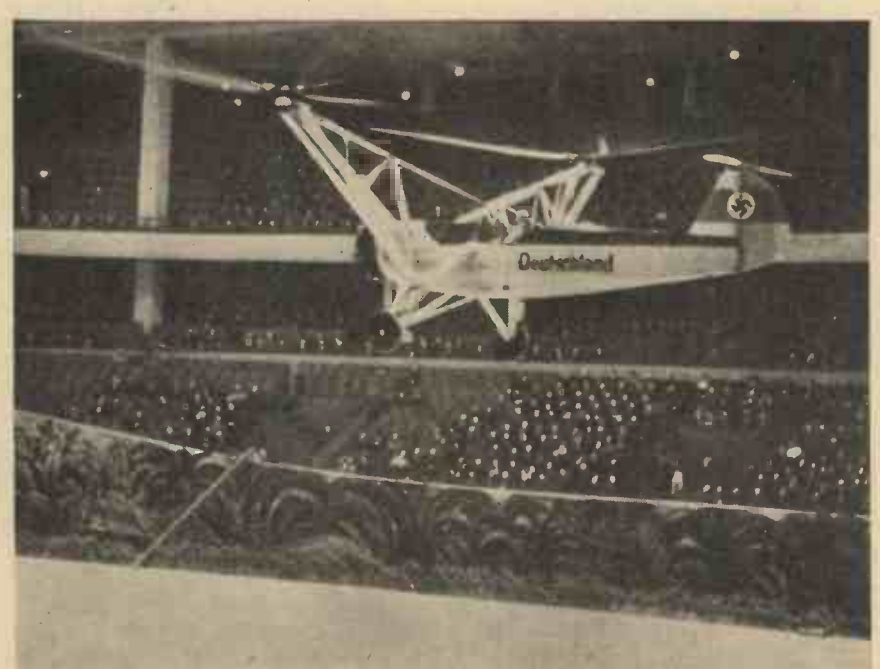
# High Speed Aircraft

*The Mayo pick-a-back aircraft in flight.*

## *The Future of Fast Travel is in the Air, for the Practical Limit of Travel by Road, Rail, and Sea has already Been Reached. This Article Discusses the Possibilities of the Future of Air Travel.*

By F. J. CAMM

IF any scientific subject were sought for a satirical monograph, none would lend itself to the purpose more than the question of speedy travel. Ever since the invention of the wheel itself, man has endeavoured to perfect some device which would carry him from place to place in a faster manner. Whilst scientists and philosophers have been busy producing the means, other sections of the community have been busy opposing such fast travel. That paradoxical state of affairs has been so since the beginning of the world, with the difference that as time has passed opposition to fast travel has increased; and it has increased chiefly by virtue of the negative policy of those interested in present means of travel. Thus, the earliest travellers were of necessity hikers, and they opposed travel by chariot. As wheel travel has progressed down the centuries, each particular industry has endeavoured to put a spoke in the wheel of any system of transport which threatened to become a rival. As recently as 1870 the fastest vehicles on the road were horse drawn. When the bicycle modestly insinuated its claim as a rival to horse transport, the wrath of those interested in the latter knew no bounds. Even magistrates were so infuriated that when trying a case against cyclists they advised those in charge of horses to throw their whips into the wheels of cyclists and bring them to earth. When the motor-car began to appear on the roads the horse-drawn, cycling, and railway interests opposed it to such good effect that the famous red flag act was passed which enforced drivers of motor-cars to be preceeded on their journeys by a man carrying a red flag and the speed was limited to 3 m.p.h. This Act was not repealed until 1896. The Government, magistrates, doctors, and the clergy opposed travel. They imagined in their ignorance that the world should continue as it was in Biblical days.



*A German airwoman, piloting a helicopter inside the Deutschlandhalle, Berlin, watched by 10,000 people. She made aeronautical history by taking off in the helicopter, flying up and down the hall, and then landing.*

### Troubles of Pioneers

It will be perceived that the pioneers of travel had not only the difficulties of their problem to overcome but, having overcome them had then to meet the fierce opposition and opprobrium of the jackanapes who posed as magistrates and members of parliament.

The good old days! Our forefathers did

not have the perception of a flock of third-rate sheep! They built their roads and ordered their being as if the world could never change. Their houses were as insanitary as their outlook, and we are now experiencing the problems, particularly in road transport, which were due to their lack of foresight. The roads were designed for horse traffic, for they could not conceive that any other vehicle would ever appear on the roads. As it is impossible to rebuild this country, we must look elsewhere for a solution of our traffic problem, for there can be no doubt that a practical limit in travel by rail, road, and water has already been reached. It is somewhat a reflection upon the twentieth century that it still takes from 6 to 8 hours to travel between London and Edinburgh—a mere distance of 392 miles.

*The Bristol "138" fitted with a special "Pegasus" engine in which Flight-Lieut. M. J. Adam broke the world altitude record. He reached a height of 53,937 ft.*

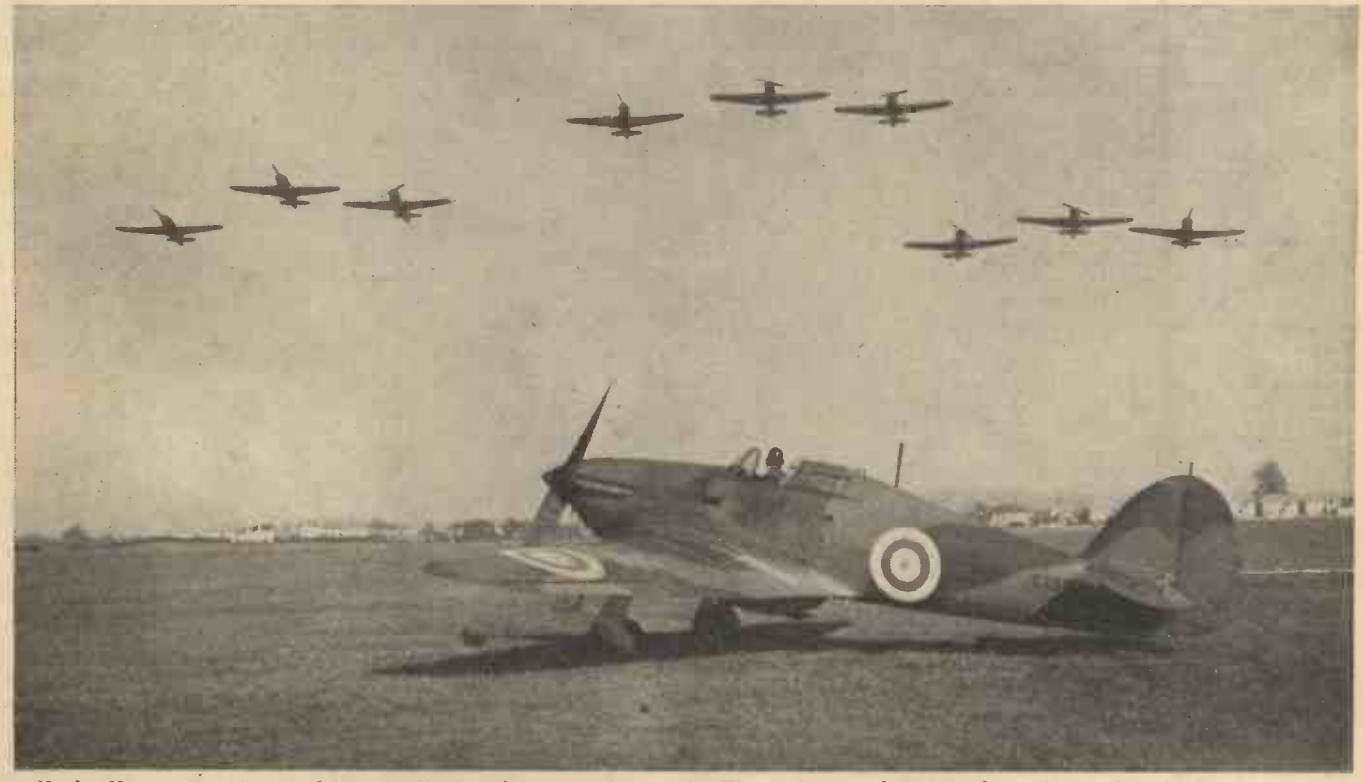
**Poetic Justice**

Perhaps the railways are experiencing some sort of poetic justice. When the railways were first introduced they suffered the same persecution as motorists are to-day suffering. In the same way people opposed the introduction of the railways. The latter to-day are opposing the development of road and air transport. Here is a typical paragraph in a journal of 1830: ". . . an England infested by these new-fangled moving machines belching out smoke was inconceivable. Anything might result from them." Stephenson was told that he should not talk about the speed of his engine, otherwise he would inevitably damn the whole thing and he himself be regarded as a maniac fit for Bedlam. A German doctor declared that it would be impossible for people to watch the trains pass along without going mad and that, unless hoardings were erected, the cows' milk would turn sour. The owners of canals were hostile, and the landed gentry made the terms for the purchase of their land so prohibitive that sums ranging from £1,750 to £5,000 per mile were paid. This opposition to speed is now directed against aircraft, but still we have a group of people trying to make the world a smaller place in which to live by reducing the time that it takes to travel from place to place. It is not distance but time which counts. It takes at least five days to travel from here to America by boat; it takes only twelve hours by air. A journey to Australia by boat is a matter of weeks, by air it is a matter of a couple of days or so. The opposition, therefore, must be expected from the railways and the shipping companies, for many firms are now using the air for the transport of goods, and it is only a matter of time before the air is entirely used for the transport of mails. It is hardly necessary to point out the immense advantage which accrues to commerce when it is able to transact business with distant countries and to deliver and receive goods in but a tithe of the time taken by older methods. The future of travel and of commerce is in the air, for, as I have said, practical limits in travel by train, road, and sea have already been reached. Air travel is now reasonably safe.

**Looking into the Future**

It is interesting to speculate on the possibilities of high-speed aircraft of the near future, and to form some idea as to what the limits will eventually be. At the moment air travel is comparatively costly, but it will become cheaper as planes become faster and are able to carry larger pay-loads.

At present, speeds of 450 miles an hour by air are an accomplished fact. The automatic pilot and other devices have made night flying and fog flying safe. Aerodromes are springing up all over the country, although the main drawback still is that the aerodromes are located some miles from cities and towns. Yet, there is still a con-



*"Hawker-Hurricane" single-seater fighters, capable of speeds in excess of 400 m.p.h. They are low-winged, streamlined monoplanes, and the fastest military aircraft in the world. The illustration shows a squadron in flight and one of the machines on the ground.*

*"Hawker-Hurricane" machines lined up for a formation flight.*

siderable saving of time travelling by air, and from the efficiency point of view we must remember that a 1,000-h.p. engine can propel an aeroplane at a speed of 450 m.p.h., whereas Captain Eyston's 2,000-h.p. car travels at the comparatively slow speed of 312 m.p.h. This latter record is a remarkable one and I do not wish to belittle it, but it does indicate that for really fast travel the air provides the solution.

**Atlantic Travel**

At a speed of 450 m.p.h. an aeroplane could cross the Atlantic in five hours, but we know that owing to the fuel which has to be carried the speed is much reduced, so that considerable interest is aroused by the possibilities of the Mayo composite aircraft. In this system a comparatively large aeroplane carries a smaller one on the pick-a-back principle, and this has been successfully demonstrated on a number of occasions. I have no doubt that this system will be developed. I am also of the opinion that fast trans atlantic and continental travel will take place eventually at speeds of at least 500 m.p.h. For such travel to become possible it must be practicable to make the return journey to Rome, Moscow, Berlin, and New York in a day, otherwise the journey might well occupy double the time. There would be no point in saving time on the journey unless it could be accomplished within a time which permits business transaction on the same day.

**720 m.p.h. the Limit**

For various reasons which I cannot enter into here, the ultimate speed of aircraft through what I may call the atmospheric layer is 720 m.p.h., and we are not so far off accomplishing that speed. Such a speed will, in one hundred years' time, be considered slow, and it is interesting to conjecture as to what the ultimate limit in speed will be in, say, two hundred years' time. We know that flight through the stratosphere in spite of the diminished efficiency of air screws in that region will be in the neighbourhood of 1,000 to 1,500 m.p.h. We also know that a great deal more is now known about the stratosphere than was known ten years ago. We have yet to devise an aircraft which can efficiently make use of the lower air resistance of high altitudes, and we have yet to discover some means for supplying the pilot with natural air. Life cannot exist in the stratosphere. Human beings are somewhat like deep-sea fish which burst when brought to the surface of the ocean. The fish are created to withstand the enormous pressures at the bed of the ocean. Human beings live in an atmosphere which exerts a pressure on them of just over 14 lb. to the square inch. That these problems will be solved and stratosphere flying become a possibility is beyond all doubt. We shall reach the limit so far as the atmosphere is concerned within the next quarter of a century, but it is impossible to conceive that the search for speed will then end. Scientists and designers by that time will have drawn together the loose ends of stratospheric discoveries and produced a machine for stratosphere flying. It will take many years to do that, but it must come.

**The Autogiro**

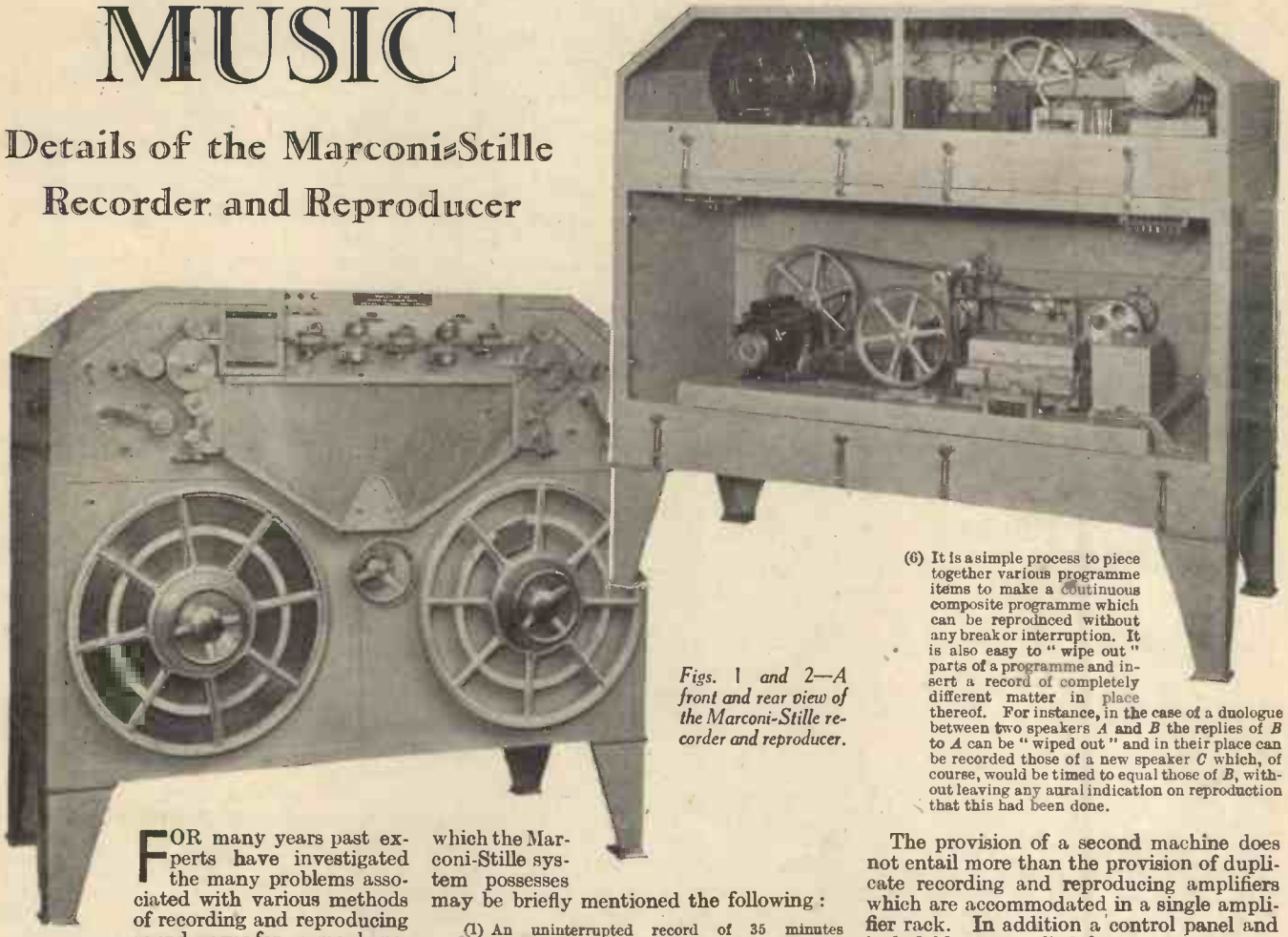
My arguments are based upon the supposition that the existing form of aircraft will not be radically changed during the next quarter of a century, and I have no reason to suppose that aircraft design will undergo any major change except in matters of detail. There is always the possibility that someone will discover a new principle or some new device which will make possible speeds of at least 1,000 m.p.h. through the air. At present it takes an aeroplane a considerable time to reach high altitudes. The autogiro can, of course, climb more rapidly than an aeroplane and it may well be that at some not too distant time someone will invent a combined aeroplane and helicopter which will rise vertically into the stratosphere and then proceed in horizontal flight in the same way as the present autogiro does. I think the possibility of that is somewhat remote, but it is my firm conviction that the stratosphere provides a solution to the ultimate in air travel. It is not possible to indicate whether such travel will be by means of rocket ship, or by an aeroplane somewhat on the lines as we now know it. There can be little doubt that the limit in speed is approximately 720 m.p.h. through air—roughly the speed of sound. The possible speed through the stratosphere and the regions above it are thousands of miles per hour. What an interesting theme for the imaginative writer !


*The Mayo composite pick-a-back aircraft recently made its first public demonstration on the Medway at Rochester, Kent. The four-motored, 1,280 horse-power "Mercury" was taken up on the back of the parent "Maia" and left it in mid-air. The "Mercury" is designed to carry 2,500 lb. of freight or mail when the Imperial Airways regular Atlantic service starts. The illustration shows the "Mercury" leaving the parent "Maia" at 800 ft. over the Medway.*

**Next Month : Free Blueprint of a Fine Flying Model of the "Hawker Hurricane," many Big Prizes, and Details of a Splendid Book Offer.**

# STORING SPEECH AND MUSIC

## Details of the Marconi-Stille Recorder and Reproducer



*Figs. 1 and 2—A front and rear view of the Marconi-Stille recorder and reproducer.*

FOR many years past experts have investigated the many problems associated with various methods of recording and reproducing sound waves for gramophone, talking film or broadcasting purposes. The Marconi processes for electric recording on gramophone discs and the successes obtained with the "Visatone" film recording and reproducing equipment are now well-known, and the Marconi Company has developed a new model of the Marconi-Stille Recorder and Reproducer Equipment for broadcast and other purposes.

A consideration of the various methods of sound recording and reproducing which might be applicable for broadcasting purposes shows clearly that the magnetic system which the Marconi-Stille utilises, possesses many important advantages over other systems.

Apart from the magnetic method the other processes which can be adapted to the recording and reproduction of sound for broadcasting purposes may be divided into two main groups, viz.: (1) Optical or film methods and (2) Mechanical or gramophone methods. There are many systems or processes which although they differ in detail can be classified under these groups and possess the same general features.

The magnetic recording system has the very important advantage over other methods in that recording and reproduction can be effected simultaneously and this affords a very simple method of checking any loss of sensitivity or deterioration of quality in the complete recording-reproducing process.

Amongst other important advantages which the Marconi-Stille system possesses may be briefly mentioned the following:

(1) An uninterrupted record of 35 minutes duration is provided which is very much longer than that obtainable with the majority of other methods.
(2) The apparatus is very simple to handle and no chemical methods of developing, as in the film method, or any apparatus requiring delicate mechanical adjustments, as in the wax recording methods, are used. As the process used is electrical throughout, no specialised knowledge apart from that which is already possessed by the technical staff of a broadcast studio is required to operate the Marconi-Stille recorder.
(3) The record can be reproduced indefinitely with inappreciable loss of sensitivity or deterioration of quality.
(4) When a record is no longer required, the programme recorded on the strip can be "wiped out," and a new programme recorded thereon. This process can be carried out indefinitely.
(5) When required, a special continuous record can be made which will repeat any given announcement or phrase of music automatically and indefinitely without any attention.

### Use of Two Machines

In many cases the demands of a broadcasting service cannot satisfactorily be met by the use of only one machine, and in such cases the use of a second machine offers a number of facilities among which may be briefly stated the following:

(1) One programme can be recorded for any length of time, and if longer than 45 minutes, can be reproduced immediately after its close.
(2) A continuous programme of any duration can be reproduced.
(3) A programme of 30 minutes duration can be recorded simultaneously on two machines.
(4) Two programmes each of 30 minutes duration can be reproduced simultaneously, if the control of one be undertaken by the control room.
(5) One programme can be recorded while a second is reproduced if both are of 30 minutes duration and the latter is controlled by the control room.
(6) It is a simple process to piece together various programme items to make a continuous composite programme which can be reproduced without any break or interruption. It is also easy to "wipe out" parts of a programme and insert a record of completely different matter in place thereof. For instance, in the case of a duologue between two speakers *A* and *B* the replies of *B* to *A* can be "wiped out" and in their place can be recorded those of a new speaker *C* which, of course, would be timed to equal those of *B*, without leaving any aural indication on reproduction that this had been done.

The provision of a second machine does not entail more than the provision of duplicate recording and reproducing amplifiers which are accommodated in a single amplifier rack. In addition a control panel and jack-field are supplied for mounting in the control room.

It should be noted that two different programmes cannot be recorded simultaneously unless the further addition of a second control panel and a second programme meter are undertaken.

### Improvements

The latest model of the Marconi-Stille equipment, the Type M.S.R. 3 incorporates several important improvements as a result of the wide experience gained with the earlier model. Amongst these improvements may be briefly stated:

(1) Simplification of the "heads" which ensures greater reliability in obtaining high-frequency response, decreased distortion and improved signal-to-noise ratio.
(2) A slow-speed synchronous motor which drives the tape at a constant speed through a special type flexible coupling, and an oil-damped flywheel.
(3) Provision of two tape reservoirs, each of which contains a slack loop of tape, both before and after the constant speed drive, thus ensuring complete mechanical decoupling between the latter and the unwinding and rewinding mechanism.
(4) The tape is rewound backwards at approximately twice the normal forward speed, thus saving considerable time when a part or whole of the record is to be repeated in a later programme.
(5) Expanding hubs are provided for the tape spools, thus ensuring that spools with slightly differing internal diameters are securely held on the hub.
(6) A single control wheel which operates all switches, clutches, reversing gear, etc., for forward and reverse winding.
(7) Red, green, and white pilot lights are mounted on the front of the equipment for signalling purposes to facilitate control.

The operations of starting and stopping the machine, adjusting the levels for recording so that the strength on a loud-speaker at input and output is the same, are all relatively simple to those used to handling broadcast studio apparatus. The apparatus as a whole and in detail has been designed so that it is in accord with normal studio apparatus. The equipment is capable of providing an output signal power of 1 milliwatt and of recording an input signal 20 db. below this power, but lower inputs and higher outputs can of course be used. It will be found, however, very convenient as a normal practice to work to an equal input-output basis as this greatly simplifies the problem of studio control.

The general principle of magnetic recording has been known for a long time, and was utilised by V. Poulsen in the Telegraphone, but it has only been comparatively recently as the result of experiment and research into the magnetic phenomena involved and by the utilisation of modern methods of amplification and frequency response correction that it has been possible to produce practical apparatus which would meet the stringent requirements of sound reproduction for broadcast purposes, and the Marconi-Stille equipment is the result of this work.

The Marconi-Stille machine is designed to operate from a medium pressure 50 cycle three-phase supply, and incorporates the necessary mechanism for driving the steel tape at a uniform speed through the electro-magnetic apparatus which produces a varying magnetic flux in the tape in the case of recording, or translates the magnetic record into currents of varying amplitude for reproduction purposes.

In the amplifying and control panel are placed all the necessary amplifying, equalising and control equipment, to enable the programme current from the microphone amplifier which forms part of the normal studio equipment, to be recorded on the tape at the correct strength, and when required, either at the instant of recording, or at any subsequent time, to be reproduced at the same strength as was put into the equipment.

The power supply unit provides for the rectification and control of the high-tension and low-tension energy for actuating the amplifying equipment, which in the normal equipment is designed for a medium pressure 50 cycle single phase supply.

A loud-speaker unit which contains its own amplifier and rectifier, can be supplied as an addition to the equipment in cases where local facilities are not already available.

### Description of Recorder and Reproducer

Considering each unit in more detail, Fig. 4 is a diagrammatic sketch of the machine itself which has been drawn to illustrate the tape driving mechanism.

From this it will be seen that for *forward winding*, i.e. recording or reproducing the tape is pulled off the spool *B*, by a motor driving the wheel *D*, the tape then forming a loop in the reservoir at *F*. The tape is then pulled out of reservoir *F*, and through the heads by the constant speed motor driving the wheel *C*, after which the tape forms into a loop in the reservoir at *E*, from which it is drawn and wound on to the motor driven spool *A*.

The reservoirs *F*, and *E*, are each provided with metal strips *H*, and *G*, respectively, with which the loop of tape can make contact. Such contact causes a gas-filled relay to actuate electromagnetic relays, which, in turn cut in or out resistances in the circuits of the motors driving the wheel *D*, and the tape spools *A*, or *B*, and thus make the necessary changes in speed to maintain single slack loops in the reservoirs. The provision of the tape reservoirs before and after the constant speed drive ensures complete mechanical decoupling between the latter and the motors drawing the tape from the spool *B* and winding the tape on the spool *A*.

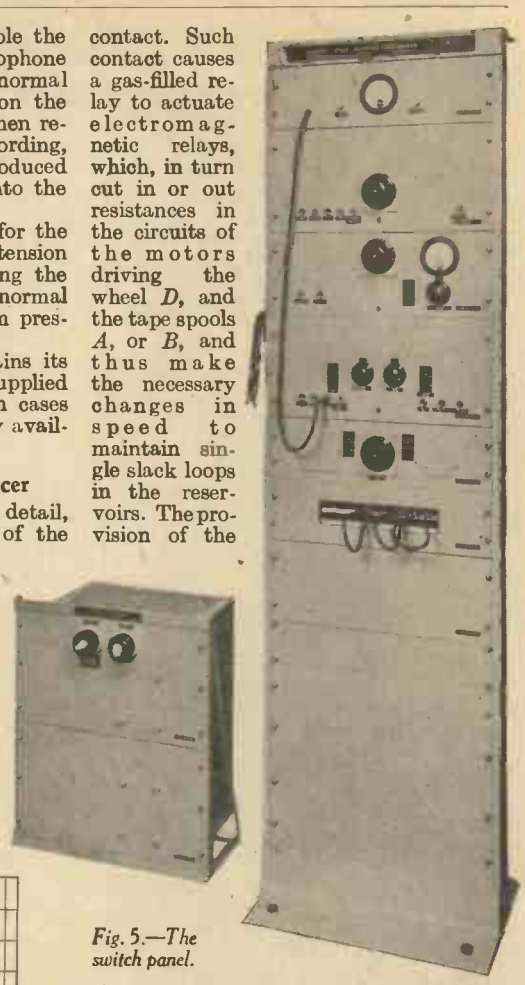


*Fig. 5.—The switch panel.*

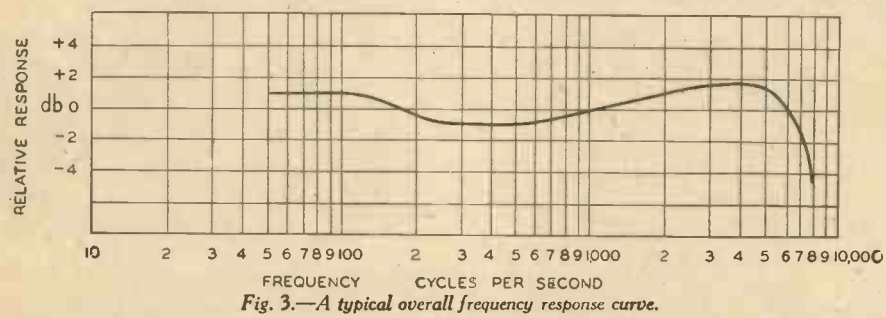



*Fig. 3.—A typical overall frequency response curve.*

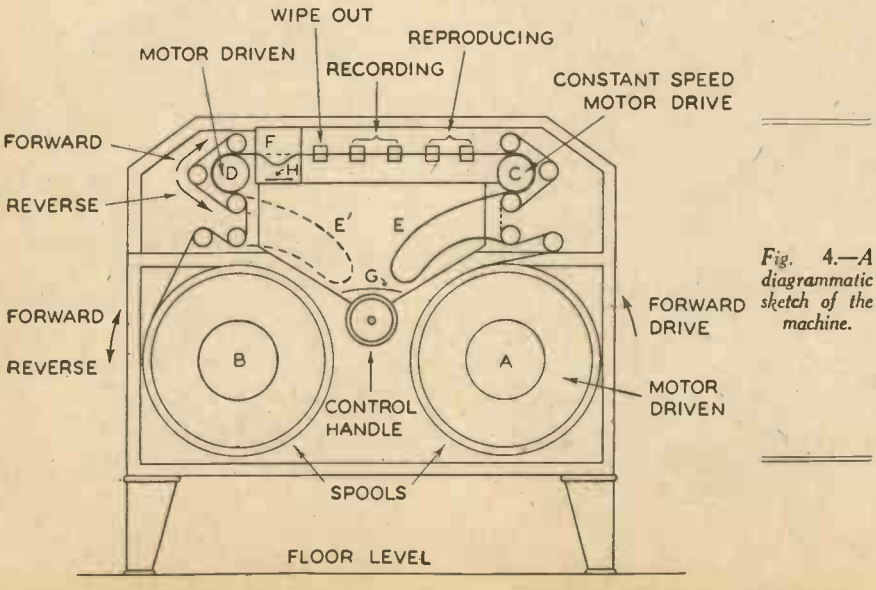



*Fig. 4.—A diagrammatic sketch of the machine.*

The constant speed wheel *C*, is positively driven in the forward direction to control the tape speed, while in the reverse or rewinding direction the wheel is driven by the tape passing over it in the reverse direction.

For *reverse* or *rewinding* the tape from spool *A*, back on to spool *B*, the wheel *D*, is driven in the reverse direction, thus drawing the tape direct from the spool *A*, without any loops in the reservoirs at *F*, and *E*, as shown by the dotted lines. The tape then forms a loop at $E^1$, in the reservoir from which it is drawn and wound on to the motor-driven spool *B*, the slackness of the loop at $E^1$, controlling the speed of the motor driving the spool *B*. For rewinding purposes the spool *B* is driven through reverse gearing by the motor used to drive spool *A*, in the forward direction.

The normal forward tape speed is 90 metres per minute.

It will be seen that when recording or reproducing the tape is drawn past the poles of three sets of special electro-magnets, each set of which has a separate function to fulfil. The first head encountered by the tape is called the "wipe out" head. Its function is electrically to eliminate any previous record on the tape, whilst the second head, the "recording" head translates the currents from the microphone into magnetic flux variations on the tape. The last head encountered by the tape translates the varying flux into currents again and is termed the "reproducing" head. The recording and reproducing heads are in

(*Continued on page* 409)

# SIMPLE STROBOSCOPES FOR THE HOME EXPERIMENTER

***How to Make a Number of Devices which enable High-speed Moving Mechanisms to be observed in "Slow Motion."***

*An illustration of the easily made "gramophone stroboscope."*

*An old Edison phonograph utilised for the purpose of rotating a disc stroboscope. Time control of the revolution speed of the disc can be obtained in this way.*

OWING to the vital necessity of studying the behaviour of many mechanisms when operating at high speed, the principle of the stroboscope has, within recent years, received much attention from engineers and inventors.

Aeroplane engines, revolving propellors, and other important pieces of mechanism are all nowadays systematically examined by stroboscopic methods, for it is by such means that faults and defects of the moving parts which occur only at high speeds can be diagnosed with certainty.

A stroboscope (the name comes from the two Greek works: *Strobos*, a turning, and *skopein*, to see) is an instrument which not only enables a high-speed moving mechanism to be observed in "slow-motion," but, also, if occasion requires, is capable of "holding" the mechanism's motion and making it appear to the observer as if it were perfectly stationary.

### Various Types

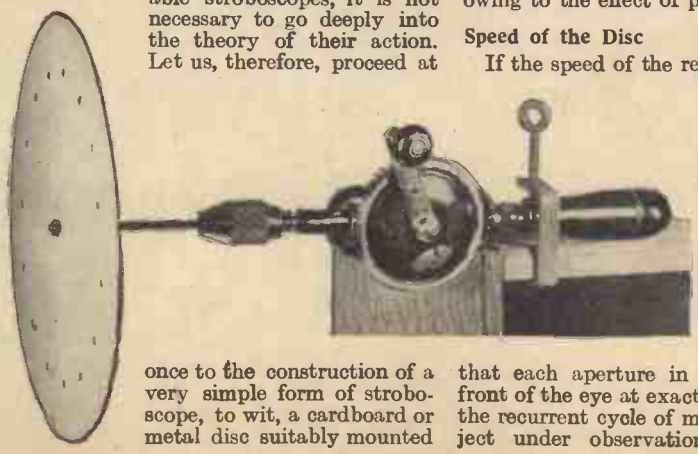
Stroboscopes for accurate and important work frequently comprise somewhat intricate and costly articles. At the same time, however, the stroboscope is a perfectly simple device in principle and it is capable of being made in a number of straightforward types each of which, within its own limitations, has the property of apparently "slowing-up" recurrent motion to a degree which is often quite startling.

The basic principle of any stroboscopic instrument or device consists in allowing the observer to see a succession of flashing views of a mechanism in recurrent or periodic motion. If each view of the moving mechanism is obtained precisely at the same portion of its cycle of movement, then the mechanism, no matter how quickly it is moving, will appear to be stationary. If, however, each succeeding view of the mechanism is obtained slightly later in its cycle of movement, then the mechanism will appear to be moving slowly in its "forwards" direction, whilst if the succeeding views of the working mechanism are each obtained slightly earlier than one another in the cycle of the mechanism's motion, the working parts will be seen in slow motion in a "backwards" or reverse direction.

Note in the above explanation that for stroboscopic vision it is necessary to have recurrent or periodic movement, such as the revolution of a wheel or the reciprocating motion of a piston. Any type of movement which is not perfectly periodic, as, for example, an animal walking, cannot be viewed stroboscopically, since the various phases of the movement do not reoccur with unfailing regularity.

### Cardboard Stroboscope

In order to construct a number of serviceable stroboscopes, it is not necessary to go deeply into the theory of their action. Let us, therefore, proceed at once to the construction of a very simple form of stroboscope, to wit, a cardboard or metal disc suitably mounted upon a spindle and containing around its edges a number of small holes or slots.



*A rough method of revolving the "disc stroboscope."*

These holes should be equally spaced and of about ⅜ in. diameter. If slots are employed instead of holes around the disc, they should be about ¼ in. wide, their actual length being more or less immaterial in a simple device of this nature.

The stroboscope disc so prepared can be mounted in a number of ways, the simplest of which consists of inserting its spindle into the chuck of a hand-drill secured horizontally to a table or bench. Alternatively, the disc can be revolved by means of a clockwork or electric motor.

Having suitably mounted the stroboscopic disc by one of the means suggested above, place behind it the working mechanism whose motion it is desired to "slow up." Let us say, for the sake of example, that the working mechanism constitutes some part of a clockwork motor, a steam engine or the vertically oscillating needle of a sewing machine.

The moving mechanism is now observed through the holes or slots in the revolving disc. By this means a series of "flashing views" of the mechanism is obtained, these separate views blending together in the eye owing to the effect of persistence of vision.

### Speed of the Disc

If the speed of the revolving disc is such that each aperture in the disc passes in front of the eye at exactly the same time in the recurrent cycle of movement of the object under observation, the latter will

appear to be quite still, for, in these conditions, the observer is only witnessing one single phase of the mechanism's movement. If, however, each aperature in the revolving disc passes before the eye of the observer slightly later than the time required for one complete cycle of the mechanism's movement, the machine under observation will be seen to be performing its movements in "slow motion." And, it may be added, if the successive apertures in the revolving disc pass the observer's eye at a slightly slower rate than that of the object's cyclical movement the latter will be seen to be going through its slow-motion movements in a backwards direction.

For the practical success of the very simple stroboscope outlined above, it is essential that the speed of the revolving disc be subject to fine control. For the effective observation of the moving mechanism in slow motion, the speed of the disc and the number of holes or slots in it should be such that the successive views of the mechanism are presented to the observer at a rate slightly above that at which the mechanism is working.

A suitably designed disc of the above type will slow down recurrent motion operating between speeds of 100 and 4,000 cycles per minute. The quicker the motion to the slowed down, the faster the disc should rotate and the greater number of holes it should contain. Half a dozen equally-spaced holes or slots in a 10-in. diameter disc is sufficient to begin with, for if this number of holes proves insufficient to set up the required stroboscopic effect it can easily be increased.

For the drive of the disc a clockwork or an electric motor, subjected to fine control, is the best.

### Another Type

Another simple type of stroboscope can be made in a few minutes by taking a 10-in. disc of wood, of approximately ½ in. in thickness. This is drilled centrally to fit on the spindle of a gramophone turntable and around the wooden disc is fastened by means of drawing pins a strip of cardboard of about 6 or 7 in. width. The upright cardboard strip encircling the wooden disc has cut in it a number of equally-spaced vertical slots, each slot being about ¼ in. wide. Care must be taken to see that the slots are all opposite one another when the cardboard strip is fitted around the wooden disc.

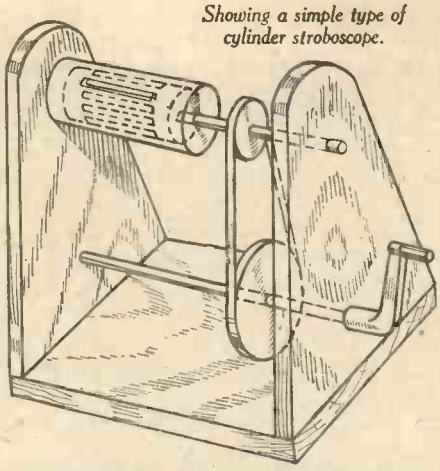
The slotted drum, thus resulting, is slipped on a gramophone or radiogram turntable. The object whose motion is to be examined stroboscopically is set up on one side of the revolving turntable, the eye of the observer being presented to the revolving slots at the opposite side of the turntable. At a suitable speed of revolution of the drum, the working mechanism will be seen in slow motion.

As before, the "slowing-down" powers of this stroboscopic arrangement are dependent upon the number of slots in the drum, their width and the drum's speed of rotation. Begin experiments with half a dozen slots and do not let their width exceed ⅜ in.

For dealing with relatively slow recurrent movement, such as the piston oscillations of a small steam engine, this "gramophone stroboscope," as we may call it, is quite effective, when suitably adjusted. Its viewing properties, however, are by no means of the best, since, in it, the line of sight is taken across the gramophone turntable.

### The "Cylinder Stroboscope"

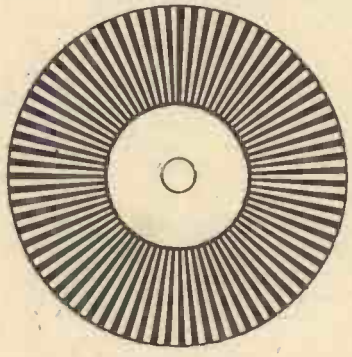
A better type of stroboscope can be made



*Showing a simple type of cylinder stroboscope.*

by revolving a slotted drum within a stationary slotted drum. We will call this the "cylinder stroboscope."

To construct such an instument, obtain a stiff cardboard cylinder of, say, 3 in. diameter and about 5 in. in length. Fit wooden circular ends into this cylinder and mount the assembly upon a horizontal spindle provided at one end with a small pulley wheel. In the cylinder cut two



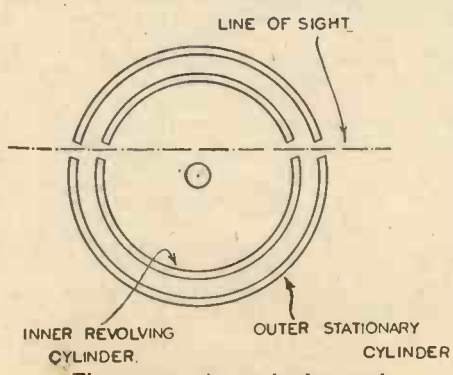
*A stroboscope disc.*

horizontal slots opposite to each other, care being taken that the line of sight from one slot to the opposite one does not pass through the central axis of the cylinder where it would be obstructed by the spindle upon which the cylinder is mounted.

The slots in the cylinder should be about ¾ in. wide and 3 ins. long.

It is now necessary to provide a larger cylinder within which the smaller one can revolve. This larger cylinder, which is mounted in a stationary position, is also provided with a pair of similar slots. Thus, when all the slots are in alignment, it will be possible to see clearly through the two cylinders.

By means of a suitable handle, or by a clockwork or electric motor, the inner slotted cylinder is revolved within the outer




*The instrument shown is hand-operated.*

stationary one. The mechanism to be stroboscopically examined is viewed through the slots in the cylinders whilst, of course, the inner cylinder is being rotated. The stroboscopic slowing-down of the mechanism's motion will be clearly apparent by means of this device when once the correct speed of rotation of the inner drum has been attained. By providing two pairs of slots in the inner cylinder—one pair on each side of the central axis—very high speeds of recurrent movement will be able to be slowed down. Generally, however, for speeds up to 4,000 r.p.m., a single slotted inner drum will prove sufficient.

### Speed Adjustment

It is necessary to emphasise again that success in the working of these home-made stroboscopes depends entirely upon the adjustment of the speed of the rotating drum or disc. The rotational speed must be capable of fine variation, such as is the turntable of a radiogram or gramophone. Given that requirement, success with and interest in these simple devices will at once be derived.

Another type of stroboscopic device, although of a somewhat different nature, makes use of the properties of the well-known neon lamp.

Upon the revolving shaft of the mechanism which it is desired to examine stroboscopically a toothed wheel should be mounted. Let us say that this wheel contains 99 teeth. This must be made to engage with a wheel having 100 teeth, the latter wheel being fitted with a rotating contact so that it lights up a neon lamp once every revolution.

With the above arrangement, the practical outcome will be that the neon lamp will be lighted up once every 1·01 revolutions of the shaft upon which the 99-toothed wheel has been mounted. Hence, if the neon lamp is used to illumine the whole of the operating mechanism, each view of the movement of the latter will be given one-hundredth of a cycle later than the previous one. Thus the movement of the mechanism will appear as if it were being performed one hundred times slower than its actual speed. A shaft, for example, rotating at 6,000 r.p.m. would, under the above arrangement, be seen apparently revolving at the pace of 1 rev. per sec.

The above method of stroboscopic examination of moving mechanisms can be applied very widely. It is particularly convenient in that it does not require the aid of any viewing apertures which, excellent though they may be in principle, do, of course, cut down the field of vision considerably.

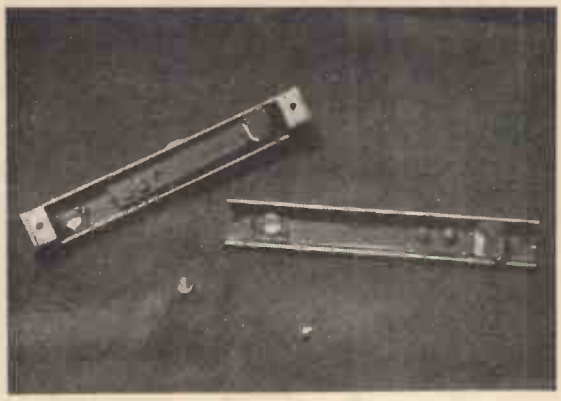
### Neon Lamp System

This neon lamp system of stroboscopic observation can be operated with a wide range of toothed wheel combinations. Thus, for instance, if the pair of toothed wheels above described were provided with 999 and 1,000 teeth respectively, the apparent slowing down of the observed motion would be increased to one thousand times.

In conclusion, a few words may be written upon a simple stroboscopic means of checking the accuracy of a shaft's or of a wheel's rotation. The method is based upon the principle of the nowadays very familiar radiogram or gramophone "stroboscopic disc," a card disc bearing black and white segments or radial lines which is slipped on the turntable of the gramophone and the lines of which, when observed under 50-cycle A.C. illumination, appear to be stationary when the turntable is rotating at its correct speed.

(*Continued on page* 409)

*These two illustrations show (left) the finished device and (right) the method of construction.*



# MAKING A RANGE-FINDER

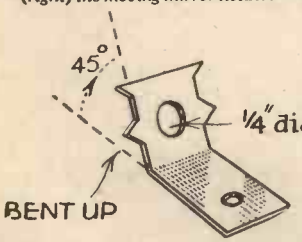
## A Useful Device for Use with a Camera.

OBTAIN a piece of brass about $\frac{1}{16}$ in. thick, bend up two pieces as shown in Fig. 1, and carefully file the edges until the two go together to form a piece of tube $\frac{1}{2}$ in. square inside. Now fit a block of wood or brass into the ends and screw the top and bottom sections of the tube to them. A piece of the $\frac{1}{16}$ in. thick brass may now be screwed or soldered to the outside of the blocks and filed to the shape of the tube or body. If soldered to the blocks, remove the body first so that this does not get soldered up. This end construction is seen clearly in Fig. 4.

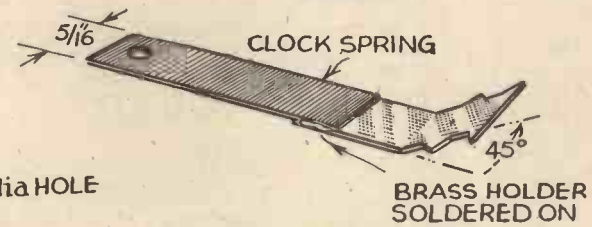
The $\frac{1}{4}$ in. diameter holes should next be drilled in the body; two holes in the top section and one below. The body is best screwed to the ends for this operation in order to get the two viewing holes in line.

### The Stationary Mirror Holder

Now make up the stationary mirror holder as shown in Fig. 2. This can be cut from a piece of very thin brass. Drill a corresponding fixing hole in the top body section so that the hole in the holder is in line with the two viewing holes.




*Figs. 2 and 3.—(Below) The stationary mirror holder and (right) the moving mirror holder.*




Next make up the moving mirror holder. This is made from a piece of clock main spring about $\frac{5}{16}$ in. wide, with a similar piece to the stationary holder soldered to the end, as shown in Fig. 3.

Now solder a block about $\frac{1}{16}$ in. thick to the bottom section, and drill a hole to correspond with the fixing hole in the clock spring. (See Fig. 5.)

Also as the dimension shown in Fig. 5, drill and tap a small hole for the control knob. This can consist of a disc of metal about $\frac{3}{4}$ in. diameter with a small screw soldered in.

For the moving mirror we require a piece of thin mirror about $\frac{5}{16}$ in. square, which should be placed in the holder and the clips carefully bent over to clamp it in position. For the stationary mirror we require a piece of transparent mirror fixed in the same way. If transparent mirror is not available, the ordinary kind may be used, but a hole $\frac{1}{16}$ in. diameter must be scratched in the silver backing exactly in the centre.

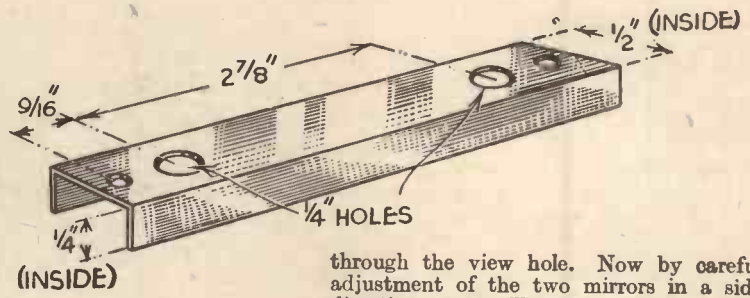



*Fig. 1.—Bend two pieces of brass as shown.*

### Completing the Assembly

Screw all the parts together with the exception of the top body section. Place this in position without screwing and look through the view hole. Now by careful adjustment of the two mirrors in a side direction, you will have a view of two images which line up in the horizontal plane. When this is achieved, the screws holding the mirror holders in position should be tightened up and the top section of the body screwed on to the end blocks.

All that remains is to calibrate the instrument, mark a short straight line on the body adjacent to the control knob for an index, and by carefully turning the knob you can line up the two images from 18 ins. to infinity.

The knob should be marked at distances to correspond with the distance marks on the camera. If no better means of marking is available, a piece of paper could be glued to the face of the knob and after marking, given a coat of transparent varnish.

A coat of flat black is desirable inside to stop reflection, and a small piece of glass may be stuck over the body holes to keep out the dust. These holes should also be well countersunk on the outside.

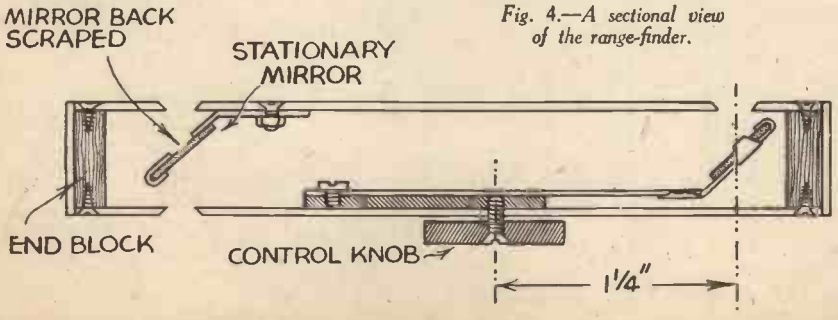



*Fig. 4.—A sectional view of the range-finder.*

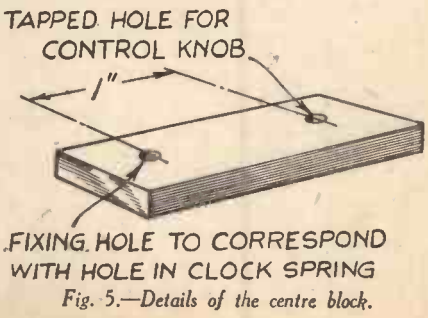



*Fig. 5.—Details of the centre block.*

# THE MONTH IN SCIENCE AND

*One of the recording clocks at the central office of the London Transport.*

## A Remarkable Experiment

LONDON TRANSPORT will soon begin an experiment never yet tried anywhere in the world, which will give them a "picture" of London's moving buses. If successful, it will mean that eventually the movements of all the buses will be automatically recorded on dials at the Board's headquarters. A coil of wire will be carried on the roof of the bus through which will pass an alternating current. At the recording point a wire will be suspended across the roadway. The instant the bus passes under the wire the current in the coil on the roof will induce a current in the fixed wire, which will be amplified and transmitted by wire to the central office, where it records the passing of a bus on a clock face.

## Damming the River Ohio

THE world's largest roller type dam, which stretches across the Ohio river, has just been completed. It was constructed under the supervision of the United States Army Engineers at a cost of over £3,000,000, and the dam is the largest unit in the modernisation programme of the Upper Ohio river. More than 600 men worked three years to complete the dam, which has a total length of 1,116 ft. Each roller is 125 ft. long, weighs 360 tons, and is 29 ft. in diameter. The rollers are raised and lowered by means of huge electric motors to regulate the stage of the water above the dam.

## A Balanced Two-stroke

THE inventions which gained silver medals at the Inventions Exhibitions organised last year by the Institute of Patentees were recently displayed in the Assembly Room at the Central Hall, Westminster, London, S.W. An interesting invention on view was a balanced two-stroke engine. All parts of this engine are balanced in every way. The only reciprocating parts are the pistons and connecting rods. It has no valves, tappets, rocker arms, push rods, cam shafts, gearing, etc., and the engine is suitable for mass production because of its simplicity. It should be suitable for propulsion of either motor-cars or aircraft.

## Rail Welding Plant

A MOBILE rail welding plant, built to the design of London Transport's engineers to further the Board's policy of providing quieter and smoother travel by train, was demonstrated recently at Brompton, London, S.W. The complete plant, capable of welding in 3 minutes the heaviest rails used in England, is mounted on two wagons that can travel anywhere in the tubes or on the surface. A push button controls the whole process. The first wagon is a mobile power station. It contains a 400 h.p. diesel engine, driving a generator that supplies current to the welding set. On the second wagon is a welding set. Rails are fed in at one end of the machine and gripped firmly by air-operated clamps. Then the operator has only to press a button and the machine does the rest. When the button is pressed the current is switched on and the rail ends are brought together and separated automatically, causing an electric arc between the ends. Because of the very heavy current flowing across the gap, the rail ends gradually heat up. Then the set changes over automatically to the actual flashing, when an arc is held between the rail ends for about ten seconds to make them sufficiently plastic for welding.

## 230 m.p.h. Railcar

PROFESSOR KURT WIESINGER, who is technical lecturer at Zurich University, has constructed a railway which, when generally adopted, will change completely the present conceptions of rail transport. Professor Wiesingers new railcar weighs about one fifth (inclusive of freight) of a present-day railcar, and in order to prevent derailment which may be caused by this drastic weight reduction, all wheels, as well as the rails are inclined inwards to the extent of about 30 degrees. This makes it practically impossible for the wheels to jump the rails and also allows a very steep banking of curves so that these may be taken at much higher speeds than was hitherto possible. Professor Wiesinger has built a scale model railcar of about 4 ft. in length. One version is driven by a tiny petrol engine and another experimental

*A radial type of two-stroke engine, statically and dynamically balanced.*

# THE WORLD OF INVENTION

car by a propeller, whose pitch can be varied and thus permits the propeller to be used as an air brake. A track has been laid down at Zurich, measuring about 900 ft. and on this speeds of 70 miles per hour have been reached in safety with the model railcar. This corresponds to a speed of about 230 miles per hour on a full size car of this design. Thus the journey from New York to Chicago would take no more than five hours. Built overhead without interfering with landed property, the tracks for this new super-speed railway could be brought right into the heart of large cities and thus provide a serious competition to air travel. Certain railway authorities in Central Europe have already shown great interest in the new invention.

## A Bird Glider

R. PISHCHUCHEV, a Russian airman, recently tested out a glider with flapping wings. This is the hundredth successful flight he has made in the machine. The glider is remarkably steady in the air and can make long flights.

## Noiseless Trams

TRAMWHEELS on Dresden tramways have been made noiseless. Strips of beechwood have been inserted in the wheels which absorb vibration and noise when the tram is rounding a corner or negotiating points. A further improvement has been made by introducing a swinging axle, the springs of which are fixed on the underside of the axle and are themselves supported on either side by rubber fittings.

## New Ticket Machine

THE London Passenger Transport Board have been experimenting with a multi-unit ticket machine which will eventually displace present stock of tickets at each tube station. The machine compares in size with a portable typewriter, and first and third class tickets are automatically printed as well as returns, and workmen's tickets to all destinations. The machine has been tried out at Baker Street Station.

## World Record

A NEW world's speed record for a 22-ton motor torpedo boat has been established by Lt. Eugenio Siofani. A speed of 55·8 miles an hour was attained in the open sea near Genoa. Isotta Fraschini engines were fitted to the craft.

## A £1,000,000 Dam

IN order to tackle the problem of the irregular flow of one of South Africa's most important rivers, the Orange, 1,100 miles long, it is proposed to build a huge impounding dam. The cost of building the dam will be roughly £1,000,000 and when constructed will mean enormous benefits for the North West area of Cape Province.

## Egypt on the Air

PLANS have been put forward by Mr. John Webb, Inspector General of the Egyptian Telegraphs and Telephones for the erection of a powerful 100 kilowat broadcasting station at Cairo. It will be designed solely to afford an improvement in the daytime broadcast service in Egypt, and the station will operate on the medium-wave band.

## World's Fastest Aeroplane

BY flying a Hawker Hurricane fighter 'plane from Edinburgh to Northolt, Middlesex, a distance of 327 miles, in 48 minutes, Squadron Leader John Woodburn Gillan became the fastest pilot over land. He accomplished the journey at the remarkable speed of 408·75 m.p.h., although we learn from a reliable source that the actual speed was 443 miles per hour. Unofficially this easily beats the world's record for "land" aeroplanes set up by Germany at 379·17 m.p.h. over a three-kilometre course. Italy holds the sea-plane record, with a speed of 440·9 m.p.h. An Air Ministry official stated that the flight was made for the greater part of the distance in darkness at a height of 17,000 ft. He also says that the wind was estimated when the pilot set out to be level north-north-west, and possibly up to about 50 miles per hour or so at altitude. It was not a complete following wind and was only partly helpful.

*Professor Kurt Wiesinger with a model of his railcar which is fitted with a petrol engine. The model has reached a speed of 70 m.p.h. on a special 900 ft. track which is equal to a speed of 230 m.p.h. on a full size car of this design.*

## Mid-air Launching

DETAILS of the Pick-a-back 'plane have appeared from time to time in these pages, and now the mid-air launch of one aeroplane from another has been successfully carried out. The experiment was made at 700 ft. at a speed of 140 m.p.h.

*A Hawker Hurricane monoplane, the world's fastest machine, in flight. It has reached a speed of 443 m.p.h.*

**A Free Blueprint for a flying Scale Model of the "Hawker Hurricane" will be given with every copy of next month's issue.**

## A "Whale" of a Job

MEN are busy at the Museum of Natural History, South Kensington, London, on a very odd sort of job. They are making a whale! They have been making this whale for more than four months, and it is only about half made now.

They have used 2 tons of timber, 6,000 ft. of laths, 4 cwt. of nails—and they have not yet got to the outside.

The whale, when finished, will be 90 ft. long by 18 ft. deep by 10 ft. maximum thickness. It will probably be the largest whale-model (or model whale) in existence, and will represent a specimen of around 120 tons—only 27 tons less than the largest blue whale recorded.

The proportions are based on a long series of measurements taken in part by Mr. P. Stammwitz, who visited the famous whaling grounds of South Georgia to study whales for model-making. Mr. Stammwitz is himself supervising the construction of the wonderful model.

## A Pneumonia Cure

A NEW chemical has been produced which it is claimed will successfully cure pneumonia. The chemical, which is known as deutro-proteose, is manufactured from fibron, a protein obtained from the blood of a recently killed oxen.

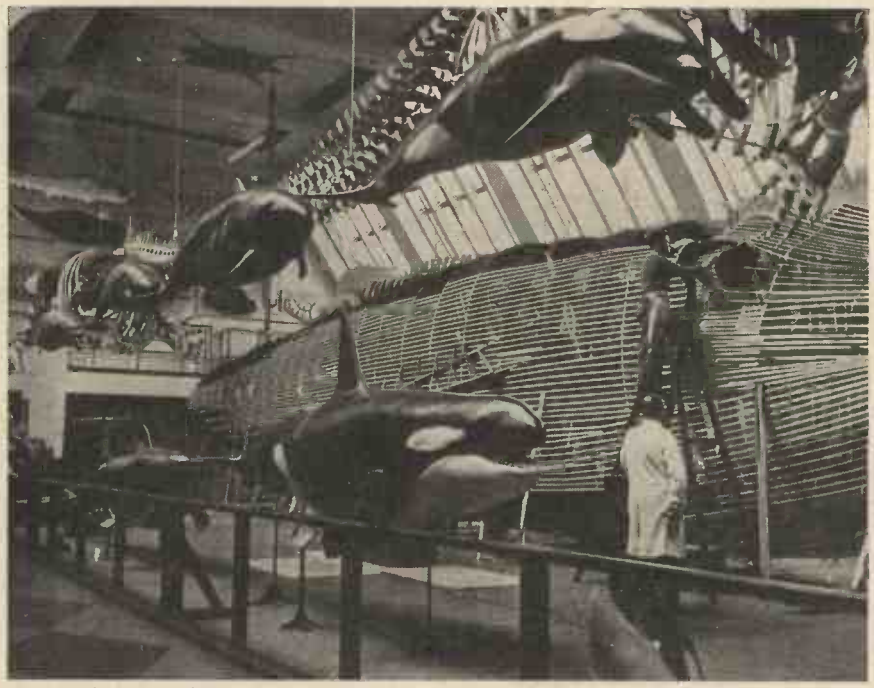
If a person is given a small injection of this chemical before the disease has had time to get a real grip, it will cause the fever to vanish and frequent injections produce complete recovery.

## Glass Bricks

THE use of hollow glass bricks as a substitute for masonry work has recently been demonstrated on a large scale by an Illinois company.

## American Air Liners

DETAILS of six new Boeing Clippers to be built for Pan American Airways have just been announced. Each machine will weigh over 40 tons and will be able to carry more than 60 passengers. Sleeping accommodation will be provided for 40. The machines, which are to be of the high-wing monoplane type, will have a wing span of 152 feet and a maximum speed of about 200 m.p.h. Like our own Short flying boats, the machines will be provided with two decks, the top one accommodating the control cabin and the crew's quarters and the lower one containing the day and night compartments for the passengers as well as the kitchen. The wings will be provided with internal gangways to permit inspection and repairs to the engines while in flight.



*The huge framework of the giant model whale taking shape under the hands of the workmen. Large paper patterns showing shapes of whale transverse sections at 3 ft. intervals are cut and copied in wood. These are placed in position and slats are nailed across till the whale looks like a gigantic eel-trap.*

## "Gassed" Fruit

£830,000 was spent last year on research by Government scientists. Some of the things discovered will no doubt interest our readers. It was found that pears "gassed" with carbon dioxide ripen more slowly when taken out of store, and so give shopkeepers more time to sell them. Grapes and strawberries are now undergoing "gas" tests.

In the wool textile industry, research has produced a new yarn which is said to be very soft and unshrinkable.

## The "Queen Elizabeth"

THE new Cunard-White Star liner No. 552, which is a sister ship of the *Queen Mary*, is to be launched at Clydebank by the Queen on September 27th. The ship will be named the *Queen Elizabeth*. The hull will weigh 40,000 tons when it takes the water, which is several thousand tons more than the launching weight of the *Queen Mary*, and a world's record will thus be established. The *Queen Elizabeth* will have a gross tonnage of about 84,000, as compared with the 81,235 tonnage of the *Queen Mary*, and an overall length of 1,030 ft., which is 12 ft. greater than that of the *Queen Mary*. She will be the world's largest ship.

## An Automatic Fuse

A NOVEL type of electric fuse has been developed which makes use of the expansion of mercury when heated. If a short circuit or overload occurs, the heat generated expands the mercury and breaks the circuit. The fuse may be restored, however, by unscrewing a plug and swinging it sharply like a clinical thermometer, thereby returning the mercury to the two contact points within the fuse.

## A Giant Dam

A DAM is now being built across a canyon near Los Angeles to prevent the disastrous floods which have taken place there from time to time. The new dam cannot be built of concrete or masonry on account of the nature of the underlying rock. As a result, more than 10,000,000 cubic yards of rock have got to be blasted, quarried, removed, and dumped to build the dam. The total cost will be nearly two and a half million pounds.

## A Large Pebble!

WHAT is believed to be the largest block of stone ever quarried has recently been broken away at Stoke Quarry, Grindlefold. It measures thirty feet long, twenty-six feet high, and fourteen feet thick, and weighs about 1,200 tons.

## A High-pressure Murcury Lamp

A HIGH-PRESSURE mercury discharge lamp in which a temperature of 8,000° C. is reached—equal to that of the sun—has been produced. The lamp, which is made of quartz, is surrounded by a glass tube through which cooling water circulates continually. The lamp itself contains mercury vapour under a pressure of over 100 atmospheres. Although the source of the light is only five centimetres long, it gives a light equal approximately to 7,500 candle power, while the power consumed is 1,000 watts. The life of these lamps is at present only about 100 hours, but the colour of the light is much nearer to daylight than is the light of the mercury lamps now being widely used for street lighting, and it is therefore to be hoped that further research will result in a greatly improved life.

## New Petter Oil Engine

A NEW type of oil engine has recently been demonstrated by Petters Ltd., in which the principle of "harmonic induction" is used to extract the exhaust gases from the cylinders. By a special design of the exhaust pipe arrangements, a wave motion is created in the exhaust gases, and a partial vacuum which occurs periodically serves to scavenge the burnt gases. In this way, more complete charging of the cylinders is possible and the power obtainable from a cylinder of given volume is increased by no less than 50 per cent.

# CHEMICALLY-MADE CLOTH

NEW materials for old might well be the motto of the modern chemist, and nowhere is this twentieth-century alchemy seen working greater miracles than by the subtle arts that change the forest tree into fine silks and laces. As if that were not enough, the latest of discoveries spin artificial wool from the waste milk of dairies. It is not difficult to forecast that the next step will be a coal tar plastic substance that will threaten natural wool with the disuse which has already fallen on the silkworm's thread.

***Two Englishmen, C. F. Cross and E. J. Bevan, were the First to Produce Artificial Silk in 1892***

### Rayon

It was the great English scientist Robert Hooke who forecast the method of making rayon—as we now call artificial silk. He predicted that some day the chemist would be able to wiredraw some gummy substance to make an imitation of the silkworm's thread. Some 200 years later another Englishman, Sir Joseph Swan, did produce such a thread by squirting a solution of nitro-cellulose into water. He required such threads for the filaments of his carbon lamps and it was left to a Frenchman, Count Hilaire de Chardonnet, to use threads made in this manner to weave into cloth. It is to him that the honour of first patenting artificial silk belongs.

The idea of going about clothed in gun-cotton, however, was not considered entirely a good thing and it was two Englishmen, C. F. Cross and E. J. Bevan, who in 1892 started to make artificial silk from a less dangerous form of cellulose by the modern viscose process.

### Wood Pulp

The story of rayon starts in the lumber forests of Canada, where the spruce pine is cut and floated down to the pulp mills. Here the logs are stripped of their bark, cut in small pieces and sent forward into boiling vats where sodium bisulphite at high pressure and temperature dissolves out the resin from the wood and leaves a pulp of pure white cellulose. The cellulose is washed, pressed free from water, and felted on rollers into the form of thick white sheets, exactly like thick white blotting paper. It is cut, baled, and shipped here to England.

*Fig. 1.—Raking out crumbs of alkali cellulose from a mixer.*

### Viscose

In the English factory chemicals again come into play, the sheets are shot into strong caustic soda and stewed up until they have formed a new chemical substance—alkali cellulose. This is dried, shredded, and crumbed up between the revolving blades of chemical disintegrators. In Fig. 1 the alkali cellulose is seen being raked out like balled-up crumbs of flour.

The next stage is the conversion of the alkali cellulose into cellulose xanthate by use of that volatile, rather inflammable, and very odorous substance, carbon disulphide. The white crumbs of the alkali cellulose magically soak up the carbon disulphide, and the whole mass becomes a rich, orange-red, sticky mixture. As the result of this metamorphosis the cellulose becomes soluble in water and by adding water it is at last turned into a thick golden syrup.

This syrup must be matured and digested, and it is put by for a period of days, during which time the opportunity is taken to filter it free from any particles of solid which have survived the chemical treatment. And by use of vacuum suction small air and gas bubbles are withdrawn from the syrup. Stringent precaution is necessary here, for in the next stage the viscose has to be pressed out through orifices which are measured in thousandths of an inch. The least particle of dirt, or the smallest gas bubble would choke such an orifice and flaw the spun thread.

### Spinning

If you are given to chemical experiment you can dissolve filter paper with strong caustic soda and make it into viscose with carbon disulphide. You will find that when you pour this viscose into weak sulphuric acid, or you can imitate the actual spinning and extrude it through a small glass jet, and you will find that the thread sets smooth and hard.

And this is how rayon is formed, only instead of one small jet the rayon spinner uses a tiny revolving nozzle pierced with a number of tiny holes. From each hole flows a fine stream of viscose into the sulphuric acid bath, and as the viscose comes out the jet revolves so that threads are all spun up together into yarn as they are formed.

The first formed end of the thread has been placed on a glass wheel which, as it revolves, draws the thread from the jet across the bath of sulphuric acid and then drops it down a glass tube into a revolving box. The glass tube rises and falls as the box revolves and by this action the newly formed thread is wound up against the walls of the box into a cake which is something like one of those criss-crossed wound balls of string you buy.

### Preparing the Thread

From the spinning machines the cake is taken and conditioned and then it is wound off into loose hanks (Fig. 2). The hanks are then spray-washed with water, dried, bleached, and finally dyed. The brilliance of dyed rayon is entirely due to the perfect whiteness to which it can be bleached in this process. There is also another process to which it can be subjected, which is called delustring. This is achieved by depositing a tin salt on the thread. It is rather an important process, as one of the earlier drawbacks which rayon suffered from was its

*Fig. 2.—Rayon cake being wound off into hanks.*

extremely smooth and shiny finish, which gave it a cheap appearance according to fashionable standards.

After hanking, the rayon thread may be wound and reeled in the several ways which are required for weaving it up into cloth or for kitting it into garments.

### Silk Wool

There is also another new method of making up rayon, that is as silk wool, or "Fibro," to give it its commercial name. Instead of spinning the thread up into fine yarn, much larger spinning jets are used, which turn out a thick rope of rayon and this is then chopped up into small lengths and shredded out again into a soft silky cotton wool. In this form it has the advantage that the machinery of the Lancashire cotton mills can card it and spin it exactly as they do ordinary cotton wool. Thus by feeding it to established mills rayon manufacturers can concentrate on making the raw material, and leave its treatment to the experienced Lancashire weavers.

### Artificial Wool

We are not much interested in artificial wool in this country, as we can get all the natural product which is required. But Italy and Germany, in striving for self-sufficiency have set their chemists to work on the problem of producing an artificial fibre which has the springiness and resilience which distinguishes the natural product. It is a question of the imitation of the curliness of the sheep's wool which gives this spring. Their efforts have been attained by remarkable success.

The starting material is the waste from creameries and dairies. The watery, non-fatty part of the milk contains a substance, casein, which may be precipitated and purified. It is then made up into a syrup exactly like the viscose of rayon manufacture and is then extruded through the spinning jet device into sulphuric acid, which, however, in this case is kept hot. The rope of spun casein is further set in a bath of formaldehyde and it is then dried and washed and cut up into floc. There has thus been made a harsh wool-like substance which can be teased out, combed, laid, and twisted into yarn. It is said that the resources of casein in Italy could produce about 25 per cent. of the whole wool needs of the country.

Almost for a certainty, as time goes on, chemists will no longer depend on cow's milk to substitute sheep's wool. The discoveries of new plastic materials, which are increasing very rapidly in number, will lead to the discovery of a way of making a viscose solution based on coal tar or even completely synthetic sources, and the sheep, like the silkworm, will go out of business.

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**"Elektron Magnesium Alloys." 10s. 6d. net. 128 pages. Published by F. A. Hughes & Co., Ltd., Abbey House, Baker Street, London, N.W.1.**

THE new ultra-light alloy known as Elektron, is being used to an increasing extent, not only in the aircraft industry but in the bicycle and other industries, not excluding models. Further progress is made possible by this new material, which is of magnesium base. By virtue of its low density and comparatively low cost, magnesium ranks high as a main constituent of almost every constructional material. Credit is due to those of high enterprise who have placed these great possibilities within practical reach. Every constructor engineer and designer will welcome this handbook which gives authoritative information on the subject of magnesium and its leading alloys.

The book deals with the origin and development of Elektron, definition of terms, casting alloys, wrought alloys, surface protection, fire risks, applications, useful tables, method of working, and all the facts, figures and formulæ.

**"The Watch and Clockmakers' Handbook," by F. J. Britten. Revised by J. W. Player, F.R.H.J. E. and F. Spon, Limited. 15s. net. 547 pages.**

THIS well-known work, which has now reached its fourteenth edition, has been revised and brought thoroughly up-to-date. In its form of a Dictionary and Guide the multitudinous phases of the watch and clockmakers' art are dealt with in a very practical and comprehensive manner, and without unnecessary detail or cumbrous explanation. Certain scattered items which have appeared in previous editions have now been collated, and are now in alphabetical sequence throughout the work. The progress that has been made in recent years on the subject of Electric Clocks has rendered necessary a considerable augmentation of the book under this heading, and no less than 34 pages are devoted to this important subject. The book is profusely illustrated with line drawings, half-tones, and woodcuts, and contains a number of useful tables of date marks, Assay Office date letters, watch movements, wire gauges, weight of metals, square roots, clock trains, etc. There is also a section devoted to French equivalents, and last, but not least, a very full index is included. This is a book which should prove very popular not only with the student and mechanic, but also the layman who is interested in the why and wherefore of the watch and clockmakers' art.

**"A Dictionary of Wood," by E. H. B. Boulton. 206 pages and over 100 half-tone plates. Price 3s. 6d. Published by Thomas Nelson & Sons, Ltd., 35–36, Paternoster Row, London, E.C.4.**

AN interesting book in which are listed over 100 species of timber. A half-tone illustration of each entry, showing the grain of the wood, are listed alphabetically, together with full scientific and practical notes on each. The book is published under the direction of the Timber Development Association, and is intended for the use of all practical workers in wood.

The author was formerly University Lecturer in Forestry, University of Cambridge; and is now head of the Timber Section, City of London College, and Technical Director of the Timber Development Association.

### A Scientific Book Club

A SCIENTIFIC Book Club has been formed by W. and G. Foyle, Ltd., which will enable interested readers to keep abreast of the latest developments of modern science, and to own a first-class library of scientific books at a fraction of the ordinary cost. A selection committee composed of Mr. H. G. Wells and Professor A. M. Low will each month select a recently-published book which in their opinion is of outstanding scientific importance. For further particulars of this club see the advertisement on page 379.

*This is claimed to be the largest transparent ball ever made. It is produced from Perspex synthetic resin, a product of I.C.I., shaped by the Triplex Safety Glass Co., Ltd., and it was shown at the stand of Mouldrite, Ltd., at the British Industries Fair at Olympia. A feature of the ball is its high light transmission, and it can be looked through from any angle without the slightest distortion.*

# MASTERS OF MECHANICS

## No. 32.—Sir Hiram Maxim
## Inventor of the Machine Gun

*Sir Hiram Maxim with his original machine gun.*

IT was the late Lord Salisbury who epitomised a portion of Sir Hiram S. Maxim's career in as invidious a manner as anyone could conceive.

"Maxim," remarked Lord Salisbury, "deserves lasting fame if only in view of the fact that he has prevented more men from dying of old age than any other man who ever lived!"

Alas, the epithet is probably a true one, for the Maxim gun, the first really efficient mechanical rifle or machine gun which Maxim brought out in 1884, was immediately taken over by the British Government, and it has formed the pattern for all other similar mechanised guns ever since.

### Fame and Wealth

There is little doubt that the Maxim gun brought fame and wealth to its inventor who, before its introduction, had been a struggling American engineer, mechanic and inventor. Hiram Stevens Maxim had known what life can be at its hardest phases. Born on February 5th, 1840, at Brockway's Mills, near Sangerville, in the American State of Maine, the future Sir Hiram Maxim was the eldest of the eight children of one Isaac Weston Maxim, a poor farmer of a sparsely populated district who eked out a meagre livelihood by undertaking wood-turning and other semi-mechanical jobs in addition to his agricultural activities.

This Isaac Weston Maxim, the father of Hiram, seems to have been a philosophically inclined individual. For instance, he pondered much over abstruse problems connected with Space and Time. He believed that it would one day be possible to construct flying machines, and when his fields suffered severely from the inroads of rabbits, he tinkered with the idea of an automatic gun which would shoot several rounds in succession.

Hiram Maxim, we find, grew up to be a queer sort of youth. He was immensely strong in body and "quick on the uptake," as they say, in mind. Left in many ways to fend for himself, he took a delight in contriving various homely appliances which he put together out of odds and ends. Maybe, during those earliest years of his, he had made a few attempts at making the wonderful automatic gun which his father frequently talked about. Whether such was actually the case we shall never know. One thing, however, we do know is this: that during his boyhood when Hiram, like all the lads of his district, was learning to shoot with an old farm rifle, he nearly had his shoulder blade broken by the recoil or "kick" of the gun. The experience was a decidedly unpleasant one and it made a lasting impression upon his mind.

### Apprenticed

At the age of 14, after some rudiments of schooling, young Hiram S. Maxim was apprenticed to a carriage-maker, one Daniel Sweat, of East Corinth, a not far distant township. Sweat's workaday policy was apparently symbolised by his name, for he worked the boy Maxim for upwards of sixteen hours per day and paid him the princely wage of four shillings (1 dollar) a week, a portion of which pittance was paid in goods obtained from a local shop.

Maxim did not stay long with old Dan Sweat. He found, in turn, a number of different jobs, among which may be mentioned those of barman in a public house, brass founder and wood-turner. During this nomadic period of his youth, Maxim always found time to read up any scientific books which he was able to get hold of. He was gifted with an extraordinarily good memory and a subject once grasped by his mind was thereafter retained without effort.

Then Maxim embarked upon a pugilistic career. He became a boxer and attained to considerable local fame in that line. But after being rather badly knocked out in one encounter, he took the advice of a country doctor and forsook the ring for a steadier if less spectacular career.

Maxim had an uncle, Levi Stevens, who was the owner of a diminutive engineering works at Fitchburg, Massachusetts. To this factory he went in 1864 where he worked in better conditions and studied practical draughtsmanship in addition to engineering and physical science.

### A NEW MASTER

Whether Maxim and his uncle failed to agree we do not know. At any rate, Maxim soon parted company with Levi Stevens and entered the service of a scientific instrument maker named Oliver P. Drake. Here Maxim found himself, for the first time in his life, in a world of his liking. He got on well with his master, Oliver Drake, and, indeed, became greatly attached to him. To Drake's careful training of his youthful abilities, Maxim in later years attributed much of the success which had come to him.

It was during his stay with Oliver P. Drake that Maxim took out his first patent. It was for a pair of improved hair curling irons. But the demand for such appliances in the district was small and thus the "improved" irons failed to obtain much notice.

A few years afterwards, Maxim moved to New York and busied himself with the invention of a gas-generating appliance and a locomotive headlight. In 1878 he was appointed Chief Engineer to the U.S. Electric Lighting Company, of New York, a post which set his feet firmly upon the ladder of success, since in the above-mentioned year he brought himself into prominence by devising a method of improving the filaments of the then newly-invented incandescent carbon lamps by heating them in an atmosphere of hydrocarbon vapour. This improvement was of the greatest possible benefit to the early electrical industry, and its originator was shrewd enough to see that he obtained his own due share of the proceeds.

### Maxim Decorated

In 1881, Hiram S. Maxim came to Europe. His object was to exhibit his carbon lamps at the Paris Exhibition of that year, an aim which he successfully achieved, for, in addition to receiving many orders for his firm, he was awarded the decoration of the *Legion d'honneur* by the Parisian government.

Whilst in Europe, Maxim made good use of his time, not only "seeing the sights," but also studying the conditions of living in the various cities.

In Vienna he came across an American business man whose contempt for Europeans showed itself in the chance remark he made to Maxim.

"If you want to make a pile of money," said this cynic, "all you have to do is to invent something that will enable these Europeans to cut one another's throats with greater facility."

The American's philosophy, which, incidentally, might have been uttered yesterday instead of nearly sixty years ago, seemed

to strike deep into Maxim's curious and ever ingenious mind.

"That remark," related Maxim himself in later years, "set me thinking. It made me think of the first powerful kick I got when I first fired an American military rifle as a boy, and a little later I made a very highly finished drawing of an automatic gun."

Maxim's celebrated gun may have been conceived in Vienna, but its actual working out took place in London. Settling in that city, Maxim opened up a small workshop in Hatton Garden and there, surrounded on all sides with diamond merchants, precious metal dealers and goldsmiths, he quickly brought into being his first machine gun which weighed some 50 lb. and was capable of firing off 2,000 rounds of ammunition in three minutes with one pull of the trigger.

In devising his gun, Maxim, of course, had utilised the energy of the "kick" or recoil of the exploding cartridge to eject the spent cartridge, feed another into its place and fire it.

Strictly speaking, Maxim's gun was not quite the first automatic rifle invented. The Gatling gun had preceded it as early as 1862, the French "Mitrailleuse" in 1867, and the German "Nordenfeldt" automatic gun had been developed in 1877. Maxim's machine gun, which he invented in 1883, was, however, easily the most efficient weapon of its class. It immediately attracted high official notice from the War Office in England, and in 1884 Maxim formed the Maxim Gun Company for the purpose of manufacturing the gun in considerable quantities. This firm subsequently associated itself with the Nordenfeldt Company and in 1890 became Vickers, Sons and Maxim, of which Maxim was a prominent director. On his final retirement from business in 1911, the latter firm became Vickers, Limited, under which name it is still known.

The success of his automatic rifle fully bore out the statement which the American business man had chanced to make to Maxim in Vienna. Maxim, indeed, did "make money," and his gun brought him independence for life.

Hiram Maxim, however, had too active a mind to be content with mere financial independence. He cast around for another subject upon which to exercise his inventive nature and found it immediately in aeronautics, a subject which was then beginning to occupy the minds of several inventors.

### Mechanical Flight

Maxim believed that it would ultimately be possible for men to fly. Even in his boyhood days, as we have already seen, his father had consistently believed that human flight would ultimately become possible, and Maxim had either inherited the parental opinions on that subject or had subsequently elaborated them for himself.

The engineers, mathematicians and others who, towards the end of the last century, wrote learnedly in periodicals in an endeavour to prove that mechanical flight was a thing for ever unattainable by man, roused the ire of Maxim. In many respects, he was no theorist and he distrusted all theoretical attempts to prove the possibility or impossibility of a thing before it had actually been tried.

Of the theorists who attempted to prove the impossibility of mechanical flight, Maxim, in his most sarcastic vein, wrote:

"These [writings] have for the most part been prepared by professional mathematicians, who have led themselves to believe that all problems connected with mundane life are susceptible of solution by the use of mathematical formula, providing, of course, that the number of characters employed are numerous enough! When the Arabic alphabet used in the English language is not sufficient they exhaust the Greek also, and it even appears that both of these have to be supplemented sometimes by the use of Chinese characters. As this latter supply is unlimited, it is evidently a move in the right direction by the mathematicians!"

Despite, however, his tilt at the theorists and in spite of the energies, time, ingenuity, money and labour which he threw into his attempted solution of the problem of mechanical flight, Maxim never succeeded in making a machine capable of sustained flight in the air.

His first "flying machines" comprised large models which were held "captive" by a strong steel wire. These were capable of flying in circles around a fixed point.

The large "flying machine," with which Maxim's name is now associated, cost him approximately £20,000 to construct. Its making occupied five years (i.e. between 1889 and 1894), and it consisted of a large central plane having a pair of wings on each side.

### Steam Driven

The machine was steam driven. Its engine weighed 600 lb., and its steam-generating boiler turned the scale at 1,200 lb. Added to this, the necessary water for the boiler brought another 6,000 lb. weight, thus making the total load of the plane really colossal.

Maxim admitted that steam was by no means the ideal power-provider for an aeroplane, but then, as he naïvely said, he had no time to invent a suitable petrol engine, and so he had to put up with the inconveniences of steam power.

The experiments with Maxim's flying machine took place on his estate at Bexley, Kent. Here he had constructed a long railway track of 9 ft. gauge which was laid down in the middle of a wooden track of 30 ft. gauge. Along these two specially constructed tracks, the monstrous aeroplane ran until it attained the speed of 40 miles per hour. Then Maxim would attempt to make it rise into the air.

Practically speaking, however, he never succeeded in his attempts. The principles of his machine—widely considered—were right, but the enormous weight of the plane, despite its 300-h.p. engine, was all against its rising from the track.

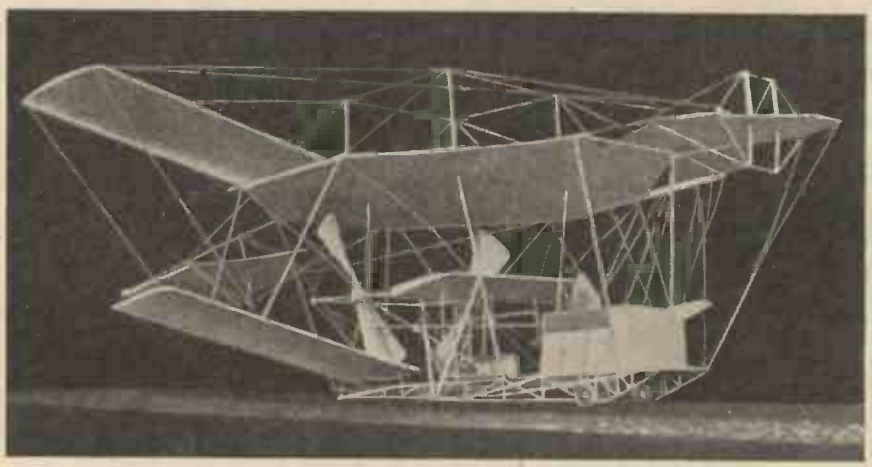
Actually, upon one occasion in 1894, it was proved that the carriage wheels of the aeroplane did for a brief period rise above the track. Hence, technically speaking, we may say that Maxim was the first man to fly.

Other inventors, however, were now coming into the field of mechanical flight, and the use of the internal combustion engine as a source of power was at hand. Maxim, therefore, somewhat disappointed in his attempts at mechanical flight, left the field to others, but always he followed with the greatest possible interest the exploits of other pioneer inventors in this subject.

### Other Achievements

The machine gun and the pioneer aeroplane which he constructed by no means constitute the whole of Maxim's achievements during his mature years. In all, he took out 122 patents in America and 149 in Great Britain. These ranged from an automatic mousetrap and fire-extinguishing appliances to roundabouts and automatic steam pumps.

The flying-boat roundabout which Maxim in his later years established at the Earl's Court Exhibitions in London proved an enormous success, and in some measure compensated for the small fortune which he had previously lost in the construction of his ill-fated aeroplanes. This form of amusement roundabout consisted of a number of boats which flew around in a circle, being suspended from wire ropes. The entertainment caught the public's fancy, and for a time "Maxim's flying boats" were the talk of London.



*Maxim's own model of his celebrated £20,000 steam-driven flying machine.*

Maxim received the honour of knighthood from the hands of Queen Victoria in 1901. In the preceding year he had become a naturalised British subject.

There was, of course, much of the showman in Maxim. As a commercialist, he invented, in his later years, a curious-looking glass pipe, which was intended to be used by sufferers from asthma. This, perhaps, was the last of his many inventions and contrivances.

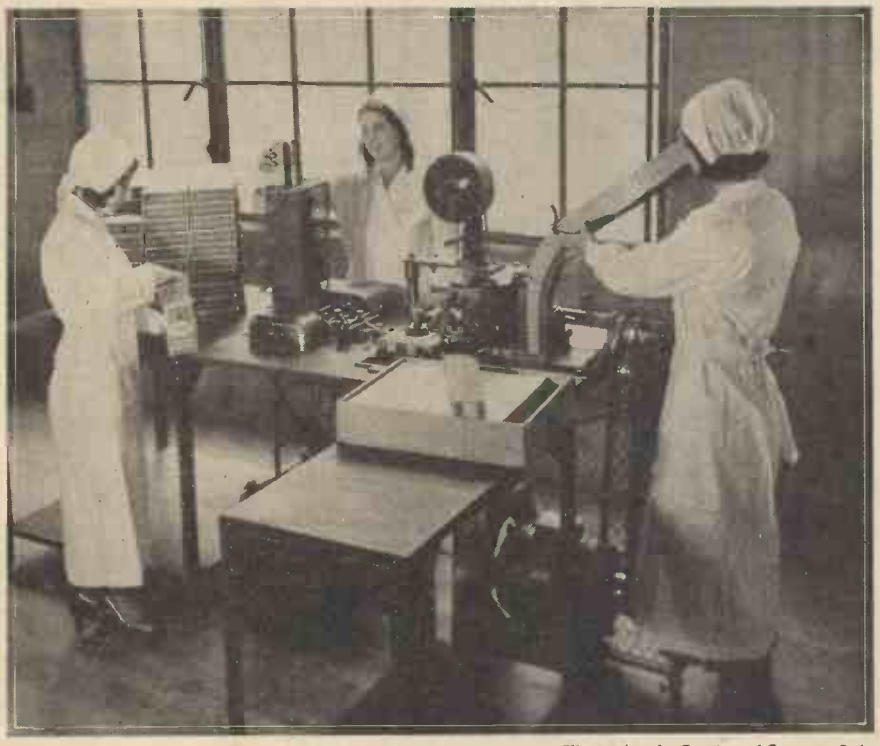
There is no doubting that Maxim was a distinctly vain man. He had personality and extreme charm of manner, but he was jealous of other inventors, Thomas A. Edison, in particular, and even of his own brother, Hudson Maxim, who, for a time, was his rival in ammunition making.

To the end, however, Sir Hiram Maxim kept up his manner as an entirely self-made American, and died on November 24th, 1916, at his home in Streatham.

# Scientific Cigarette Making

## By Our Special Correspondent

## Machines that Turn Out 1,000 Cigarettes a Minute



*Illustrations by Courtesy of Carreras, Ltd.*

*The finished cigarettes are packed by one of the most ingenious machines ever invented. This machine sorts the cigarettes into the desired number, wraps them in silver paper and encloses them in a carton. It is absolutely fool-proof, and signals any mistake, such as a wrong number of cigarettes, by ringing a bell or showing a light, and rejecting the faulty packet.*

TO you and me a cigarette is just a paper cylinder of tobacco that goes up in a few puffs of smoke from which we obtain the most heavenly pleasure. But have you ever given a thought, as you stubbed the smouldering end into an ashtray, of the amazing industry and cleverness that went into its making. For, although a cigarette may appear to the layman to be a very simple affair, its construction brings into play some of the most ingenious machinery ever invented.

No one knows for certain who invented the cigarette, but credit is generally given to an unknown Egyptian soldier who was fighting in the Turkish war of 1832. There was plenty of tobacco, the story goes, but not enough pipes to smoke it in, and the Egyptian soldier solved the problem by packing tobacco into a cartridge case and smoking that.

### The First Cigarette

It was quite a time before this crude substitute for a pipe evolved into anything like the slick, compact cigarettes we know to-day, and even when this did happen, cigarettes continued to be a luxury that only a few could afford : one reason for this was that the labour of hand-making the cigarettes was very considerable—the very most one man could roll in a day was a couple of thousand.

Then, towards the end of the century, a young man named Bernhard Baron conceived the idea of using machines to turn out cigarettes in thousands an hour.

*At every stage in the manufacture the cigarettes are subjected to the most rigorous system of checking. This work is done by girls who are specially trained so that they can see even the slightest fault at a glance. The picture shows one of the girls working on the final inspection.*

He brought a machine of his own design to England—and so the "gasper" was born.

I have just visited Carreras' colossal factory in the Hampstead Road and seen the wonder of cigarette making for myself. The cigarettes are still produced by the machine of Baron's own design, and to-day these Baron machines, as they are known, turn out 1,000 cigarettes a minute.

### The Tobacco

The tobacco arrives at the factory in huge drum-shaped hogsheads, each containing about 1,000 lbs. of tobacco. After the tobacco has been unpacked the leaves are sprayed finely with water in order to moisten them sufficiently to make them workable. Girls with specially trained fingers then strip them and remove the hard centre veins and stalks, which are sent back to the Customs for rebate on the duty paid when they entered the factory.

Science then takes over. The leaves are transported in trucks to the cutting rooms where huge electrically driven machines cut them into thin yellow strands, at the rate of 10 lbs. a minute. Gigantic razor-sharp knives move rhythmically up and down, chopping the strands of tobacco so that they fall in a shower of golden rain. In this process the strands of tobacco must be fed into the machine a certain way, otherwise the tobacco will not be of the right cut and the blades will be damaged. As a matter of fact, the strain on the knives is so great that one blade is only used for 10 minutes at a time and afterwards has to be removed for re-sharpening to a special department maintained solely for that purpose.

### Removing Impurities

The shredded tobacco is next passed over a revolving drum with a surface like a sieve. This process removes all impurities such as tobacco dust and sand, and to make it even more thorough an overhead suction apparatus is also used ; by this device all matter heavier than the tobacco falls through the sieve, and lighter substances are drawn upwards by suction.

The tobacco then passes into the care of the machine with which Bernhard Baron revolutionised cigarette production. This machine holds three miles of paper at a time—enough for 60,000 cigarettes. As the paper unwinds from a spool the name

*The cigarettes are rolled by a machine that holds over three miles of paper at a time—enough for 60,000 cigarettes. This machine also tips the cigarettes with cork. The cork arrives at the factory already wound in spools, one of which is seen on the left of the picture.*

of the cigarette is automatically stamped on it at regular intervals. This paper in a continuous length is then drawn round the tobacco and the two sides joined so that it has the appearance of one fantastically long cigarette. Another spool of paper-thin natural cork fixes cork tips at regular intervals along this tube of paper and a minutely adjusted cutter chops off the cigarettes in the required lengths.

**Finished Cigarettes**

The finished cigarettes are now shot into a trough at the rate of 1,000 a minute, cork tips uppermost. (My guide explained to me that the advantage of tipping cigarettes with cork was not only the obvious one that cork is more comfortable to the mouth than paper, and prevents the cigarettes from sticking to the lips. Damp tobacco burns hot and the tips, being waterproof, prevent the cigarette from being moistened by the lips and at the same time helps to eliminate sore throats.)

The machines which pack the cigarettes are almost human in their ingenuity. The required number of cigarettes is selected, the tinfoil wrapped round it, and this in turn enclosed in a packet, all by the same machine. Any fault in a packet, such as a wrong number of cigarettes, is automatically signalled by the machine ringing a bell or showing a light.

At every stage in the manufacture the cigarettes are subjected to the most rigorous system of checking. Part of this work is done by girls who are specially trained so that they can see even the slightest fault at a glance.

**Testing for Moisture**

One of the most interesting technical tests is that which is used to check the moisture content of the cigarettes. A certain number of cigarettes are placed in a condenser of known capacity. Alternating current is passed through this condenser, and by means of headphones a man listens in to the hum of the current (caused by the changing poles). By means of a dial he adjusts the current until the hum ceases and the difference made by the cigarettes to the capacity of the condenser can be told from a galvanometer reading. From this the moisture content of the cigarettes can be calculated.

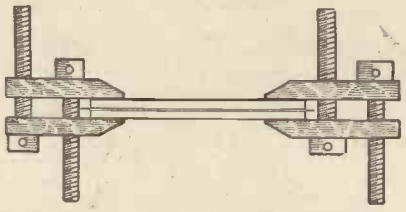
A gigantic air-conditioning plant regulates temperature and humidity throughout the entire factory. There is also a special room used for test purposes.

## DRILLING THIN METAL

THE best way of making holes of any diameter in thin metal is with a punch and die, but if only one or two holes have to be made, it is obviously not worth the trouble to make up the tools.

Small holes can be safely drilled without any tendency to tear by clamping the thin sheet between two pieces of thick brass, as shown and passing the drill right through the three pieces.

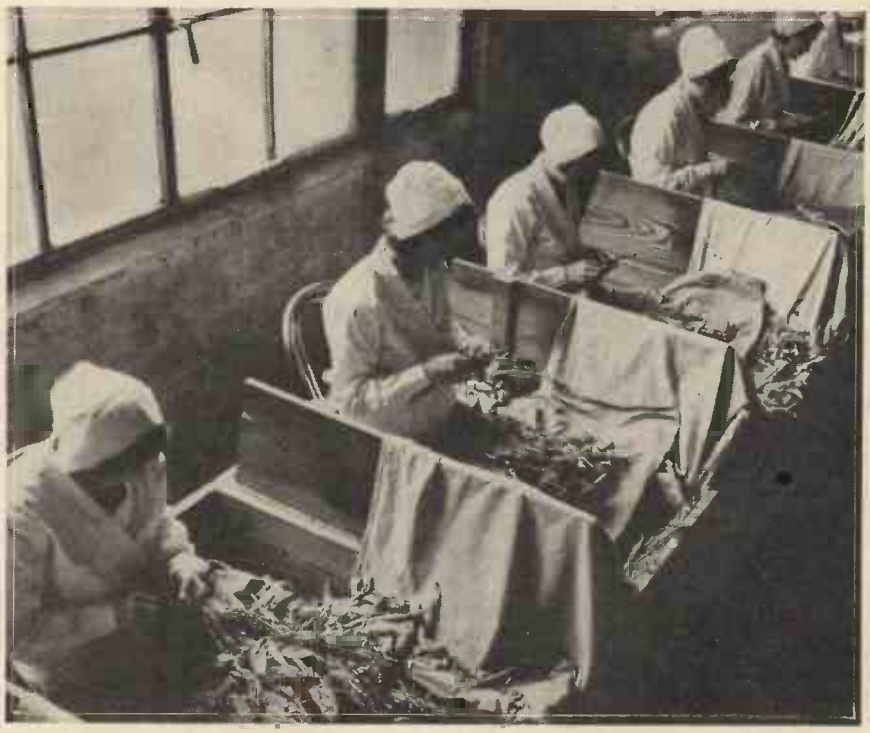
If it is desired to use the same clamping plates as a drilling jig for other similar pieces of thin metal, it may be found that



*Clamping thin metal between two thick sheets of brass.*

the drill will push the metal into the lower hole, drawing same from between the plates, before sufficient pressure can be applied for the drill to bite, and a ragged or torn hole being the result. The trouble can be overcome by piercing the centre of the sheet with a scriber point and by binding the clamping plates, so that pressure is exerted immediately in the region of the hole, as soon as the clamps are tightened.

Larger holes are best made by first drilling the two clamping plates to the desired size, inserting the thin metal, and clamping up. The metal can then be removed with the point of a knife, and finished off with a scraper. This method is particularly good for cutting square or shaped holes.



*Stripping the tobacco leaf after it comes into the factory. This work is done by girls who have been specially trained. The hard centre veins and stalks of the leaves are sent back to the Customs for rebate on the duty paid when they entered the factory.*

# STARGAZING FOR AMATEURS

A NEW SERIES

By N. de Nully

## A GUIDE FOR APRIL

SUMMER time commences on the 10th April at 2 o'clock in the morning, when watches and clocks must be put forward one hour. All times mentioned in this article have been adjusted accordingly. The Sun should be examined for "spots" at every opportunity and a look-out kept northwards after dark, in case of possible recurrences of the Aurora Borealis.

### The Moon

The Moon will be at its nearest to us during April—229,000 miles—on the 5th. It will then be between new and first quarter On the 20th it will be at its farthest in the same period—251,380 miles—and the phase will be within two days of last quarter. The earlier date will be a favourable one on which to inspect the face of our satellite. As every stargazer knows, the lunar features consist of vast level areas called *maria* by the ancients, who believed them to be seas. Even now many people consider that they are probably the dried-up beds of oceans, evaporated long ago owing to the feeble gravitational pull of the Moon being unable to hold the aqueous envelope with which it is assumed to have originally been equipped. There are also extensive rocky regions pitted with "craters" and immense walled-plains. Parts of the *maria* are bordered by stupendous mountain ranges, many of their peaks proportionately higher than those of the Himalayas and Andes. The comparatively smooth expanses are here and there traversed by sinuous ridges: while numerous ring-formations stand isolated in various situations. The fine Mt. Wilson Observatory photograph, reproduced on this page, gives an "aerial" afternoon view of a district displaying several types of these characteristics. In the top left-hand corner will be seen the magnificent curving Appenine range, its precipitous cliffs bounding the western end of the Mare Imbrium. At the extremity of the rugged South-eastern arm of the former, stands the massive structure Eratosthenes, its encircling buttresses rising nearly 15,000 feet above a floor depressed 8,000 feet below the outside level. The lofty crests of the Appenines bristle with summits 10,000 to 12,000 feet in height. On the *mare* at their feet, lies the great walled-plain Archimedes 50 miles in diameter; and the adjacent ring-mountains Autolychus and Aristillus, 23 and 34 miles across respectively. The interiors of the two latter were steeped in the inky shades of oncoming night when the photograph was taken; but when fully illuminated, much rich detail is revealed. Numerous vent-like pits and snaky ridges and furrows are scattered around this fascinating region which is best observed about the time of first and last quarters.

### The Planets

Mercury is now an "evening star." It will be at greatest eastern elongation on the 2nd, when, at about half-past seven, it may be perceived eight degrees (16 Moon's widths) above the W.N.W. horizon. If the sky is clear Mercury will be discernable rather higher up than the more brilliant Venus; but it is losing lustre rapidly as it drifts back into the glare of sunset towards "inferior conjunction" between the Earth and the Sun on the 11th. During the first week of the month Mercury will nevertheless be visible through a small telescope as a diminishing crescent. Venus will soon be conspicuous in the fading western twilight and, at 7 o'clock on the evening of the 1st, will be to the left of the slender slip of the twenty-four-hour-old

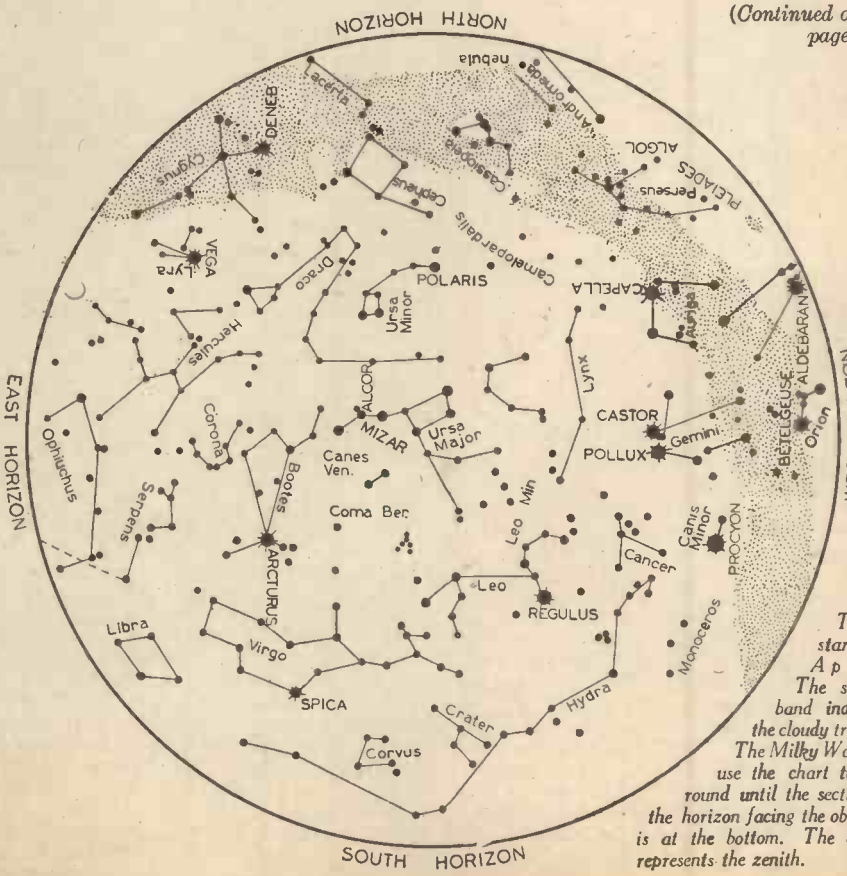
*The Lunar Appenines and adjacent region.*

"new" Moon. If the atmosphere is free from haze and clouds and there is a clear view down to the sky-line, the pair will offer an attractive spectacle. Looked at through an astronomical telescope, the present phase of Venus is a tiny disc slightly past "full." Mars continues in the same region and, on the evening of the 3rd, will likewise be close to the young Moon. By the end of the month, however, it will have apparently moved near to its almost equally ruddy stellar counterpart Aldebaran, in the constellation Taurus. Both will then be setting at 10.45 p.m. Jupiter is a "morning star" rising about an hour and a half before the Sun. Possessors of instruments of not less than 3 in. aperture who are enthusiastic enough to get up as early as 5.30 a.m., may have an opportunity of seeing this planet in the dawn with but one of its principal "moons" on each side of it and the other two passing in transit across the disc. On that morning Jupiter will be rather low over the eastern horizon. Saturn is temporarily lost in the radiance of daylight.

### The Zodiacal Light

If conditions are favourable and the observer's situation is in a district free from smoke and glare, this ghostly celestial phenomenon may be discernable in the dusk during the first few evenings of the month before moonlight gathers overpowering strength. It usually takes the shape of an immense pale luminous cone, pointing slantingly upwards from the place along the skyline where the Sun set a couple of hours previously. The Zodiacal Light is attributed to a diffused glow reflected by myriads of minute particles of matter constituting an extension of the solar corona. Its precise nature is, however, still unknown.

(*Continued on page 402*)




*The stars in April. The shaded band indicates the cloudy track of The Milky Way. To use the chart turn it round until the section of the horizon facing the observer is at the bottom. The centre represents the zenith.*

# BUILDING A 1-C.C. ENGINE

*Further Constructional Details of the First 1-c.c. Engine to be Described.*

By W. H. Deller

## Part IV

### Details of the Cylinder

(Complete Sets of Blue prints are now available at 5s. per Set)

**The Cylinder. Fourth Operation**

FINISH turning on the outside, leaving a small amount on the face of the bottom flange for final facing after silver soldering the transfer channel in position. Screw the neck at the bottom of the cylinder 40 threads per inch to fit into the crank case, cutting the thread as close to the flange as possible, and turn away the front threads to the core diameter for a distance of $\frac{1}{32}$ in. Treat the opposite end of the blank in the same manner.

Turn the fins with a parting tool ·036 in. wide, having the corners slightly radiused. It should be noted that the end fins are purposely left thicker than those intervening. Control the depth of the grooves by working to an index on the cross-slide as the amount of metal between the bottom of the grooves and the cylinder bore is only $\frac{1}{32}$ in.

**Fifth Operation**

Screw the cylinder tightly into the crank case to obtain the position of the ports, bearing in mind that there is an amount of ·01 in. to be subsequently removed from the under face of the flange. This means that when the metal has been removed the cylinder will screw in approximately one half-turn farther. Therefore allowance for this must be made by marking the centre lines for the ports 180 degrees in advance of the position now obtained. Having ported the cylinder walls and the bottom flange, prepare the sheet-metal transfer channel.

**The Transfer Channel**

This part calls for no special comment beyond the fact that it should fit between the under side of the lower fin and the upper side of the bottom flange neatly. Also the edges require filing to seat closely on the cylinder barrel. Care should be exercised in fitting, as any silver solder which may flow inside will be difficult to remove. The outside chamfering is carried to about half the thickness of the metal.

**The Cylinder. Sixth Operation**

The inside of the channel and the portion of the cylinder covered by it can be neatly "blackleaded" before wiring in position, when the outside and adjacent portions of the cylinder may be so treated, to leave a narrow track for silver solder. The actual soldering should be executed with a minimum of material, sufficient only being applied to leave a small fillet in all corners.

If the work has been properly prepared no cleaning up, beyond perhaps the removal of the flux scale, should be necessary.

This leaves the final "facing up" of the bottom flange to be done, using the mandrel on which the turning was executed for this purpose. It is, of course, unnecessary to mention that the face must be smooth and flat and that the port covered by the transfer channel must line up with that in the crank case when the cylinder is screwed home. Mention must also be made of the fact that no packing for this joint is used except a smear of liquid jointing introduced in the final assembly of the parts.

Before leaving the cylinder lap the bore to finished size. This operation must be carried out with an expandable lap, so that the size may be controlled. Use a very fine abrasive and finish with rouge. A mirror finish may be imparted in the same manner as that recommended for the main bearing bush.

Once again emphasis is laid on the fact that the cylinder bore must be perfect in every respect, and in order to ensure that the hole is parallel and to size it is as well to work to a "size" plug gauge, aiming at a good "push fit" as finality.

**The Cylinder Head**

This part is made from nickel-chrome steel of the same diameter as that used for the cylinder. The screwed boss on the top holds the gland nut for the sparking plug, which consists of an insulator and electrode only, the usual body of the plug being incorporated in the head.

**First Operation**

Chuck the material, face, centre-drill and with a No. 14 drill, drill a hole $\frac{9}{16}$ in. deep. Turn the outside to $\frac{3}{4}$ in. diameter for a distance of about $\frac{5}{8}$ in., and work in at the back to rough out the boss to $\frac{9}{32}$ in. diameter. Counterbore the centre hole to ·479 in. diameter to a depth of $\frac{1}{8}$ in. Undercut the back of the hole with a narrow tool to ·505 in. diameter to clear the nose of the screwing tool. Screw internally 40 T.P.I. to suit the thread at the top of the cylinder, boring away at the mouth of the thread to core diameter, so as to allow the head to screw home.

Turn the fins with the tool that was used for the same purpose on the cylinder to a depth of $\frac{3}{32}$ in., the grooves in this instance being slightly wider, so that a side cut must be taken in each in addition. Part off at the back of the boss to leave the head $\frac{13}{32}$ in. in length overall at this stage.

**Second Operation**

Hand ream the centre hole to $\frac{3}{16}$ in. diameter. Turn a peg in the chuck and mount the partly finished head on same with the boss outwards. Face the boss to length and finish turn to $\frac{17}{64}$ in. diameter. Screw with a full thread 40 T.P.I. up to the edge of the fillet, and mouth out the front of the hole to an angle of 60 degrees for the gland packing.

**The Sparking Plug**

As previously stated, this consists of three main parts. The gland nut is made from $\frac{5}{16}$ in. A/F hexagonal mild steel bar, or from $\frac{3}{8}$ in. diameter material turned down to ·360 in. diameter and the hexagon head afterwards milled or filed on. The ·245 in. diameter bore can be screwed 40 T.P.I to suit the cylinder head boss or a tap made for the same purpose.

The insulator is part of a small wireless resistance; the diecast ends and resistance element are removed from it to leave a porcelain tube ·186 in. diameter × $\frac{5}{8}$ in. in length. Carefully grind the end of the porcelain to leave a slightly tapered spigot $\frac{1}{8}$ in. diameter × $\frac{3}{16}$ in. in length. The centre hole in the tube will just pass a No. 13 B.A. screw size, but any roughness that may cause interference is easily removed by lapping.

Pure nickel wire $\frac{3}{32}$ in. in diameter is required for the electrode. Owing to the soft nature of this material the ·0472 in. diameter portion should be reduced to size by turning it in $\frac{1}{4}$ in. sections at a time, allowing a short piece to project from the chuck and feeding the material out at intervals as the turning progresses. Any surface irregularities are subsequently removed with a fine file. The bent portion when turned finishes at the collar with a small radiused corner to minimise the chance of breakage. Hold the stem close up to the collar in a pin vice when bending and make the bend as close as possible.

A brass cap is employed to retain a small quantity of frayed asbestos string to prevent compression leakage between the stem of the electrode and the insulator. The assembly is pulled up with a No. 13 B.A. brass nut and retained with a similar lock nut.

Asbestos string is also used as a gland packing to hold the plug in the cylinder head and to maintain compression at the joint. It may be thought that the gland will be insufficient protection against the plug blowing out under the force of explosion, but this happening will not occur if the precaution is taken of seeing that the packing is dried out and the nut well tightened.

**The Piston**

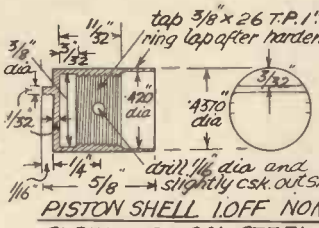
It will be noticed that the piston is built up in two parts. The shell of the piston is made from tool steel which is hardened and lapped to size. A duralumin gudgeon pin adaptor screws into the shell, supplanting the normal bosses provided for the same purpose in a one-piece piston. An aluminium wire pin passing through the gudgeon pin and sides of the shell forms the means of locking the whole assembly.

Owing to the impracticability of incorporating piston rings of so small a diameter, it was necessary to adopt this or a similar design of piston. As a ringless piston made of normal material would wear too rapidly to maintain compression for a reasonable length of time, a steel piston seemed to offer the best solution, but for a part made from such material to function reliably it needed to be hardened. A steel piston with the bosses cut from the solid was passed over as being likely to be of excessive weight and, further, the irregular distribution of metal round the bosses might present hardening difficulties in the direction of distortion.

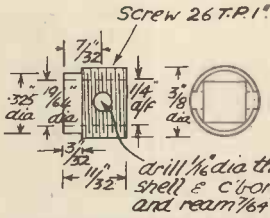
*NEXT MONTH'S ISSUE WILL CONTAIN A FREE BLUEPRINT OF A FLYING MODEL OF A HAWKER HURRICANE (Rubber-driven) AND DETAILS OF AN INTERESTING BOOK OFFER*

# THE 1 c.c. TWO STROKE PETROL ENGINE

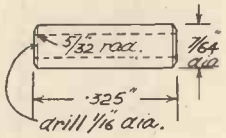
## *Stage-by-Stage Constructional Details*



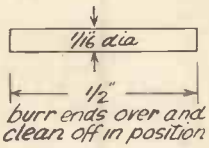

PISTON SHELL 1 OFF NON-SHRINKING TOOL STEEL HARDENED & TEMPERED



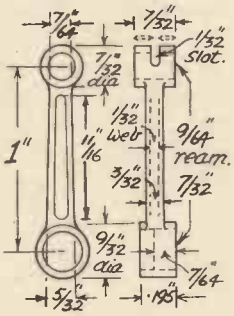

GUDGEON-PIN ADAPTOR 1 OFF DURAL.



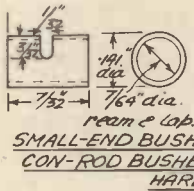

GUDGEON-PIN 1 OFF SILVER STEEL HARDEN AND TEMPER




PISTON ASSEMBLY RETAINING PIN. 1 OFF SOFT ALUM WIRE

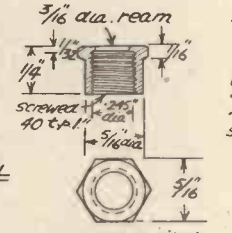



CON. ROD 1 OFF. DURAL

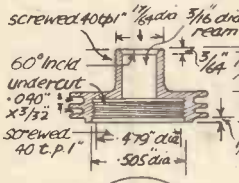



SMALL-END BUSH. BIG-END BUSH

CON-ROD BUSHES 1 OFF EACH. SILVER STEEL HARDENED

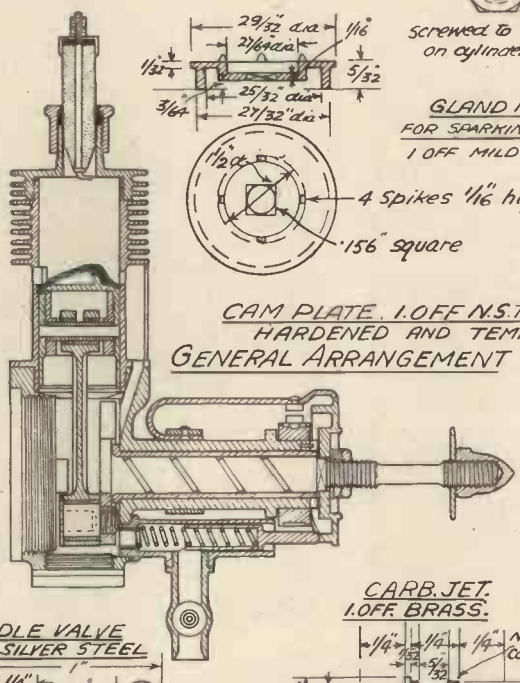



screwed to suit boss on cylinder head





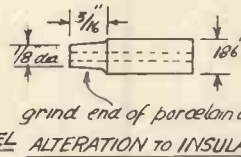
CYLINDER HEAD. 1 OFF NICKEL-CHROME STEEL



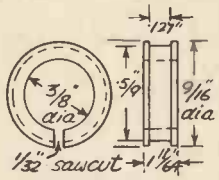

GLAND NUT FOR SPARKING PLUG 1 OFF MILD STEEL

CAM PLATE. 1 OFF N.S. TOOL STEEL HARDENED AND TEMPERED

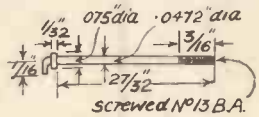
GENERAL ARRANGEMENT



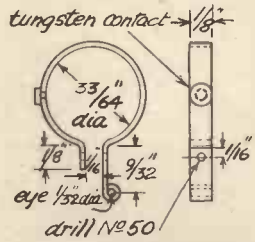

ALTERATION TO INSULATOR

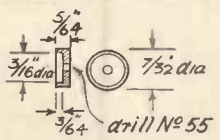



RING INSULATOR 1 OFF BONE FIBRE.

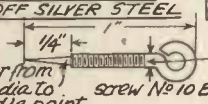



ELECTRODE 1 OFF. NICKEL WIRE

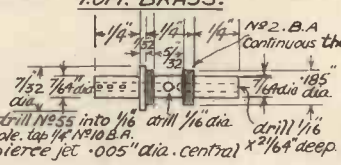



NEEDLE VALVE 1 OFF SILVER STEEL

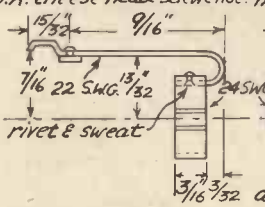


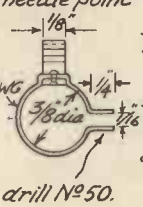

CARB. JET. 1 OFF. BRASS.

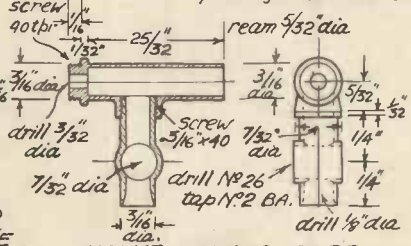



PACKING CAP 1 OFF. BRASS

FIXED CONTACT CLIP 1 OFF 24 S.W.G. P. BRONZE. also required 1 1/4" x No 10 B.A. cheese head screw & nut.



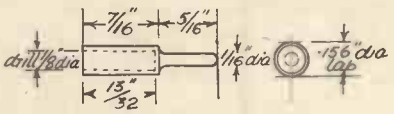




CONTACT BREAKER ARM & CLIP 1 OFF COMPLETE PHOS. BRONZE also required 1 1/4" x No 10 B.A. C.H. Screw & nut.

VALVE BODY & CARB. 1 OFF MILD STEEL

SPARKING PLUG DETAILS also required 2 No 13 B.A. NUTS

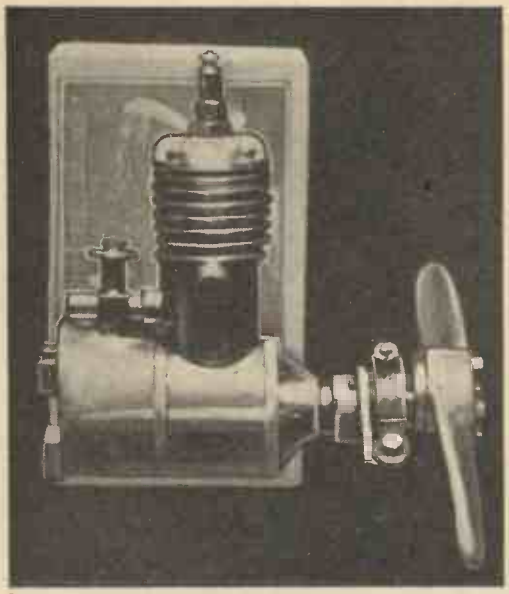



harden and temper ring lap to size

VALVE 1 OFF. SILVER STEEL

# MODEL AERO

CURRENT NEWS FROM THE
A REVIEW OF SOME OF



*The "Little Briton" 1 c.c. engine, the size of which can be judged by the matchbox in the rear. It is made by J. Hallam & Son.*

### The Sixth Annual Gala Meeting

THE Sixth Annual Gala Meeting of the Northern Heights Model Flying Club takes place at the Gt. West Aerodrome, on Sunday, June 19th, from 11 a.m. to dusk. Mr. C. R. Fairey, M.B.E., F.R.Ae.S., has given his permission for the use of the aerodrome. There will be popular contests for hand-launched duration flights, a duration contest for lightweight and heavyweight models, a women's contest, a concours d'Elegance for engine-driven models, general models and gliders, flying scale models, and novelties; a seaplane duration contest, inter-club team contest for the Fairey Challenge Cup, a pusher contest, women's contest, coronation cup contest, and flying scale model contest. For further details apply to Mr. C. A. Ripon, 58, Campden Way, Southgate, N.14. Mr. Ripon tells me that the club has a well-appointed workshop.

### The Hallam 1 c.c. Engine

I HAVE received a folder dealing with the 6 c.c. and 3 c.c. Hallam engines, as well as details of the new Hallam 1 c.c. engine. I have already dealt with the two former engines, and give herewith the specification of the 1 c.c. This is known as the "Little Briton," which has the following specification:

Height 2½ in., length overall 3 in. The conical nose mounting, which also forms the tank of 7 c.c. capacity, is 1¼ in. diameter at the back with a ⅞ in. square for location.

The engine starts quite as easily as larger models, and drives an 8 in. diameter propeller at 4,500. Weight as illustrated, 3 oz. Complete with coil, condenser and 3-volt battery, 6 oz.

Sets of castings with transfer and inlet passage ways cored, drawings and materials are available, price 12*s.* 6*d.*; finished engines ready shortly.

Only plain machining is required to make up these castings, no screw-cutting or brazing necessary. The renewable steel liner has been retained in this design.

I hope to be able to publish a design for a model to suit one of these tiny engines in an early issue.

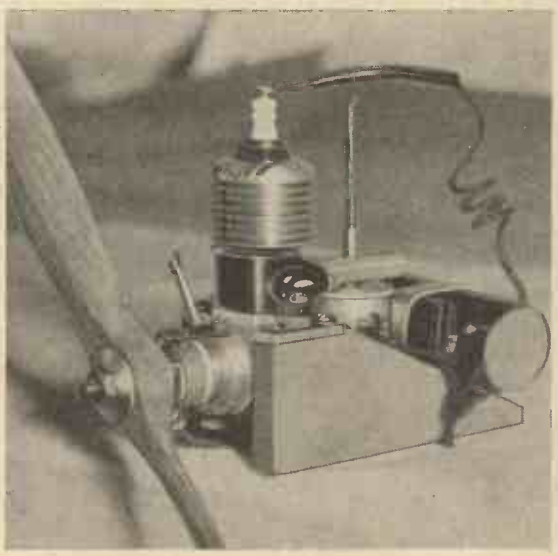
### Insurance for Petrol Models

MR. D. A. GORDON, of the Hornchurch M.A.C., has sent me some details of an insurance scheme he has been able to effect with the Union Assurance Society Ltd. This society is willing to issue policies indemnifying individual members of Model Aero Clubs affiliated to the Society of Model Aeronautical Engineers, against claims in respect of injuries to persons and/or damage to properties arising out of the use of model aircraft, whether petrol or rubber driven. For an annual premium of 5*s.* the Union Assurance Society will provide cover up to £2,500 for any one accident, which will include indemnity to an affiliated club in respect of any claim made against them due to an accident caused by the policy holder.

I have also received from Mr. Dudley Ship, of National Provincial Chambers, Bournemouth, details of his third party insurance for petrol driven model aircraft. This covers claims by third parties against the insured for personal injuries or damage to property caused by flying of model aircraft up to £2,500, any one accident and/or series of accidents arising out of one event unlimited in the year. The premium covers one engine, which must carry an identification plate, but any number of fuselages are covered and these also must bear an identification mark.

*A model Gloster Gauntlet built to a scale of ⅛ in. to 1 ft., made by Messrs. P. M. Sweeten, Ltd.*

*The Comet II (the British record holder) taking off. This model is obtainable from Model Aircraft Stores.*



*The Trojan Junior 2-3 c.c. engine with ball-race crankshaft complete on stand with coil. This is also obtainable from Model Aircraft Stores (Bournemouth).*

### S.M.A.E. Notes

MR. R. BROWN, of Blackheath, has been informed that his indoor R.O.G. flight of 3 mins. 36 secs. has been passed by the S.M.A.E.

The S.M.A.E. point out that if any damage is done by petrol models, or any other type of model, the timekeepers may, in a court of law, be held legally responsible for that damage. Moreover, any individual member of the club or any other club affiliated to the S.M.A.E. could be held legally responsible, although the individual thus named had nothing to do with the actual running of the competition. Timekeepers and other organisers of petrol model competitions should, therefore, see that all the petrol rules, particularly those dealing with third party insurance and airworthiness of the model, are carried out. The Council have instructed Mr. Smith to completely satisfy himself that the owners of any petrol models desiring to register with the S.M.A.E. are properly insured for the current year. The suggested altera-

# TOPICS

## WORLD OF MODEL AVIATION

### THE LATEST MODELS

tion to the petrol model rules was defeated.

King Peter's Cup for International Competition will be held near Belgrade on July 20th to 25th this year. This competition will be held one year for rubber-powered models and the following year for gliders. There will be six attempts allowed with each model. The winner of the competition will be adjudged that person whose model has flown the longest time and greatest distance. One point will be allowed for every ½th of a second flown and one point for each metre of distance flown. Mr. Houlberg has informed the Council that under the F.A.I. rules, competitors in International Competitions and those desiring to claim International records must hold a *sportive* (*sic*) licence from the F.A.I. This will be supplied to members of affiliated clubs for quite a small charge to cover the actual cost of the work involved. F.A.I. certificates and badges will also shortly be available. These will be awarded in three classes :

1. For a duration of one minute with a rubber-powered model or glider.

2. For those who have flown a rubber-powered model or glider for two minutes.

3. For those whose glider has flown for three minutes or whose rubber-powered model has flown for five minutes. The question of King Peter's Cup, F.A.I. licenses, certificates and badges, will be thoroughly discussed at the next Council meeting.

Mons. Desnoes, who had regularly competed in the Wakefield since 1934, suggested that an International Wakefield Club be formed, membership of which would only be eligible to those who have actually competed in the competition, the object being to keep in touch with foreign competitors.

#### New Season's Models

THE Model Aircraft industry is rapidly growing, and if evidence were needed it can be founded in the pile of very interesting and well produced catalogues which has found its way on to my desk, and which I now deal with in a somewhat rapid survey. I am dealing with them in no particular order, and am selecting items from each. The Model Supply Stores of Deansgate, Manchester, show in their catalogue a full range of flying scale model kits at reasonable prices. I select two, The Cadet Major and the "Flea," the latter being a gas type rubber model: this means that whilst it is propelled by elastic a device is fitted which gives the crackling sound of the exhaust of a petrol engine. It is claimed that the model flies half a mile, and the kit costs 12*s*. 6*d*. It is of 36-in. wing span, 28 in. long, and weighs only 4 oz. The Cadet Major is of 30-in. wing span, the kit costing 9*s*. Copies of the catalogue will be sent upon receipt of 4*d*.

*A ½-in. scale model "Aeronca," which has an 18 in. wing span. It is sold by Bonds of Euston Road, Ltd.*

The Model Aircraft Stores of Bournemouth have produced a catalogue which includes a very full petrol engine section. This company sells several of the well known engines and supplies all of the material necessary for building rubber and power-driven models. Illustrations on page 384 show some of their products. The Comet the Second, which is the British record holder, can be supplied as a kit with full plans, and many finished parts, air wheels and timer, £2 19*s*. 6*d*., or with engine £7 15*s*. 0*d*. The 18 c.c. Comet Skyrocket kit costs £11 15*s*. 0*d*., or 4 guineas less engine. The Trojan Junior 2-stroke three c.c. engine with ball race crankshaft costs £4 18*s*. 6*d*. The same firm is supplying a super-lightweight coil of 1½-oz. weight at 13*s*. 9*d*. Readers should obtain a copy of this catalogue.

* * *

The Model Aircraft Supplies, Ltd., the well known suppliers of materials, fittings, kits, etc., have produced a "Green Book," which is a handy little catalogue, containing a great deal of useful information, and it costs 4*d*. I observe that the two latest kits put on the market by the company, whose address is 171, New Kent Road, S.E.1, are the Berkeley Super Buccaneer, a 7 ft. 6 in. span petrol model kit at 38*s*. 6*d*., and the standard Buccaneer of 5 ft. 6 in. span model at 27*s*. 6*d*. Both these kits contain full size drawings, printed balsa, bamboo covering, and electrical switch gear. The engine recommended is the Brown Junior, type C, with aluminium piston and cylinder at £4 7*s*. 6*d*. The "Green Book" is packed with details of materials and fittings.

*(Above) The "Kanga Kite," which has an outstanding glide, and is amazingly stable. (Left) The "Kanga Dragonfly" biplane. These are two of the many models marketed by Kanga Aero Models.*

*Bond's Syncro Ace miniature petrol-engine of streamlined design.*

*Bond's compressed air plant which is made of brass and aluminium, weighing only 7¾ oz.*

* * *

Messrs. P. M. Sweeten, Ltd., of Bank Hey Street, Blackpool, famous as suppliers of kits for scale flying models, have sent me details of their Gloster Gauntlet kit at 6*s*. 6*d*. It includes an exceptionally detailed plan to exact scale of § in. to 1 ft., full details for building, the radial Bristol Mercury engine, pushrods, sparking plugs, cylinder fins, etc. The cockpit can be completely modelled, all controls, pilot's seat, fire extinguisher, throttle, tank, instrument board. Full details for twin machine guns, including the sights. The insignia for No. 19 Fighter Squadron is supplied ready printed. Though the plan is so detailed it is very large and clear to understand and follow. The kit has all parts needed, including hand-carved hardwood screw. Very finely illustrated catalogue illustrating this model and 34 others will be sent for 3*d*. in stamps.

* * *

Messrs. Aerokits (Sheffield), Hanover Works, 135, Scotland Street, Sheffield, 3, inform me that during the next few weeks they will market a fine range of petrol engines, model aeroplane kits—about 11 types in all. They will shortly introduce a beginner's type of endurance machine which has shown excellent results on test.

* * *

Messrs. E. Gray & Sons, Ltd., 18/20, Clerkenwell Road, London, E.C.1, inform

*Another Bond product is this petrol-driven model, which has a first-class specification, complete with air wheels.*

me that they have produced a Grayson Gnome Aero Engine specially for model aeroplane work, for which it is very suitable owing to its small dimensions and lightweight, which are 3¾ in. high, 3¾ in. long, 1½ in. wide, weight 5¼ oz. in electron and 8 oz. in aluminium. A point which has not been overlooked is ease of machining and construction, which can be carried out by anyone possessing a lathe and reasonable ability. The engine is of ⅝ in. bore by ¾ in. stroke, the total capacity being approximately 3·5 c.c.

The engine operates on the standard 3-port 2-cycle principle, with one small difference: the piston is ported. This obviates the use of a long transfer passage, and also helps to keep the piston-head cool. The crankshaft is of the overhung type, having two separate bearings on one side only. This helps towards ease of machining, and also assists in keeping a good gas-tight seal in the crankcase. The crankcase and cylinder are in one casting, and the last mentioned is fitted with a separate iron liner and a finned detachable head. Lubrication is on the petroil system.

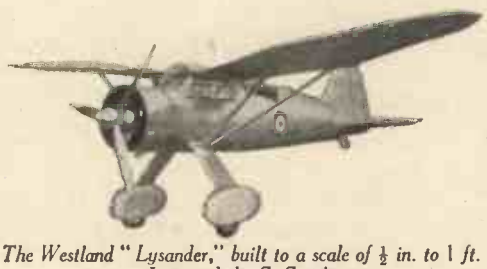
Messrs. Gray & Sons, a very old-established company, specialise in tools, lathes, materials, engines, castings, and so on.

* * *

Kanga Aero Models of 1, Colonnade Passage, New Street, Birmingham, have a special range of model aeroplanes of their own design and obtainable only from them. The models range from rubber driven to petrol machines, special features being their stability and portability. There are three petrol model kits each with approved performance, including the Kanga Kub, a very small and stable model suitable for a 6 c.c. engine and of 4 ft. 9 in. wing span, and which won the Sir John Shelley Power Cup in 1937. The Kanga Kite is a fast and suitably modified edition of the Kub and has an outstandingly slow glide. It can be powered by a 6 c.c. Cyclone or a 9 c.c. Brown or Ohlsson. The construction is very simple. Another kit is the well-known blue Dragon of 8 ft. span. This high-wing model held the British record for 1934 to 1937. This firm also supply the Kanga rubber driven models, including The Dragonfly biplane kit, one model of which has recently made a flight of over 6 minutes out of sight. It is of 30 in. span. The latest edition is the Kanga Kitten, a pretty little cabin high wing of 29¼ in. span. This firm stock a wide range of American and British kits, petrol engines, and all accessories.

* * *

Messrs. Hamleys, Ltd., of 200, Regent Street, W.1, have produced a specially fine catalogue which includes not only model aircraft but models and novelties of all descriptions. Amongst their model aircraft range I notice the Southern Star, which is a petrol-driven model of realistic appearance and good performance. It is of 5 ft. span, fitted with a mighty midget engine and automatic time switch. All parts are neatly cut out ready to assemble. The kit costs £4 15*s.*, or with engine parts £7 17*s.* 6*d.*, with built engine £9. They also list the Comet 11, a robust monoplane suitable for hard work. It is of 6 ft. wing span, the kit costing £4 19*s.* 6*d.*, or with assembled engine £8 17*s.* Diana is a fine high-winged cabin monoplane, the original being the winner of the Sir John Shelley Cup for 1936. It is powered with a Brown Junior engine, and one of the models has flown 12 miles at 3,000 ft. It has an automatic time switch and is of 7 ft. span. The kit costs 5 guineas, or with assembled engine £11 15*s.* Messrs. Hamley supply petrol engine kits for accurate scale models of famous aircraft and some nicely designed rubber driven flying models. Messrs. Hamleys claim

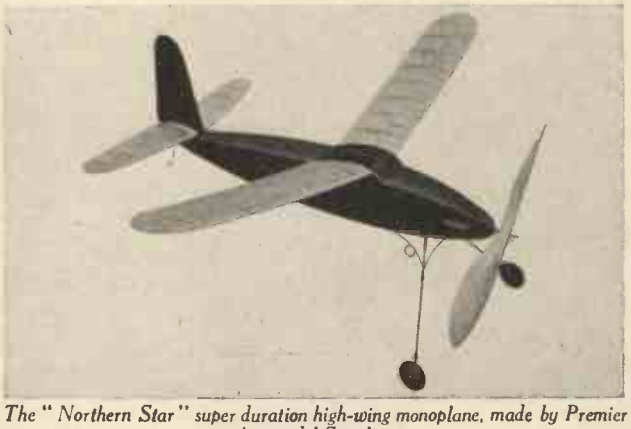


*The Westland "Lysander," built to a scale of ½ in. to 1 ft. It is made by S. Smith.*

that they hold the largest range of model petrol engines in London, and these can be seen in action on their specially constructed test bench in the Aviation Department on the ground floor. Messrs. Hamleys will at the customer's request complete and assemble the models for which they supply kits.

* * *

Messrs. Bonds of Euston Road (357, Euston Road, London, N.W.1) are selling the 1937 Ohlsson Gold Seal Motor and the Syncro Ace. The latter sells for £3 15*s.*, and the former for £4 15*s.* 6*d.* Messrs. Bonds,



*The "Northern Star" super duration high-wing monoplane, made by Premier Aeromodel Supplies.*

Ltd., have been catering for model makers for more years than I care to remember. They supply not only model aeroplane materials but model locomotives, and other specialities, including all materials. I

*The Scalecraft "Kestrel" (now-flying), one of the kits supplied by Scalecraft.*

notice that they are also stocking a compressed air plant, complete and ready to work, British made, at the very low price of 32*s.* 6*d.*, the engines alone costing 18*s.* 6*d.*, or the kit of parts 8*s.* 6*d.* The engine is a 3-cylinder, weighing only 1¾ oz., and is of $\frac{7}{16}$ in. bore and stroke. The cylinder is streamline, 2 in. in diameter at the ends and 3 in. in diameter at the centre, and 18½ in. overall. The weight of tank and engine complete is only 7¾ oz. Messrs. Bonds supply a full range of very nicely carved air screws at very low prices, hand carved and balanced, gears, propeller shafts, ball-bearing shafts, cup washers, twin gear brackets, piano wire, balsa wood, silk and tissue, elastic, lubricant, glue, wheels, super flying model kits, at prices from 3*s.* 6*d.* to 17*s.* 6*d.*, and petrol-engined aeroplane kits A visit to Bonds is always interesting.

* * *

Mr. S. Smith, of 48, Legh Street, Warrington, sends me details of the Westland "Lysander," the complete kit of which sells for 10*s.* 6*d.*

The model, which is of 25 in. wing span, is built to a scale of ½ in. to 1 ft.

Although this model has remarkable flying capabilities, its structural strength and beauty have not been sacrificed, and as can be seen from the photograph above, all the intricate details of the real thing, such as the Bristol "Mercury" engine and cowl, the glass-covered cabin which is reproduced in acetate sheeting, the landing lights in the wheel pants, and the three-bladed De Havilland Variable pitch propeller (which is interchangeable with a flying propeller), have been incorporated in the model with amazing accuracy.

The model is robustly constructed with an internal framework of ⅛ in. square balsa, and has no less than 30 stringers in the fuselage, which accounts for the perfect appearance of the completed model.

The same firm also market an interesting range of non-flying scale models, one of the most notable of these being a 5 ft. model of the famous airship *Graf Zeppelin*.

For the individual, whether he be interested in flying scale, non-flying scale, or duration-type models, a very comprehensive supply is listed by the firm of S. Smith, of 44, Legh Street, Warrington, who will always be glad to offer any advice.

* * *

Scale Craft, of 145, Liverpool Road, Southport, are the manufacturers of Scale Craft all-British constructional kits for solid scale, non-flying, and flying model aeroplanes. Each kit contains every item necessary to produce the finished model, including the Insignia. The prices of the kit are from 1*s.* to 1*s.* 6*d.*

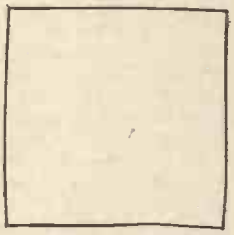
The new Scalecraft "Kestrel" Flying Model has been an immediate success. This model is a semi-scale, high-wing, cabin monoplane of 27 in. span. The appearance is particularly attractive, whilst the design is exceptionally robust. The kit is complete with all materials required and includes celluloid balloon wheels and finished hardwood propeller completely assembled on nose-block and incorporating free-wheel device. At 7*s.* 6*d.* this kit is excellent value. The original model regularly exceeded one minute duration, under adverse winter conditions, and the 'plane should certainly put up some excellent performances in the coming summer months.

(*Continued on page* 410)

# IS TIME THE SAME AS DISTANCE?

## *We could Perform Miracles if we were Able to "Employ" the Fourth Dimension*

LENGTH, breadth, thickness, and what else ?—the mysterious fourth dimension. Probably everybody has heard of it, but very few have even the haziest idea of what it means. Yet, unconsciously, we constantly use time as an extra dimension in every-day conversation. We say it "is a long time," or "a short time," just as we say, "a long road," or "a short one." We speak of, "the length of time" as if it were a piece of cloth or a road. Four figures are always required to specify any event. Four figures will locate Vesuvius



*A square, a simple two-dimensional figure, which is bounded by four lines (one-dimensional) and contains an infinite number of lines. It has only height and width.*

when it erupted and destroyed Pompeii; they are, latitude 41 N, longitude 15 E, height 4,000 ft. above sea level, year 79 A.D. Those are our four dimensions, but time must not be thought of as entirely different from and nothing to do with the others.

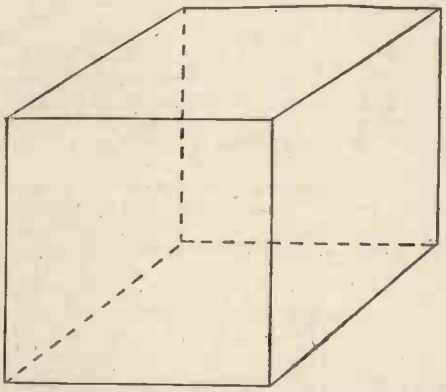
### The Fourth Dimension

Time is just the same as the other dimensions. It only seems different to us because of our own physical make-up. The difference exists in ourselves; it is "subjective." If there were no human beings there would be no question of any dissimilarity between the four dimensions. In a way, the sensation of time is like the sensation of tickling, which is in the person being tickled, not in the thing that tickles. If there were no persons to be tickled there would be no such thing as tickling, although the act of tickling could still exist.

Actually, mathematicians have found the fourth dimension to be a combination between space and time, which they call the "separation." Minkowski, famous scientist, summed up present theory in these words, "From henceforth space in itself and time in itself sink to mere shadows and only a kind of union of the two preserves an independent existence."

As only a few philosophers claim to have obtained, after great concentration, even a fleeting glimpse of the fourth dimension, it is obviously impossible to paint a picture of it in an article. However, it is possible to get some idea of it by analogy; by taking a simple case and then advancing step by step.

Try to think of some beings which have only two dimensions, not three, like us. They have only width and length, no height at all, and therefore they live on a plane surface, which is their two-dimensional world. Call them "planelanders" if you like. Suppose some planelanders lived on this page of PRACTICAL MECHANICS, which is a plane surface. If you caught one in the margin and drew a line round him, he would be imprisoned! Any line would be an impenetrable boundary to a planelander, so that this page of type would be something like Hampton Court maze to him. Our third dimension, thickness, might be apparent to them in something like time. If they had a two-dimensional Einstein among them, he would say that if there were people of three dimensions, these people would be able to see inside planeland houses, although the houses were completely "shut up." You could see inside the circle or square you drew round the planelander you imprisoned, although to him it would have seemed absolutely impossible.



*A cube, a simple three-dimensional figure, which is founded by six planes (two-dimensional) and contains an infinite number of planes. It has height, width, and thickness.*

### Seeing Into a Sealed Box

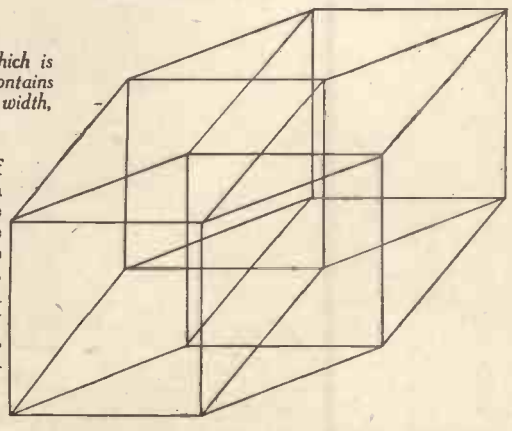
In the same way we could see what was in a sealed box if we could see through the fourth dimension. We could also turn solid things "inside out," reversing them left to right. If you turned your left hand inside out in this way, it would look like a right hand. A planelander could not reverse an L-shaped thing left to right however hard he tried. To demonstrate this, cut out of paper an L-shape, with one arm longer than the other, of course. Lay this on a table and try to reverse it as you would see it in a mirror by sliding it about on the surface of the table, *i.e.* in two dimensions. You cannot do so; but turning it over (using three dimensions) it becomes possible.

In two dimensions, if you had a piece of string fastened at both ends the nearest you could approach to tying a knot in it would be to make a U-shape, closed at the top. In three dimensions, you can make a loop and in four you could tie a knot without using the ends!

### Four-dimensional Fiction

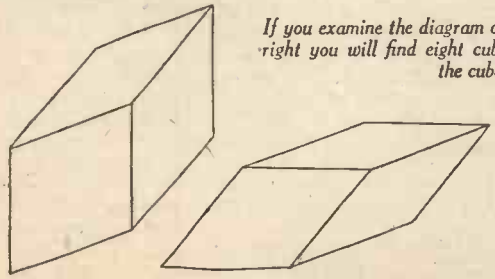
If you find you cannot imagine manipulating things in four dimensions, you are in good company, for it is only a few great thinkers who can, but the idea has been current for a long time. H. G. Wells has written a story in which a chemist was involved in an explosion and was blown into the fourth dimension. When he returned to normal some time later, he was found to have the organs of his body reversed, with his heart on the right, and to be left-handed.

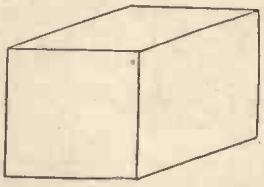
Many years ago a distinguished German

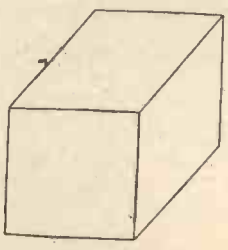


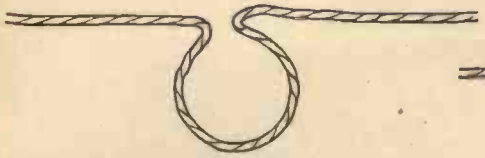
*A four-dimensional figure, which is founded by eight cubes (three-dimensional) all of which are on the exterior, and contains an infinite number of cubes. Of course, it would not look like this, as this is only a graphical representation.*

*If you examine the diagram of the four-dimensional figure on the right you will find eight cubes in it. There are two of each of the cubes shown below.*

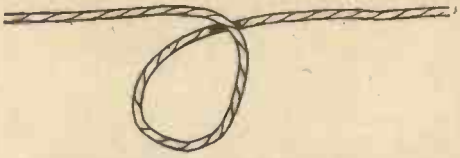








*In two dimensions, this is the nearest you could approach to a knot with a piece of string, both ends being fixed.*



*In three dimensions, as you know, a loop may be formed without using the ends.*

*In four dimensions it would be possible to make a knot without using the ends.*

scientist was given "evidence" of another dimension by a medium, who tied knots in a piece of string when both ends were sealed. On these grounds the scientist wrote a book about the "proof," but the medium was found to be a fraud while demonstrating his "powers."

Here is another way of attempting to visualise the extra dimension. You will remember learning at school that a point has only position; no length, breadth, or thickness. A line has one dimension, length. A plane surface like this page has two dimensions, length, and breadth, but no thickness. This book has three dimensions, length, breadth, and thickness. A thing of four dimensions has all these and one other apparent to us in the form of time or "duration."

### More Geometry

Two dimensions are made by putting one line at right angles to another; three by putting three planes at right angles; and four by putting four cubes all at right angles to each other. Any line contains an infinite number of points, any plane an infinite number of lines, any cube an infinite number of planes, and any four-dimensional "cube" an infinite number of cubes. A square (two dimensions) is bounded by four lines, a cube (three dimensions) by six planes, and a four-dimensional "cube" by eight cubes.

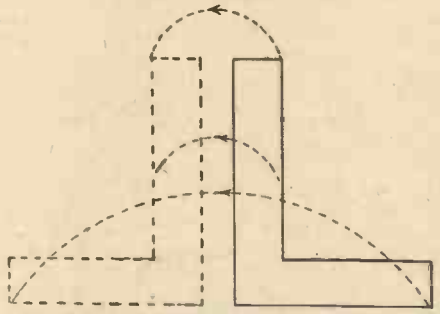
That just gives you an idea of the powerful imagination required to visualise the fourth dimension!

It is difficult to represent three dimensions on the surface of a sheet of paper, which has only two, and to represent four is practically impossible. Mathematicians have attempted this, however, and the figure on page 387 shows a four-dimensional "cube" as well as it can be represented in two dimensions.

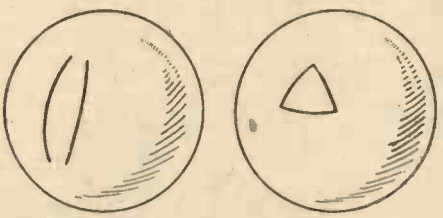
### More Dimensions

There is no reason why there should not be a fifth, sixth, or seventh dimension; in fact, there could be any number. The modern theory of the atom requires a multi-dimensional universe. The more complicated the atom, the greater number of dimensions it wants in which to exist.

A special multi-dimensional geometry has been developed by mathematicians. It



*A piece of paper in the shape of an* L *cannot be slid in the position shown by the dotted line. It is only possible to do this by turning it over, i.e. by using an extra dimension.*



*(Left)* "*Parallel lines*" *on the surface of a sphere. (Right) A* "*triangle*" *on the surface of a sphere.*

is very complicated and varies according to the part of the universe where it is used. Our geometry in common use—Euclidean geometry which we learn at school—has been regarded as the only true one and by many as the only one. It is based on a number of axioms or "obvious truths." Now these "obvious truths," one of which is that a straight line is the shortest distance between two points, have been found, by observation, in some circumstances to be incorrect and a different geometry has been built on the new truths, or axioms.

Another interesting point is that distances may be shorter through an extra dimension. For example, suppose some of our planelanders were on the surface of this page at, say, the top left-hand corner. If they wanted to travel to the bottom left-hand corner they would have to cover about eleven inches. Suppose some exterior force, unknown to them, crumpled the page so that the two corners were only one or two inches from each other, the planelanders would still have to travel eleven inches to get to their destination because they are confined to a two-dimensional world, but if they could take advantage of a third dimension they could get there by covering only one or two inches.

If we, in the same way, could take advantage of a fourth dimension, we probably should find that our world has been "cramped" too and that distances which seem great or time which seems long in three dimensions would be much shorter if we could take advantage of a fourth.

### An Analogy

An analogy will also help us to understand the modern theory that the universe is finite yet unbounded ("unbounded" meaning having no boundaries). That is to say, it is of a definite size, but has no "edges" or "sides." We have always believed that the heavens were infinite; that they stretched on for ever and ever. We believed that if a straight line, say a ray of light, were projected upwards to the skies, it would continue for ever; but it may come back to its starting point.

To understand this, imagine for a moment the surface of a sphere, say of a tennis ball. This is two dimensional, it has no depth, only length and breadth. A planelander living on a surface of immense size like this would find that if he drew a straight line and continued it, it would eventually come back to its starting point. A straight line being the shortest distance between two points, a straight line on the surface of the sphere would be a "geodesic," a circumference, like the lines of longitude on the earth. Two of these straight lines, drawn parallel to each other, would meet, if produced, like lines of longitude meet at the North and South poles. While these lines would not seem parallel to us, the planelanders might find them so if the sphere were of immense size. Note that the surface of a sphere is of a definite area (it is finite) and has no boundaries, i.e. edges or ends.

### Different Geometry

Of course, on this surface, the planelanders would probably develop a geometry different from ours, as, for example, the angles of a triangle would add up to more than two right angles on this curved surface.

Now try to imagine our own three dimensional universe as finite but unbounded, when all the arguments applied to the two-dimensional spherical "universe" apply. Straight lines would eventually come back to their starting points. Parallel lines would eventually meet, or cross each other, in doing so, and light would not travel in straight lines as we have always thought. As the universe would be finite it would be possible to measure it, and the radius has been estimated.

It is claimed to be somewhere about $10^{10}$ light years. A light year is the distance travelled by a ray of light in a year, and as light travels at 186,000 miles a second, a light year works out at about 5,900,000,000,000 miles. The radius of the universe is in that case about:

60,000,000,000,000,000,000,000 miles.

This figure is very, very approximate.

# MAKING EBONITE FLEXIBLE

## A New Chemical which Renders it Impervious to Acid

EXPERIMENTS with a new chemical for the treatment of rubber and vulcanite, which may revolutionise certain sections of the trade, have just been completed in the laboratories of the well-known manufacturers of pneumatic cushions, David Moseley & Sons, Limited.

By mixing this chemical, neoprene, the constituents of which are an I.C.I. secret, with rubber, it has been discovered that the latter becomes immune to the effects of certain acids, and also paraffin.

One experiment carried out with two rubber rollers which had been immersed in paraffin for twelve months, revealed that the first, during the making of which there had been no neoprene treatment, was swollen to double its normal size, was disintegrating in large "chunks," and had completely lost all signs of its original smooth surface.

The second, specially made of rubber-neoprene mixture, was entirely unaffected. The same treatment of vulcanite makes it slightly flexible and much less liable to break.

Neoprene is also only a recent discovery.

# The Mystery of Catalytic Action

## A Chemical Conundrum of Far-reaching Importance

*Platinised asbestos—a well-known catalytic agent. It consists of asbestos fibre impregnated with metallic platinum.*

PERHAPS the simplest of all chemical equations is the following one :

$$2H + O = H_2O$$

which signifies that two parts of hydrogen unite with one part of oxygen to form water.

Place, for instance, two volumes of hydrogen in a jar and add one volume of oxygen. Then ignite the gaseous mixture by means of an electric spark, a lighted taper, or some other similar means. A violent explosion will result, indicating that the chemical reaction which the above-quoted equation represents has taken place almost instantaneously.

Imagine, however, that you have a jar or a bottle containing two parts of hydrogen and one part of oxygen, and that (being a modern Methuselah yourself) you allow the vessel to stand untouched for five hundred years. After the elapse of this time, would you expect to find that, at least, a small proportion of the hydrogen had combined with some of the oxygen or would you anticipate the mixed gases still remaining in their uncombined state ?

### Oxygen and Hydrogen

Actually, the gases would not show the least trace of chemical combination. Indeed, scientific speculation seems to point to the fact that even if the mixed gases were allowed to remain in contact with each other for as long as 1,000,000,000,000 (one trillion) years, no trace of chemical combination would be able to be detected in them, after even that astronomical period of time.

We say, therefore, that unless their temperatures are raised by external heating or by compression, oxygen and hydrogen are absolutely without action upon each other.

Actually, though, such a statement does not embody the whole truth. Suppose we take a jar filled with two parts of hydrogen gas and one part of oxygen, and into this jar we plunge a clean fragment of platinum foil or platinum black, the latter being a black powder consisting of metallic platinum in an impalpable form. Rapidly the platinum will become hot. It will attain a dull red-heat and, after that, increase in temperature to a bright-red stage. Finally, the gaseous mixture in the jar will explode violently, thereby announcing the fact that the mixed gases have combined together chemically to form water, which, of course, will have passed off as steam.

### Gases United

And yet, on examining the scrap of platinum foil after the explosion (if, in practice, we are able to locate it) we shall find that it is exactly the same as when it was first introduced into the jar. No alteration has taken place in its nature or character, yet in some mysterious way that scrap of metallic platinum has caused the oxygen and the hydrogen to unite together chemically without any externally applied aid.

The platinum, in short, has acted as a sort of chemical stimulant and has brought about the union of two substances which, under normal conditions, would have remained separate for ever.

There are quite a number of materials which, in one way or another, bring about chemical reactions—and some of them, as we shall see later, highly important reactions—which would not ordinarily occur, or which, in other instances, would normally only proceed with difficulty.

In the jargon of chemical science, such mysteriously-acting materials are called "catalysts," the whole of the phenomena associated with them being referred to as "catalysis" or "catalytic action."

### Automatic Gas-lighter

The well-known automatic gas-lighter containing an "element" which glows when held for a few seconds in a stream of coal gas presents a common example of catalytic action. The "element" consists of a fine piece or coil of platinum wire which, in consequence of this mysterious catalytic action, heats itself up rapidly until it attains a temperature sufficiently high to ignite the gas.

Years ago, a German called Döbereiner devised a self-lighting lamp which worked upon a catalytic principle. It consisted of a portable hydrogen generator, the supply of hydrogen gas being led over a small portion of platinum sponge, or finely-divided platinum. Immediately, the platinum glowed and ignited the issuing hydrogen.

For a time "Döbereiner's lamp," as it was called, appeared to have commercial possibilities, but with the coming of electricity it quickly became obsolescent.

It was the great chemist, Berzelius who, in 1835, first coined the word "catalyst" to apply to a material which initiated, stimulated or otherwise speeded up a chemical reaction. Berzelius derived his new term from the Greek "kata," *down* and "lyo," *I loosen*, thereby implying that a catalytic agent is one which "loosens down" or unloosens something.

The word "catalyst" is a particularly bad one, being almost devoid of exact meaning. Yet, from long usage, it has, like many other expressions, become inseparable from scientific terminology and, doubtless, it will remain so indefinitely.

### Simple Experiments

Many first-class brains have puzzled over the mystery of catalytic action, but surprisingly little has been done to solve the problem of why some materials, notably certain metals and their compounds, should be capable of starting up chemical reactions without undergoing any change themselves.

Some say, of course, that catalysts do actually undergo chemical changes during the reaction which they influence, but that such changes are cyclical ones, and the catalysts return to their original conditions at the end of the reactions.

Such an hypothesis will not hold water in many instances. When platinum effects the explosive combination between oxygen and hydrogen it obviously does not take any chemical part in the reaction, a fact which close observation has time and time again confirmed.

Maybe the practical reader would be interested to put one or two of these catalytic reactions to actual trial. For the most spectacular ones, it is usually necessary to employ platinum metal, but this, in the

form of an inch or two of fine wire, can be procured from any laboratory furnisher at a cost of a shilling or two.

Suppose, as a first experiment, we suspend a spiral consisting of a few turns of fine platinum wire over an ordinary bunsen burner. The gas is lighted until the platinum spiral is red hot. Then the gas is quickly turned out. Before the platinum spiral has had time to cool completely, the gas is turned on again. Immediately, the platinum will glow and will ignite the gas. This interesting example of catalytic action can be carried out repeatedly.

Let us now try another experiment on the same lines. Take a small glass beaker and place at the bottom of it a quantity of methyl alcohol (wood spirit). Now take the platinum spiral, heat it to redness and quickly suspend it just above the level of the methyl alcohol in the beaker. The spiral will continue to glow red and pungent fumes will be slowly evolved. These fumes comprise formalin vapour, the platinum spiral, by virtue of its catalytic effect being able to bring about the continuous combination of methyl alcohol vapour and the oxygen of the air to form formalin, which is an oxidation product of the alcohol.

### A "Perfume Vaporiser"

It is not difficult to devise an interesting —and useful—catalytic "perfume vaporiser."

Take an ordinary spirit lamp—one of these may readily be made by drilling a hole through the metal cap of a small glass jar and by thrusting a piece of round wick through it—and fill it with ordinary methylated spirit in which has been dissolved some odiferous compound such as oil of lavender or some other essential oil. Take a small fragment of platinised asbestos (that is to say asbestos which has been impregnated with metallic platinum) stick it on the head of a pin and thrust the latter down into the wick of the lamp so that the platinised asbestos just rests above the wick. Now light the wick until the platinised asbestos becomes red hot. Blow out the flame of the lamp and await results. The platinum material will remain red hot owing to catalytic action and, as a result, the dissolved essential oil in the fuel of the lamp will slowly be vaporised and will fill the surroundings with a pleasant odour.

Platinum, in its various forms, is the catalyst *par excellence*. Nevertheless, other metals, in their powder form, can act in a similar way. Copper, for instance. Also, vanadium, nickel, molybdenum, palladium and iron. In some instances, iron oxide forms an effective catalyst, its mere presence bringing about chemical actions which would not ordinarily occur.

Perhaps, however, the commonest catalyst of all is water. Gases which, suitably mixed with air, would explode violently when ignited, refuse to burn at all when they are absolutely devoid of water vapour, thus proving that even water possesses this mysterious property of catalytic action.

Many an important industry owes its life to this as yet unexplained catalytic action.

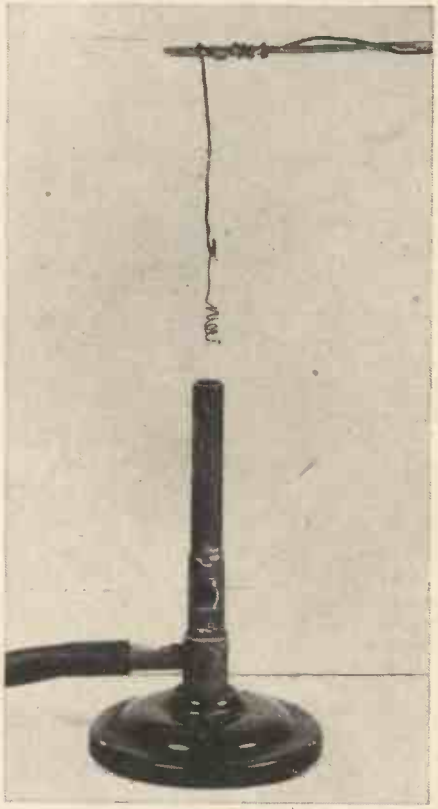
### Sulphuric Acid

Take, for instance, the present-day manufacture of sulphuric acid, which consists in roasting pyrites—a sulphur-containing mineral—and by passing the sulphur dioxide gas evolved over specially-designed "mats" of platinised asbestos or asbestos impregnated with iron oxide which are heated to a definite temperature. Simply by its contact with the platinum or iron oxide the sulphur dioxide gas combines with the oxygen of the air (with which it is admixed) to form sulphur trioxide, which is then absorbed into water, thus giving rise to sulphuric acid.

Graphically, we may represent the series of reactions:

$$SO_2 + O = SO_3$$
$$SO_3 + H_2O = H_2SO_4$$

The wonderful modern method of manufacturing ammonia from the nitrogen of the



*An automatic gas lighter. A spiral of platinum wire when suspended above a gas burner and heated to dull redness is able to ignite the stream of gas.*

air is another example of an industry based upon catalytic action.

In this process nitrogen, obtained from liquid air, is mixed with hydrogen, compressed to two hundred atmospheres, heated to a temperature of 1,300° F., and passed over metallic uranium in fine-powder form. A portion of the nitrogen and the hydrogen, under the catalytic effect of the uranium, combine together to form ammonia, and the stream of gases issuing from the plant is charged with about 4 per cent. of ammonia. This is extracted, and the unchanged nitrogen and hydrogen is passed again through the pressure furnace.

### "Hydrogenation"

The "hydrogenation" of oils and fats, modern processes by means of which an enormous variety of products are being manufactured, is entirely catalytic in nature. In these instances the catalyst usually takes the form of nickel powder. This is mixed with the oil or fat to be "hydrogenated," and hydrogen gas is then bubbled through the mass. Under the catalytic influence of the nickel, the fat, oil, or whatever it may be, adds on hydrogen, becoming changed in composition and in physical properties. Subsequently, the nickel is separated from it and the new product purified.

In this way, products such as margarine, lubricating oils, motor fuels, synthetic fats, and a host of specialised oils are now being produced—all of them consequent upon the operation of a chemical principle which is not in the least understood.

Catalytic agents are curious and oft-times temperamental things. They have their "off" and their "on" periods, their ailments and their ills. Catalysts, too, can be "poisoned," and, curiously enough, it is just those substances which act as human poisons which also destroy the power of the catalyst.

### A Deadly Enemy

Arsenic, for instance, has a deadly effect on all catalytic agents. Platinum and other materials which have been exposed to arsenic fumes become permanently "poisoned," and thereafter refuse to perform their catalytic duties. No wonder it is, therefore, that industrial technologists in charge of the vast manufacturing operations in which catalysts are employed take particular pains to eliminate even mere traces of deleterious substances from their reacting materials, so that their finely-balanced and often exceedingly costly catalytic agents can continue to function with maximum efficiency over prolonged, and almost indefinite periods.

Small amounts of platinum wire or platinised asbestos for conducting the experiments detailed in this article may be purchased from Messrs. Johnson Matthey & Co., Ltd., 73–82, Hatton Garden, London, E.C.1. ("5 per cent. Platinised Asbestos" should be obtained.)

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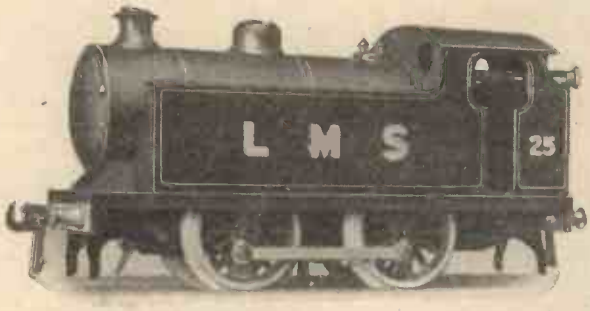


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# MAGIC WITH COINS

*Fig. 1.—How the coins are held in the hat for the money catching trick. The forefinger of the left hand pushes them down one at a time and drops them into the hat.*

CONJURING tricks performed with coins or notes always have a particular fascination for an audience. Sometimes there is added to the mystery of the trick the thrill of seeing someone apparently find money floating about in the air. Sometimes the money, usually borrowed, is seemingly destroyed but, of course, eventually turns up safe and sound. And always there is the fact that the coins or the notes are familiar objects which everyone handles every day, though perhaps not in such quantities as they would like. There seems very little room for trickery in money magic.

But before you can conjure with money you must have the money, so I propose to begin this month with a description of one of the most popular of all coin experiments: the money catching trick. Probably every reader of PRACTICAL MECHANICS has seen the trick performed. The effect is very simple. The conjurer just catches coins one after the other and drops them into a hat or other receptacle until he has an imposingly large quantity.

There are various ways of doing the trick, some very easy and some demanding a great deal of skill while others again call for apparatus of a more or less complicated nature. Here is a simple method and one which I use myself.

### A Simple Method

The only articles required are an opera hat, a china saucer and a heap of coins. The latter need some description. It would be possible to do the trick with real coins but, as silver coins are advisable because of the interest they add to the trick, this would mean a fairly substantial sum of money. Also real coins are thick and heavy. Most conjurers use imitation coins, very thin and light with milled edges which make them easy to grip and manipulate. They can be bought at any conjuring store.

The coins, about twenty-five will be enough, although as you can practise you can use more, are in the left pocket of your trousers. You show your hands empty and pick up the hat. While you are talking about showing the audience how to make money without working you hold the hat in your right hand and casually put your left hand in your pocket. You then secure the pile of coins in your right hand and presently take your hand out of your pocket and rest it for a moment on your hip, the back of the hand being towards the audience. Then you place the hat over your left hand. The crown of the hat is towards the spectators and your left hand lays the pile of coins against the lining. The fingers of the hand hold the coins in position and the thumb curls round the brim to support the hat.

If you look at Fig. 1 you will see how the coins are held. I have purposely exposed the coins to make the method clear, but in actual use the coins are almost entirely hidden by the fingers.

### A Saucer in the Hat

Now, keeping the crown of the hat always turned towards the audience so that they cannot see inside, you pick up the saucer

*Fig. 2.—Catching a coin. The photograph on the right shows the coin clipped at the roots of the fingers. It is slid forward to the finger tips under cover of a catching movement. The photograph on the left shows the half-way stage.*

and put it in the hat. As you do this the forefinger of the left hand pushes the top coin of the pile down and drops it into the hand holding the saucer. It is quite easy to do this as the thin material of which the hat is made gives you plenty of control over the coins.

*By Norman Hunter*

*(The Well-known Conjurer of "Maskelyne's Mysteries"*

*Further Articles on the Secrets of Conjuring will appear Regularly and Exclusively in this Journal*

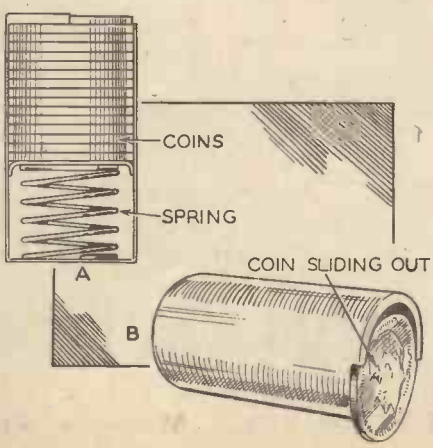
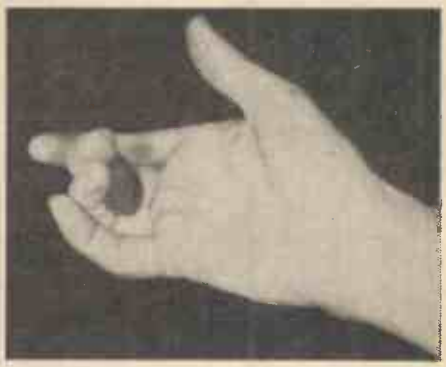



*Fig. 3.—Details of the coin dropper.*

The general principle of the trick is now as follows. The right hand apparently catches coin after coin from the air, actually showing the same one each time, and pretending to drop it in the hat while the left hand pushes down and lets fall a coin at the right moment to coincide with the one that is supposed to fall from the right hand.

Refer to the two photographs in Fig. 2 and you will see an easy way of doing the catching part of the trick. The coin is clipped at the base of the second and third fingers, which are curved slightly round it. In this position the coin is invisible even if the palm of the hand is turned towards the audience, as long as the knuckles are kept pointing forward. To "catch" a coin, make a grabbing movement in the air as if seizing something floating in the atmosphere. As you do this push the coin



forward with your thumb as shown in the lower illustration in Fig. 2. Push the coin right up to the tips of the fingers and hold it between first finger and thumb, curling the other fingers out of the way. The catching movement of the hand will hide this piece of sleight of hand and the effect to the audience is that the coin has been literally picked out of the air.

Appearing to drop the coin in the hat while retaining it for producing again is equally simple. Move the hand over the hat, then bring the fingers round the coin, clipping it as before at the base of the fingers and letting go with the thumb. At the same time drop a coin from the pile held in the hat. Carefully timed the illusion is perfect.

### Improving the Trick

The effect of the trick is much improved if you occasionally appear to push a coin through the side of the hat. You use exactly the same movement for this, holding the coin for a moment clearly visible against the side of the hat, make one or two movements as if to push it through the hat, then finger palm it as already described and let fall a coin inside the hat. The saucer in the hat causes the coins to sound and helps the illusion.

One of the pieces of apparatus sometimes used for the trick consists of a holder for the coins. This is something like a very deep sovereign purse, made big enough to take coins the size of half-a-crown. A section is shown in Fig. 3 at *A*. The fake is simply a piece of light tubing just large enough to take a stack of coins easily. The bottom is closed and the top is open, but there is a lip not quite half way round the open end, as shown at *B* Fig. 3. A small weak spring has a plunger fitted to it and when fully extended fills the tube. The

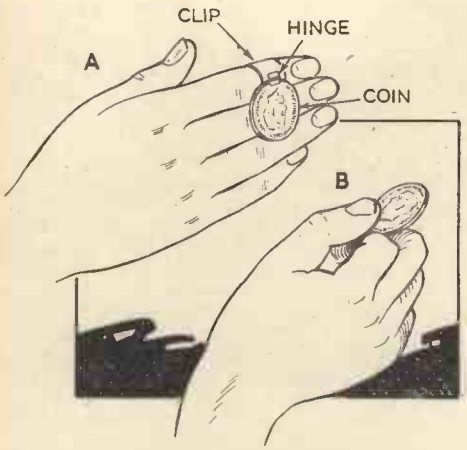



*Fig. 4.—A fake for catching coins.*

fake is filled with coins by sliding them one at a time under the lip of the tube. As the coins are fed in they push the platform down and depress the spring. The loaded fake is used in exactly the same way as the loose pile of coins and it is held in the hat in the same way. Coins are dropped from it by pushing the top coin down and out from under the lip. The coins cannot fall more than one at a time and as each drops another takes its place.

### Catching Coins

Fig. 4 illustrates a fake for catching coins. This is a small tin clip which fits on the back of the first finger, near the tip. A tiny hinge is soldered to the clip and a coin is in turn soldered to the hinge. When the hand is held out, palm to audience, as shown at *A* Fig. 4, the coin hangs down out of sight behind the fingers. A catching movement in the air jerks the hinged coin upright, where it is immediately gripped by the thumb on one side and the second finger on the other.

Yet another and extremely simple version of the money catching trick can be managed with a bowl, some coins and a length of fine black cotton. One coin is fixed to the end of the cotton with a little piece of wax and the opposite end of the cotton is tied to the middle waistcoat button. The coin is held in the hand and dropped into the bowl. In dropping it, however, care is taken to see that the thread runs over the hand. The thread is of such length that if both hands are then extended the coin will be drawn out of the bowl back into the right hand. The hand is kept close to the bowl during the process, being afterwards moved away to "catch" another coin. The catching process is very easy because the coin is simply hanging against the palm of the hand, the back of the hand being towards the audience. A light movement upwards brings the coin up to the fingers. The bowl may have a supply of coins introduced into it in the same way as that described for the hat at the beginning of this article.

Now we come to a trick of a more showy nature in which some of the coins just caught from the air can be used.

### A Coin Stand

A simple stand is shown and four coins are placed on it. The coins are then taken off and made to disappear while the stand is covered with a handkerchief. When the handkerchief is removed the coins are seen to have returned.

The stand is triangular in section and a convenient length to accommodate four coins at intervals. More than four coins may be used if desired. The triangular stand has all three of its surfaces covered with velvet and on two of the surfaces there is a narrow ledge on which the coins can be lodged. See Fig. 5. Four coins are permanently glued to one of these surfaces, their edges resting against the ledge. Reference to Fig. 6 will show that if the stand is placed on the table with the hidden coins underneath and the ledge against which they rest towards the back of the under side, the stand will tilt very slightly forward and the coins will be completely concealed. The empty ledge is then facing the audience.

To perform the trick, place four duplicate coins on the visible ledge. Now take a small paper bag such as those used for wrapping sweets, and open it out. Hold it in your left hand. You now apparently put the four coins into the bag. What you really do is this. You pick up the first coin by standing behind the stand and sliding the coin up and off at the top as shown in Fig. 7. As the coin reaches the

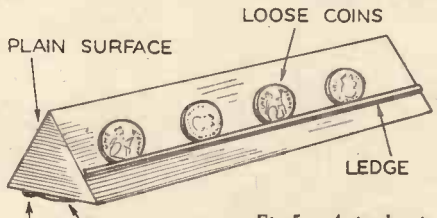



*Fig. 5.—A simple coin stand.*

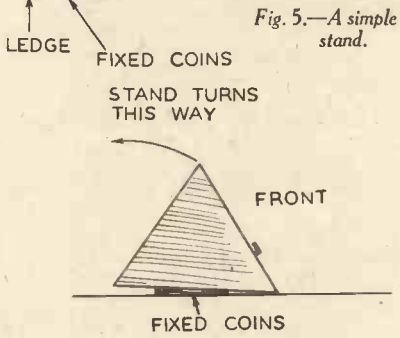



*Fig. 6.—How the coins are made to "disappear."*

top you cover it with your fingers and let it drop behind the stand (there must be a thickish cloth on the table to deaden any sound). You then carry your empty hand over to the bag, put your hand inside the bag, kick the bag with the tip of your finger with a sort of snicking movement and show your hand empty as you bring it out. The illusion of putting the coin into the bag is quite deceptive, and as you have not told the audience that you are going to make the coins vanish they will not be alive to anything suspicious. Repeat the movement with all four coins, then tuck the bag into a glass tumbler. If you place it on the table it will rock about and give away the fact that there are no coins in it, but tucked lightly into a glass it is quite safe.

### The Fake Stand

Leaving the bag in the glass you now cover the stand with a handkerchief. In doing this you roll the stand over backwards so that the side previously underneath is now to the front. Fig. 8 shows an exposed view of this movement taken from the back. The corners of the handkerchief are held between the thumbs and forefingers while the other fingers are stretched downwards and inwards and tip the stand over. The handkerchief is drawn over the stand from front to back and makes a perfect cover for the movement. Care must be taken not to use too thin a handkerchief or the coins, which are glued to the now front part of the stand, may glint through and betray their presence.

If you have done the vanishing of the coins neatly the stand when tipped over will also cover these four loose coins, but it does not matter a great deal if it does not.

You can now take the bag from the tumbler and either burst it or tear it to pieces, or if you like you can burn it. The coins have gone and you flick the covering handkerchief from the stand to reveal their return. You cannot, of course, take them off the stand, but as the trick finishes quite dramatically with the flicking off of the handkerchief, this is not necessary.

In Fig. 9 you will see another useful device for coin conjuring, known as a shell penny. This consists of a genuine penny with one side turned hollow on a lathe and a second penny, as much like the

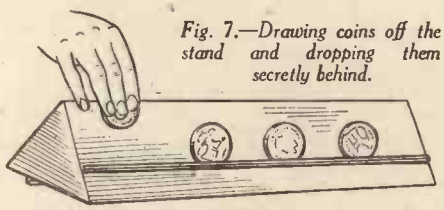


*Fig. 7.—Drawing coins off the stand and dropping them secretly behind.*

first as possible, with the edges just sufficiently turned down to allow it to fit snugly into the shell.

A simple use for the shell is as follows:

Two coins are held in the hand. One is picked up and the hand with one coin remaining is openly shown and held beneath a table. The coin in the other hand is then vanished and apparently passes right through the table into the other hand.

The two coins are of course shell coin and solid, the shell being held hollow side down and appearing as a genuine coin. When one coin is apparently picked up all that happens is that the shell is slid quietly

*Fig. 8.—A trick coin stand. The triangular stand is rolled over while being covered and coins fixed to the underside are thus brought into view when the covering is removed.*

*Fig. 9.—A shell coin. The plain disc is a penny which has been turned hollow on one side. The other penny has it edge turned down to fit into the shell.*

over the solid coin and the other hand is taken away closed but empty. The hand holding the double coin is then placed under the table and shell and solid again separated, while the closed empty hand performs the marvellous feat of vanishing a coin that was never there !

**A Trick with Paper Money**

Finally, we come to one of those exciting tricks in which paper money is recklessly burned to ashes but in due course reappears whole again. The whole point of this class of trick, like the watch tricks described last month, is that the note should be borrowed.

A ten shilling or pound note having been borrowed—and it is rather surprising how willing people are to lend a conjurer so much money all at once, with the certain knowledge that he is going to do something drastic to it—the note is folded and placed in an envelope. The envelope is then laid on top of a tumbler while a small parcel is fetched from behind a screen. This parcel is given to the owner with the promise that if anything happens to his money he may have the contents of the packet. This he is assured is worth quite as much as his note. Needless to say nobody believes it.

**A Penny Bun**

The conjurer then holds up the envelope in front of a candle flame and the shadow of the note inside is clearly apparent. The next moment consternation reigns. Or at least it ought to, for the performer has carelessly allowed a corner of the envelope to stray into the flame. It catches fire and soon envelope and note are reduced to ashes. After as much fun as possible has been extracted from the situation the owner of the note is asked to open the parcel. It

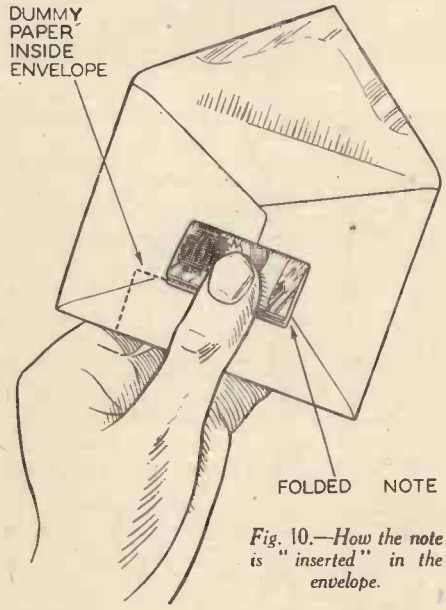



*Fig. 10.—How the note is "inserted" in the envelope.*

contains a penny bun. The conjurer assures the gentleman that the bun is worth quite as much as his vanished banknote and asks him to break it open. Inside the bun is found the missing note and the number on being read out is found to tally correctly with the number of the original note, which was taken down by a member of the audience at the beginning of the trick.

For such an effective result the means are ridiculously simple. The envelope has inside it a piece of paper the size and shape of a ten shilling or pound note. This is folded and put in the bottom of the envelope before the show begins. A note having been borrowed and the number taken down, it is folded into a packet similar to the concealed paper. The performer then holds the envelope with the address side towards the audience, opens the flap and apparently tucks the folded note inside. Actually he simply slides it down at the back of the envelope and holds it there as shown in Fig. 10. He then seals the flap of the envelope and lays it on top of a glass, retaining the folded note concealed in his hand.

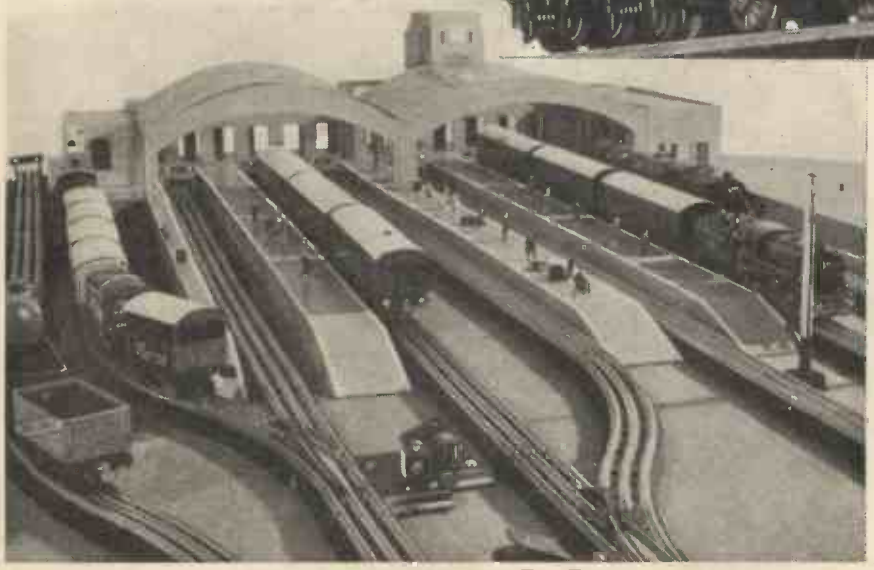
The parcel containing the bun has the paper opened a little at the place where it is folded over. This opening comes at the side of the bun and a slit is cut in the bun at this point. When the conjurer goes to fetch the parcel it is the work of a moment to force the folded note into the bun and press the paper together. If a new bun is used the slightly sticky nature of its texture will cause it to close up round the note leaving hardly any trace of the way in which it was introduced.

The rest of the trick is simply a matter of playing up the situation and getting as much comedy out of it as you can.

# THE TWIN-TRAIN MODEL RAILWAY

## Details of a New Train and Station Equipment

HERE is a layout showing the latest developments of the Twin Trains in Southern equipment. The stations are built up of the "many-ways" parts, and the goods train consists of a goods locomotive, four Southern refrigerator vans, a Carter Paterson container, and a S.R. brake van. On the arrival platform is a three-coach Southern electric train, and on the departure platform a Southern locomotive and tender and three coaches, and a S.R. tank locomotive and two oil wagons. The passengers and railway personnel and merchandise are the latest in "00" gauge scale model equipment, and this layout was put together in quite a short time, and is suitable for a dining-room table.



*Layout of the latest developments in Twin Trains.*

*A Model Continental 4-6-2 Pacific.*

## A New Engine

THE Continental 4-6-2 Pacific shown on this page is built to the scale dimensions of 3½ mm. to the foot (gauge 16 mm.), constructed specially to run on the Trix twin track. It is fitted with a powerful motor, working off 14 volts A.C., or 12 volts D.C., all parts are interchangeable ; precision work throughout, and is provided with continuous lubrication. The body is die-cast with all external detail carefully modelled, fitted with an eight-wheeled tender ; over-all length of 10¾ in., negotiating with ease a 13½ in. radius circle. The eight-wheeled tender has automatic couplings, and head light. Price complete is 65*s*.

We have had one of these models under test for nearly three months (total test time of 140 hours) and it has not given the slightest trouble. It is excellent value for money.

# NEW INVENTIONS

### Dolls that Make Faces

"THE young are happy; they shall see wonderful things," quoth a prophet before the French Revolution. The child of to-day, catered for in so many ways, is, indeed, happy and sees wonderful things in the shape of cleverly constructed toys; for example, the miniature Zoo exhibited by the gutter merchant on the London pavement. The doll is a joy for ever in the eyes of the mothers of the future. One of the latest things in boy babies is a doll which is capable of facial expression. Surrounding its rosy lips is an elastic portion, and movement of the head and shoulders renders the physiognomy of the doll mobile. I presume that the infant smiles and does not draw down the corners of its mouth.

It is obvious that the principle of this device could be applied to a golliwog and produce the grin of a gargoyle.

### Gorgeous Chewing Gum

CHEWING gum is now in a position to vie with the Aurora Borealis. Hitherto its complexion has been permanently pale, but to-day it is able to change colour like a chameleon. The British Patent Office has granted a patent for a process of manufacturing chewing gum which will enable it to undergo a complete transformation. When introduced to the mouth, its complexion may be a somewhat anæmic pink, but after a little chewing, its shade will resemble the purple of Cæsar's Imperial toga. This will result from the incorporation with the gum of a non-poisonous dyestuff, which the saliva will cause to appear in all its glory. Blue dyestuff, for instance, co-acting with the yellow of the gum will produce a delightful green, verdant as an American prairie. It is sad to think that, hidden within the tiny cavern of the mouth, this gorgeous gum will be born to blush unseen. The brilliant effect would be apparent if it were occasionally removed from the mouth, but, I understand, this is not done in the best circles. It is akin to a lollipop in the Victorian Era, which showed a series of colours as it was sucked, and its novelty will undoubtedly appeal to the young.

When this glowing gum is placed on the market, its price may be more than that of its pale predecessor. The chewing gum of the future may be charged for at the rate of those old pictures which were 1*d*. plain and 2*d*. coloured.

### A Comprehensive Chair

AMONG the Pharisees in ancient times one of this sect used to claim that he had kept the whole law. As a consequence, he was known as "The What More Can I Do Pharisee." A chair which has been manufactured of late, if it had a voice, could in truth reasonably ask, "What more can I do?" It is the last word in seating accommodation, providing everything possible for comfort and utility. You press a knob and the back of the chair can be adjusted to suit the comfort of the sitter. Lowering the back to the horizontal position, one converts the chair into a bed. In the right arm of the chair are a wireless set, a 'phone, a clock, and a cabinet for tobacco and cigarettes. Underneath this arm is a gramophone, or, if you prefer, a typewriter. The left arm comprises a lap board, which can be used as a tray, game board, or as a typewriter and writing table. There is also accommodation for razor, pencils, note-books, comb and brush, etc. Beneath the left arm also is a storage for refreshments and glassware for four people. And, lastly, above the back is a reading lamp. Verily a chair which makes itself generally useful.

**The following information is specially supplied to "Practical Mechanics," by Messrs. Hughes & Young (Est. 1829), Patent Agents, of 9 Warwick Court, High Holborn, London, W.C.1, who will be pleased to send readers, mentioning this paper, free of charge, a copy of their handbook, "How to Patent an Invention."**

### Rubber-coated Decks

ANTI-SLIPPING resilient coverings for the decks of ships are already known. These consist of rubber sheeting with or without fabric on the underside and a number of knobs placed close together. When the deck of a vessel is at an inconvenient angle, this anti-slipping surface enables one to make terms with the law of equilibrium. But an inventor maintains that, hitherto, this kind of covering has had a drawback: water does not freely drain from it. He has set himself the task of remedying this defect. His plan is to provide a layer of resilient material, for example, rubber furnished with or without canvas backing; and a number of areas equipped with nipples. But between these areas are zones free from nipples and extending to the edge of the deck. These zones provide channels for water to run away. This device will be helpful to those folks who have difficulty in finding their sea legs.

### Garters for Cows

THE Order of the Garter may now be conferred upon a cow. At least, the United States Patent Office has granted a patent to the inventor of a circlet to surround one of the hind legs of the animal in question. The garter is connected to a tail clasp. This contrivance has been devised to prevent the cow from putting her foot in it—that is the milk pail and the tail clasp will have an anti-swishing effect.

### Fly Electrocutor

THE antiquated fly-paper has a powerful rival in an electric bulb which can be screwed to a socket and hung on the wall or suspended from the ceiling. Insects coming in contact with this bulb will be electrocuted.

There has also recently been devised an apparatus for killing poultry by electricity. One concludes that its operation is so rapid that it is a merciful method of sacrificing birds for human food.

### White Blackboards

BOTH in England and America white blackboards (as they might term them in Eire) are, in certain schools, superseding the boards upon which the white chalk gave instruction to the more or less attentive scholars. Black chalk is used on these white boards. This, it is affirmed, is easier to read than white on black. It is also contended that the new style of board relieves eyestrain. But why not have green boards? Green is Nature's colour and should suit the eyesight of the young who themselves sometimes resemble that colour.

These white boards will certainly help to brighten the schoolroom. And, for that reason, they are to be preferred to the funereal shade usually seen, which is fit only for a mourning school.

### Cages for Kiddies

DARWIN is credited with the theory that man is descended from the monkey. The Puck-like pranks of the normal, healthy youngster certainly supports this belief. To keep within bounds the juvenile who has just found his feet, the play pen was invented. But this rectangular fence is sometimes pushed down by the infant Hercules. To guard against such a collapse, there has been devised a play pen of the usual design, but each of the four posts at the corners has a spike. This may be inserted in a socket in the floor. In the open air the spikes can be driven into the ground, thus forming an alfresco pen somewhat resembling the pound which is used to confine stray donkeys and other wayward animals.

Verily this pen is a blessing and a boon to men, or rather to their wives, who have not time perpetually to guard their mischievous offspring.

### To Baffle the Bandit

IN future the gunman who enters a bank and cries, "Stick 'em up!" may find himself baffled by an invention for which a patent has recently been granted in the United States. The hero of the staff whom the villain addresses will indeed raise his arms. But that very action will be the means of frustrating the gunman. It will operate an alarm which will most of all alarm the bandit. The device in question provides an equipment worn by the bank clerk and connected with an alarm. When his arms are close to his body, this danger signal is disconnected. But immediately the arms are lifted a bell calls attention to the fact that something is wrong. The only inconvenience attached to this system is that the wearer of the device has a wire trailing after him.

Bandits who happen to know that such an appliance is fixed to the clerk will naturally exclaim, "Keep 'em down!"

### Cigarette Saver

THE United States Patent Office has accepted an application for a patent for what is called a cigarette saver. The object of the contrivance is neatly to cut off the charred portion of a partly smoked cigarette. It is said that a fortune is made out of the mustard left on the plates of diners. Undoubtedly much money is wasted through cigarettes being lighted and, owing to some interruption, flung away. To prevent this waste, an inventor has produced the above-mentioned device. It comprises a small cylinder which holds the cigarette and contains a knife for chopping off the burnt section.

The inventor will not be blessed by those unofficial scavengers whose tobacco supply is derived by making a collection of partly consumed "fags."

### Perfume Puffer

WHILE upon the subject of cigarettes, I am moved to mention a device for flavouring cigarettes. This consists of a holder in the lower end of which is a wad of absorbent material designed to be impregnated with scent. I do not think the average smoker fancies an aroma in addition to the natural fragrance of the tobacco. But now that so many of the fair sex are daintily puffing, it is possible that some of these ladies will be disposed to blend a perfume with the incense of the weed.

### Pocket-book Pencil Grip

MANY pocket-books have an attendant pencil, which, when not on duty, reposes in a sheath attached to the pocket-

(*Continued on page* 408)

# Scientific Stain Removal

*BEFORE—*
*(Left) An engraving badly damp-stained and soiled.*

*—AFTER*
*(Right) Treatment of the print in an acidified solution of sodium sulphide removes the permanganate and leaves white, clean and free from stain.*

THERE are few individuals, particularly those having a reputation for scientific ability, who do not, time and time again, come up against the ever-recurring problem of stain removal. It may be a sheet of paper, a picture, the pages of a book, an article of fabric material, a piece of furniture or woodwork or even a portion of one's own skin that cries out for the removal of some unsightly stain. Or, again, a piece of surface-stained metal may require renovation or an article of antique interest may need careful stain-removal treatment during its process of restoration.

It will be evident, therefore, that the subject of effective stain eradication is a vast one, covering an enormous field, and since the many problems associated with it are often complicated by the fragile or perishable nature of the material bearing the stain, it follows that at least some knowledge of the principles of chemistry should be possessed by the individual who essays to remove marking and stains from delicate or valuable articles.

### Stains Classified

Speaking generally, the majority of stains which occur upon common articles can be divided up into several classes, viz. :

Grease, oil, fat and tar stains.
Paint, varnish and lacquer stains.
Ink, dye and colour stains.
Chemical stains, including stains due to fruit juices and other vegetable markings.
Animal stains, as, for instance, blood, perspiration and milk stains.
Miscellaneous stains.

The above classification is, admittedly, purely an arbitrary one and, naturally, it could be extended and modified in many ways. It will, however, serve to cover the generality of stains which occur from day to day and will enable the reader to refer to its own particular class any type of stain the removal of which is confronting him.

It goes without saying that the effective and permanent removal of any stain is intimately bound up with the nature of the material upon which the stain exists. For instance, although one can quite easily remove an ink stain from a sheet of white cardboard, it is quite another problem to eradicate a similar stain from a sheet of thin tissue paper or a delicate silk garment.

Hence, it must be made clear that, although this present article attempts to systematise the methods of stain removal, it is really impossible to do so completely. Each problem of stain removal must be considered and dealt with in its own individual aspects and it is only by the constant application of this ruling that a variety of stains on different materials can be successfully and safely treated.

Let us, however, begin our practical survey of the subject by considering, firstly, the methods available for the removal of grease, oil, fat, and tar stains.

### Dry Cleaning

When a garment is sent to be "dry-cleaned" it is frequently immersed bodily in a vat of some powerful grease solvent, such as carbon-tetrachloride, trichlorethylene or some similar liquid. The garment is treated with the hot solvent and, after withdrawal from the liquid, is carefully dried, pressed and finished. Most of the "dirt" stains due to the ordinary wear of a garment or a suit of clothing can be removed by these means.

When, therefore, a grease, oil or fat-stained article is presented for treatment, it should, if possible and practicable, be immersed wholly in a bath of grease solvent. Carbon-tetrachloride is an excellent solvent of all kinds of oils, fats and waxes and, additionally, it possesses the very decided advantage of being non-inflammable. Solvents such as trichlorethylene are usually unprocurable by non-technical individuals, but, in their place, may be used benzene or toluene, due respect being paid, of course, to the inflammability of these liquids. Solvents of the above nature do not injure even the most delicate materials and they will rapidly evaporate from the treated material after it has been removed from the bath.

### Using Petrol

It is not advisable to employ ordinary petrol as a grease-stain remover. Petrol usually contains a small proportion of contaminating grease which is liable to appear in "waves" upon the treated material, especially if it be a white fabric.

Grease and oil spots may frequently be removed by mere "physical" treatment. Place over the offending spot a piece of clean white blotting paper. Then take a warm iron and rest it lightly for a few seconds over the blotting paper. The heat of the iron will penetrate the blotting paper and, melting the grease, the latter will be absorbed into and held tenaciously by the blotting paper. Very frequently one or two applications of this simple method will clear away even a bad grease stain in quite a remarkable manner.

Another good method of removing a stain due to grease, wax or oil consists in dusting it and its surrounding area over with chalk, Fuller's earth or some other clean, absorbent powder. Then pour over the powder a small quantity of benzene or other grease solvent and rub the resulting paste well into the fabric. Allow the solvent to evaporate and, when perfectly dry, brush the powder away. It will be found that the powder has absorbed the grease dissolved by the solvent, thus removing the stain from the material. This method may also be applied for removing stains from wall papers.

For removing grease stains from very delicate and valuable materials, ether is recommended. This volatile liquid is perfectly safe to use and acts, in most cases, like a charm.

Tar stains, are, of course, treated on the same lines as grease and oil stains, but, of their nature, they are more difficult to remove. Eucalyptus oil is a good softener, and remover of tar stains, and can be applied to most surfaces without injury. It should not, however, be used on oil-painted surfaces, since it is an excellent solvent of many varnishes.

### Removing Paint, Varnish, etc.

Paint, varnish and lacquer stains, despite the disfigurement which they cause are frequently easy to remove by the solvent

**There are very Few Stains which will not yield to Correct Treatment. Here, the entire subject of Stain Removal is Reviewed in a Comprehensive Manner, Practical Directions for the Eradication of many Types of Stains being given.**

methods outlined above. All cellulose paints and lacquers are soluble in acetone or a myl acetate, and these liquids should be employed for their removal. If a splash of paint or varnish of any kind whatever has dried hard upon a firm, enduring surface, as, for instance, a surface of wood, it can be removed very readily by rubbing it with the edge of a copper coin. This method leaves the underlying surface untouched and is often employed by furniture restorers for removing old varnish from pieces of valuable furniture.

Alternatively, paint and varnish of all descriptions may be removed from a firm surface by making use of one of the new paint-softening liquids. A good "paint softener" of this description may be made by dissolving 1 part of candle wax in 6 parts of benzene or toluene and then by adding to it 4 parts of acetone. Keep this liquid tightly corked and remember that it is inflammable. For use, spread it with a soft cloth or brush over the paintwork or stain to be removed. Wait one minute and then, with a blunt edge, strip the softened paint or varnish away.

Ink stains vary a good deal in their amenability to treatment, some inks being readily removable, whilst others are only eradicated with some difficulty.

Formula books, recipe conpendiums and other volumes of the "household hints" type have for generations faithfully copied into edition after edition old time ink stain-removing recipes containing oxalic acid which, although excellent enough for dealing with the former iron-containing inks, are generally of little use when it comes to treating modern ink markings.

### Ink Stains

A strong solution of oxalic acid or of ammonium, sodium or potassium oxalate, is a good solvent for iron compounds and, if an ink (as formerly was the case) contains nothing else but an iron compound, this oxalic acid treatment will undoubtedly effect the stains removal. Modern inks, however, are "reinforced" with colouring matters such as indigo and chemical dyes. Indeed, some of the cheaper varieties of present-day inks comprise nothing more than solutions of chemical dyes. Oxalic acid may deal with the iron content of an ink, but it is powerless to effect the removal of the added colouring matter. This must be carried out by dabbing over the ink stain a rag charged with a solution of bleaching powder made very slightly acid with hydrochloric acid. Alternatively a solution of sodium hypochlorite may be used. The ink will be bleached away, after which the treated area should be swabbed thoroughly with a clean soft rag saturated with pure water in order to remove the applied chemicals.

Inks of all kinds except marking and Indian inks, can be removed by this simple treatment which, if carefully applied, will not injure the paper upon which the ink mark has been made.

Marking inks frequently contain silver nitrate which darkens under the influence of light, forming an indelible stain. An ink mark of this type may be removed by dabbing over it a fairly strong solution of potassium ferricyanido containing a little photographer's "hypo."

True Indian ink marks cannot be removed by any known means without, at the same time, abrading the surface on which they are placed. Printer's black inks, too come under this category, for all such inks contain carbon or lampblack as a base and for this material there is no known practical solvent.

### Chemical Stains

Chemical stains are best bleached away by the bleaching-powder treatment described above. When they occur upon woollen fabrics, they are best dealt with by immersing the fabric in a solution of sodium sulphite acidified with a few drops of sulphuric acid. This forms a "sulphur bleach" which is better adapted to such fabrics than the former bleaching method.

Dye splashes, fruit juice stains, damp markings and all sorts of miscellaneous stains may be bleached away by one or other of the above methods.

Another method of removing miscellaneous stains, particularly damp stains from paper, consists in the use of ordinary permanganate of potash. Soak the material bearing the stain in a fairly strong solution of potassium permanganate for a minute or two. Then withdraw the material from the bath and rinse it in plain water. At this stage, the material under treatment will be stained a deep brown. This is of no consequence, however, for, upon immersing it in a solution of sodium sulphite acidified with a few drops of sulphuric acid or in a solution of sodium bisulphite or sodium metabisulphite, the brown stain will rapidly disappear, leaving the material white and clean.

*The "penny method" of paint removal. Paint and varnish can be removed from a surface without injury to the latter by rubbing with the edge of a copper coin.*

Naturally, fabrics bearing colours should not be given this permanganate treatment, since the colours might be bleached a way as well as the stains. Thin paper which has undergone this treatment may sometimes have to be re-sized. This is effected by passing it through a warm solution of cooking-gelatine of about 2 per cent. strength, after which the paper is drained and hung up to dry.

Stains on glass and pottery can usually be removed by soaking the articles in a solution of potassium bichromate acidified with sulphuric acid or, alternatively, in a solution of chromic acid. Unsightly markings on metal surfaces can, also, usually be eradicated by the same treatment, but, of course, before applying it, care must be taken to make sure that the metal is not soluble in the acids employed.

### "Animal" Stains

"Animal" stains are not always easy to remove. Milk stains, in particular, often prove intractable owing to the coagulation and insolubilisation of the casein present in the milk. If the surface upon which they are present is an enduring one, they are best removed by treatment with caustic soda solution. Ordinary washing soda may be applied to milk stains on weaker materials, whilst for their removal when present upon delicate fabrics, nothing is better than treatment with a solution of lithium thiocyanate which is an excellent modern solvent of casein.

For getting rid of fresh blood stains, ordinary "heavy" washing will suffice. Older blood stains which have oxidised will usually yield to treatment with soap and washing soda but, often enough, a yellow stain remains. This represents the oxidised product of the iron content of the blood. It can be dissolved away in oxalic solutions.

Perspiration stains are extremely tenacious and difficult to treat. Not only that, but they often weaken and sometimes actually corrode the material carrying them, so that vigorous treatment for their removal becomes impossible. The best method of dealing with them consists of hot soap and water washing, followed by washing soda treatment and, if a yellow stain still persists, by oxalic acid treatment. If, despite all these treatments, the stain still remains, it may be given the permanganate treatment, previously described, always of course, assuming that the material has not been unduly weakened by the acid perspiration.

Rust stains and those of "iron-mould" are very common ones and are sometimes difficult to eradicate. Like all stains containing iron, however, they will yield to treatment with oxalic acid solution or with a solution of an oxalate, such as "salts of lemon" (potassium binoxalate). Care must be taken in using oxalic solutions, since they are poisonous.

### Mould and Mildew

Among the most difficult of markings to remove from any surface, but particularly from fabric materials, are mould and mildew stains, and if these will not yield to the gentle bleaching powder treatment described above, they may be taken as being absolutely ineradicable.

Chemical stains on the hands may often be bleached away by one or other of the treatments mentioned in this article. If, however, the skin has actually been corroded in any way, the bleaching treatment will not work. Thus, it is impossible to remove the yellow stain produced by contact of strong nitric acid with the skin, for, in this case, the skin is actually changed in composition.

Ordinary "black dirt" (consisting, for the most part, of carbon or soot) on the skin cannot be bleached away. It can, however, be removed by treatment with a gentle abrasive combined with soap and a grease solvent. An entirely harmless and extremely useful "hand-cleaning" preparation can be made by mixing thoroughly 8 ounces soft soap, with about ¾ oz. of strong ammonia. To this add 2 ozs. petrol or benzole and finally 2 ozs. of powdered brick dust or pumice. Stir the ingredients well together and preserve the product in a can provided with a well-fitting lid.

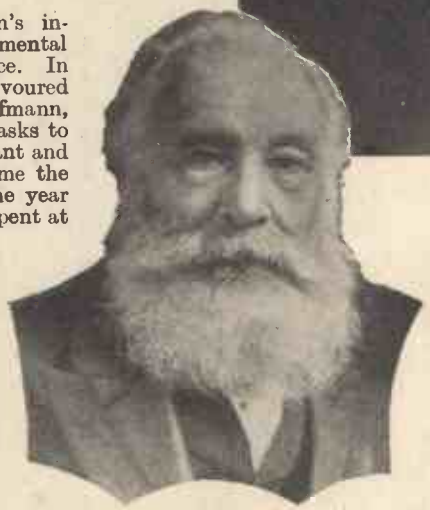
For mechanics, motorists and all others whose work is necessarily of a "messy" nature, this soap, as a stain-remover for the hands, will be found to be inexpensive and excellent in every way.

SEE PAGE 361 FOR AN IMPORTANT ANNOUNCEMENT

# COLOURS FROM COAL

## A Chemical Triumph Recalled

*(Right) Standardising a dye by micro-spectroscopical observations. (Below) Sir William Henry Perkin.*



Last month occurred the Centenary of the Birth of Sir William H. Perkin, Discoverer of the First Practical Aniline Dyestuff and Inaugurator of a New Era. The Story of his Accidental Discovery of "Mauve" Constitutes one of the Romances of Scientific Enquiry.

COLOUR is necessary for our well being. A purely black and white world, as colourless as an ordinary photograph or cinema picture, would, we should find, be almost unendurable in its monotony. In even the drabest surroundings of a town slum, there is colour to the found. No condition of existence, however deplorable it may become, is devoid of colour, for the world of affairs in which we live is essentially a many hued one.

Since the earliest era of his existence, Man has sought to make colours for his own use and, indeed, to beat Nature at her own chromatic work. Thus it is that from the dawn of civilisation, coloured minerals and earths have been employed for the making of paints and, as a matter of fact, are even nowadays so utilised, whilst for countless centuries woven fabrics and cloths have been dyed by immersing them in various highly-coloured extracts obtained from a variety of vegetables, roots, barks, lichens, and other natural materials.

Some of these "natural" dyes gave very beautiful and highly permanent colours when applied to cloth. The trouble was, however, that their range of colours was very much restricted and, also, quite apart from their natural scarcity or difficulty of production, the various shades which such materials produced could not be readily standardised.

### The Art of Dyeing

Dyeing, right up to the middle of the last century, was very much an art, a rule of thumb business, the technique of which had been handed down through the ages. There was little science about it. Colours, in 1850, were pretty much the same as they had been two hundred years previously. Dyeing was very much a "settled" art, like gold-beating and violin-making.

The nineteenth century had just passed its halfway mark when there occurred in England one of the biggest upheavals which the world of science and industry has ever known.

A lad of eighteen, home on a holiday from school, happened to be experimenting in his little improvised laboratory. He was trying to make quinine, but, instead, he produced a small quantity of a blackish looking stuff which, when dissolved in water, gave an intense purple solution having strong dyeing properties.

William Henry Perkin was the lad's name. He was born on March 12th, 1838, his father being a builder by trade and a man who had the good sense to encourage the scientific leanings which developed in his son at an early age.

Young William Henry was, perhaps, a queer boy. He would rather perform chemical experiments than eat. When, at the age of thirteen years, he was a pupil at the City of London School, he gave up his lunch every day to attend a noontime course of Chemical lectures which at that time was being given by a German chemist named Hofmann, who, on the invitation of the Prince Consort, had come to London and had opened a laboratory there.

So W. H. Perkin's interest in experimental chemistry grew apace. In due course, he was favoured by the great Hofmann, who set him some tasks to perform as an assistant and then, eventually, came the Easter holiday of the year 1856 which Perkin spent at home and occupied in trying to make quinine in his own small laboratory.

### A Lucky Failure

Perkin had devised a plan for synthesing quinine by oxidising aniline. But the plan didn't work. When the lad heated up aniline and chromic acid (a powerful oxidising agent) he obtained nothing having the faintest resemblance to the pure white crystals of quinine. Instead, he got a black, semi-sticky mass, unpleasant in appearance and possessing a decidedly unattractive odour.

The young experimenter, however, became struck with the fact that when washing out his chemical flasks, the water was strongly tinged with a violet colour, the colour coming apparently from the black, tarry mass which had been left as a result of his quinine-making efforts.

After extracting the colouring matter with alcohol, Perkin obtained a dark-coloured powder which, when dissolved in water, gave a brilliant mauve-coloured solution with strong dyeing properties.

W. H. Perkin, besides being an ingenious youth, was, also, a shrewd one. He realised at once that there might be commercial possibilities in his newly-discovered dye. So he forthwith dispatched a sample of it to Messrs. Pullar, of Perth, for their examination and test.

Pullars, of Perth, commended the dye very highly. It had undoubtedly very many possibilities, they remarked.

Perkin's next step was to the Patent Office, where, on August 26th, 1856, he patented his new process of artificial dye making.

### "Perkin & Sons"

Young William Henry must have had not only the courage of his own convictions but, in addition, the capability of transferring it to others, for, aided by capital obtained from his father and assisted, also, by the direct services of the latter and of his brother, he at once embarked upon the building of a small factory at Greenford Green, near London, for the purpose of manufacturing his new dye, which he called "Mauve," or "Mauveine."

Towards the end of 1857, a new industrial enterprise had come into existence, that of the firm of "Perkin & Sons," artificial dyestuff manufacturers. "Mauve" soon began to be turned out in small but regular quantities and it was purchased readily by dyers both at home and abroad. Particularly did the French dyers fall in with this newly-created colouring matter.

Mauve, as we have seen, was manufactured from aniline. Now, aniline, in Perkin's earlier days, was a very scarce and expensive commodity. It was made from nitrobenzene, which, in its turn, was produced from benzene by treating it with nitric and sulphuric acids. And since benzene itself is produced by the distillation of coal tar it is easy to see why all the dyestuffs derived from aniline have come to be classified under the category of "coal-tar colours."

Finding it difficult, nay, impossible, to obtain adequate supplies of nitrobenzene and aniline, Perkin, aided, once again, by his father and his brother, commenced the manufacture of these essential materials for himself. Their manufacture involved putting up additional plant, but the Perkin plans seem to have been well laid, for the firm of Perkin & Sons began to prosper and, very quickly, it found itself to be in an exceedingly good way of business.

### "Perkin's Violet"

A new era had, indeed, been created by Perkin's lucky Eastertide accident. Dyers clamoured for supplies of "Perkin's Violet," as the dyestuff, Mauve, was sometimes

called. A demand for artificially-made dyes of other colours quickly grew. Hofmann, the German chemist, turned his attention to dyestuff chemistry and began to search for further artificial dyes. Furthermore, under the encouragement of the Prince Consort, other German chemists flocked to England, there to engage in the manufacture of and search after new artificial dyestuffs of a type similar to Perkin's "Mauve."

There is no doubt that these German chemists did excellent work in this country, but most of them went back to the Fatherland after the death of the Prince Consort in 1861, taking with them, of course, all the valuable manufacturing data which they had freely obtained in England.

Perkin & Sons progressed at a steady rate. Other artificial dyes were discovered and added to their manufacturing programme.

In 1869, Perkin discovered how to make alizarin artificially. It was a discovery of high importance, for alizarin constitutes the principle of the well-known "Turkey-red" dye, and it had previously been obtained from the madder plant. Perkin & Sons, therefore, began to make artificial alizarin and, after a few short months of trial, were turning the material out upon an unprecedented scale.

It was in 1874 that W. H. Perkin relinquished active participation in the now widespread industry which he had initiated. From that time to his death, which occurred on July 14th, 1907, he devoted himself entirely to the service of his first love—chemical research.

Perhaps it is a strange coincidence that the British dyestuff industry began to take retrogate steps after Perkin severed his active connection with it. Yet it is, nevertheless, a fact.

### Dyes from Germany

The German chemists had taken back to their country many firm impressions of the valuable nature of an artificial dye industry. Full of enthusiasm for continued chemical research, they met with encouragement at the hands of their Government. Money in Germany was poured out in chemical research. Large factories for the making of artificial dyes were erected. Very soon, German-made dyestuffs were flooding into England under new names. "Manchester Brown," a valuable dye which was first made in that city, now came into this country from Germany under the guise of "Bismarck Brown," and many other colours were similarly re-named.

William Henry Perkin was very much a prophet in his own country. It is true that he received the honour of Knighthood in respect of his many discoveries, but, at the best, such an honour was a needlessly belated one, being awarded only in 1906, the year preceding his death.

Britain's dyestuff industry, at the beginning of the Great War, despite the heroic efforts of Ivan Levinstein, the foremost English dye manufacturer, had got into such a plight that even the dyes for our Army and Navy uniforms were German produced.

The war taught us, however, that a dyestuffs industry is essential for a nation in modern times just as much as artificial dyes in their many varieties are essential to the smooth-running of civilisation.

Nowadays, fortunately, Britain has become one of the leading dye-manufacturing countries of the world, but even in these modern times the story of the late Sir William Henry Perkin and the remarkable era-making discovery which he achieved is too little known outside the realm of historical chemistry. The Centenary of Perkin's birth which is now upon us should, at least, serve to remind us once again of the British origin of artificial dyes as well of the far-reaching courage and amazing initiative of the man who, working almost alone, introduced an entirely new note into industry and civilisation.

*A corner of the new research laboratories of British Dyestuffs Corporation, Blackley, Manchester. This is the Anthraquinone Laboratory.*

# STARGAZING FOR AMATEURS

(*Continued from page* 381)

### Notes

The double star $\gamma$ (Gamma), one of the principal components of the W representing the constellation Cassiopeiæ, has for some time past shown signs of getting brighter. As this is not one of the recognised variables, it is interesting to recall that the famous "Pilgrim Star" of A.D. 1572 blazed out not far, so to speak, from this spot. It speedily rivalled the planet Venus in brilliance and was visible at noonday. In about a month it began to fade and in less than two years had disappeared from sight, the telescope not having then been discovered. Astronomers are specially noting the behaviour of $\gamma$ Cassiopeiæ, not so much on account of its own possibilities, but because it is believed that the radiations from its superheated hydrogen and helium "atmosphere" may be the source of the faint glimmer emitted by a relatively adjacent, but really very remote, nebula. Simultaneous rising and falling of the luminosity of both, would go far towards establishing the existence of yet another of those dark cloudy masses in space which, unless lit up by the rays of distant suns would otherwise be invisible to us.

* * *

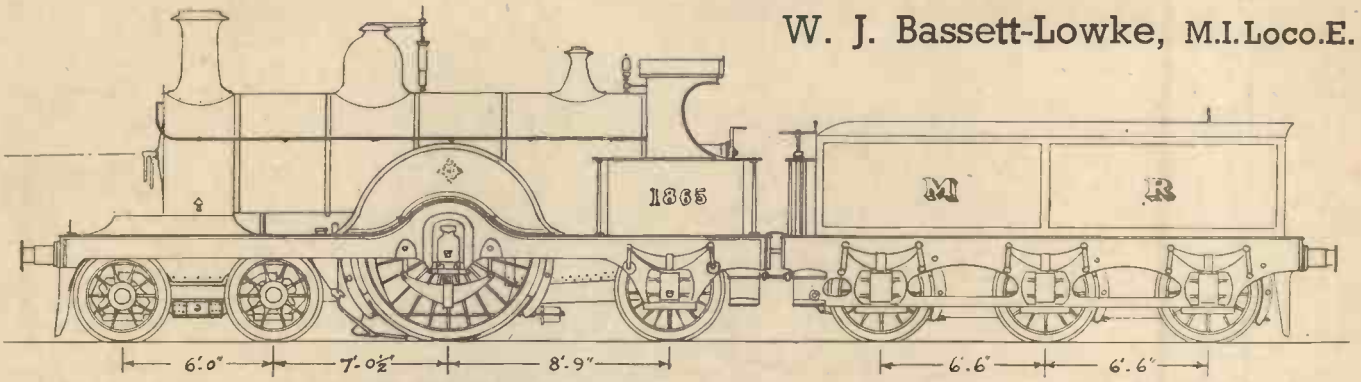
The construction and assembly of the huge lattice tube and massive equatorial mounting of the reflecting telescope of 72 in. aperture for South Africa, have been completed. In consequence of failures to perfectly cast the heavy disc of the main mirror of Pyrex glass (as also happened in the case of the mammoth 200 in.), it will probably be another year before the telescope can be at work. The site chosen for the observatory is in a wild region a few miles outside the city of Pretoria. The neighbourhood is subject to thunderstorms of unusual violence, many of which provide amazing sights when their approach is viewed from a convenient distance. The country teems with snakes of the Puff Adder species that are able to spit their venom into people's eyes and cause blindness. Dr. Knox Shaw, who has done wonderful things in celestial photography at Heluan, near Cairo, will be in charge. He has already left England to take up residence at the Observatory. Astronomers' lines are not always cast in pleasant places!

### Lathes for Amateurs

THE Myford Engineering Co., Ltd., Neville Works, Beeston, Notts., who specialise in small lathes solely for the use of amateurs, are incorporating a number of new features in their 3-in., 3⅜-in. and 3½-in. lathes. Features include the parallel set-over of the tailstock for taper turning, a reversing fork for quick change in screw cutting, fully compound slides, top slide indexed and swivelling, and all slides are carefully hand-scraped and fitted to precision limits. The lathes turned out by this firm are all of robust proportions, are moderately priced and designed on the lines of large workshop lathes.

# PROGRESS OF THE BRITISH STEAM LOCOMOTIVE—PART III

By W. J. Bassett-Lowke, M.I.Loco.E.



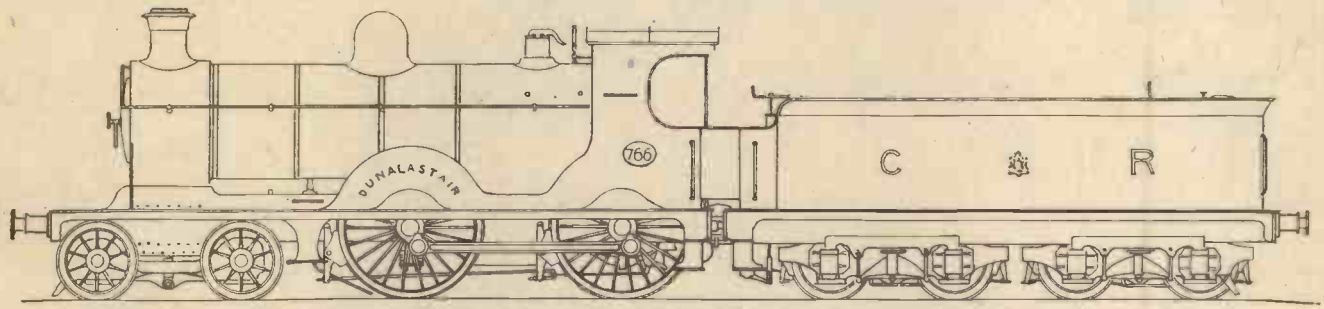

*S. W. Johnson's 4-2-2 locomotive No. 1865, M.R. 1889. Noted not only for its fine performance for a single driver but its excellent beauty of outline.*

PASSENGER trains in the 'eighties were still very light. There were not corridor stock, or dining- or sleeping-cars. So the adhesion given by a pair of single driving wheels was still sufficient to transmit the power of the engines to the rails. Many railways built single drivers of the 2-2-2 and 4-2-2 types, and not until 1901 did the last British single express appear. Of these, Samuel Johnson's Midland design of 1889 has never been surpassed, and this you see illustrated. The large 7 ft. 6 in. diameter driving wheels and brass axle-boxes had much to do with the handsome appearance of the "Spinners," as they were called.

"Dunalastairs" of the Caledonian Railway (1897) were probably a product of the 1895 "Race to Aberdeen," and these engines were designed for steep grades and put up fine performances. An important feature was the large size of the boiler, with 4 ft. 8 in. diameter boiler, and a total heating surface of 1,403 sq. ft. In running trim these engines, in sky blue colours, weighed 47 tons, with 8-wheeled tenders, carried on two bogies.

### Ivatt's "Atlantic" Type

We next reach a turning-point of British locomotive design in the direction of much larger and more powerful locomotives than previously. The first vestibuled trains, with 12-wheeled American pattern stock, had made their appearance on the East Coast route and H. A. Ivatt, Locomotive Superintendent of the Great Northern Railway, designed an engine to handle these increased loads—a successor to the Stirling "Eight-footers." Appearing in 1898, it received the American nickname of "Atlantic" and, following its American predecessors, it has outside cylinders driving the rear pair of driving wheels. The first large-boilered "Atlantics" with 5 ft. 6 in. diameter barrels, took the road in 1902. Ivatt's motto, that the success of a locomotive was measured by its capacity to boiler water, with the mating of a boiler of large size with cylinders only 18½ in. diameter by 24 in. stroke, was quite contrary to locomotive practice of his time, but his large-boilered "Atlantics" have been the most successful engines ever introduced in this country, every one still at work on the L.N.E.R. main lines. The first engine of this type was only recently withdrawn.



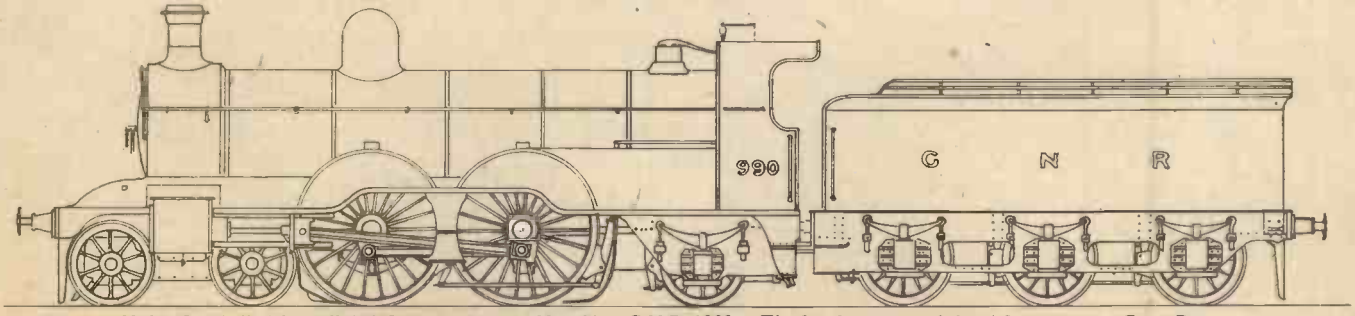

*McIntosh's "Dunalastair" 4-4-0. Caledonian Railway, 1897. This locomotive was probably a product of the 1895 "Race to Aberdeen."*

### Heavier Trains

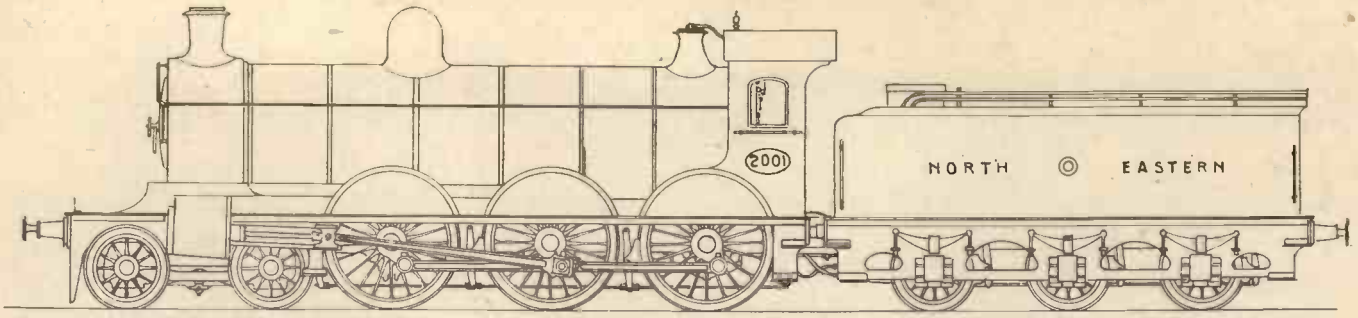
For heavier trains and steeper gradients, the 4-coupled locomotive, with its double adhesion weight, was by now firmly established for express passenger work. In this connection, more passenger engines of the 4-4-0 wheel arrangement have been built than any other. Good quality British coal makes it possible to raise steam in small fireboxes, and the excellence of British track makes it unnecessary to restrict the axle loading as in some other countries. The

### William Worsdell

The North-Eastern Railway also was not far behind in quest of increased locomotive power. Wilson Worsdell, whose father, William Worsdell, had built the North-Eastern engines which made fine records in the 1895 race to Aberdeen, built the first 4-6-0 express passenger locomotive in the country. Worsdell was the first to demonstrate that coupling three axles together would not affect the capacity of a locomotive for high speed. The driving wheels of these




*H. W. Ivatt's "Atlantic" 4-4-2 type locomotive No. 990. G.N.R. 1898. The first locomotive of the Atlantic type in Great Britain.*



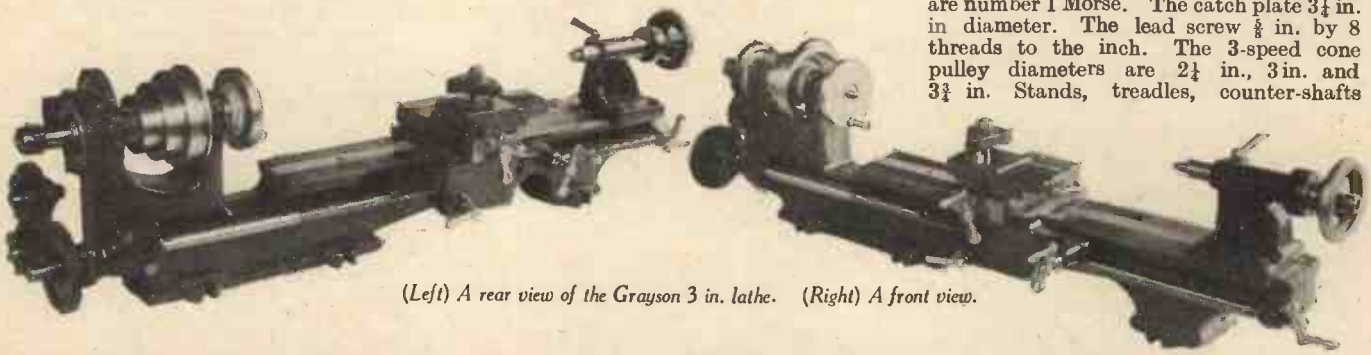

*William Worsdell's 4-6-0 locomotive No. 2001. N.E.R. 1900. The first express passenger engine of this type in Great Britain.*

North-Eastern 4-6-0's were only 6 ft. 1 in. in diameter, but after building five further 4-6-0 engines with 6 ft. 8 in. wheels, he occupied himself with building nothing but "Atlantics" for express passenger service, and his 4-6-0's were relegated to express freight work. One of the 6 ft. 8 in. series was shown at the 1900 Paris Exhibition.

But another engineer, now famous as one who directly influenced the entire locomotive practice of this country, soon afterwards introduced 6-coupled wheels for express passenger service—George Jackson Churchward, of the Great Western Railway. His first experimental two-cylinder 4-6-0 appeared from Swindon Works in 1902. In 1906, with the fruits of experiments of three compound "Atlantics" imported from France, Churchward brought out "North Star," with four 14½ in. by 26 in. cylinders and a working pressure as high as 225 lb. per sq. in. The capacity for sustained speed and economy in working of the Churchward designs gave the Great Western the lead in British speed for many years. The London & North Western took the "Polar Star," the G.W.R. locomotive illustrated, in exchange for "Worcestershire," the latter's "experiment" 4-6-0 type. Both engines essayed each other's work, but whereas the "Polar Star's" runs were most successful, the "Worcestershire" could not keep time with the fastest Great Western trains, and burned more coal.

*(To be continued)*

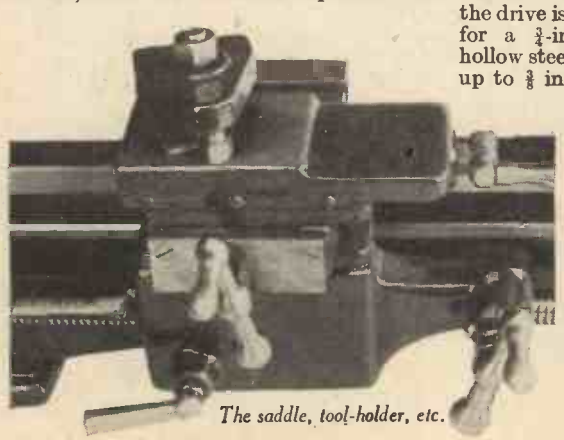
# A VALUE-FOR-MONEY LATHE: An Ideal Tool for the Workshop



*(Left) A rear view of the Grayson 3 in. lathe. (Right) A front view.*

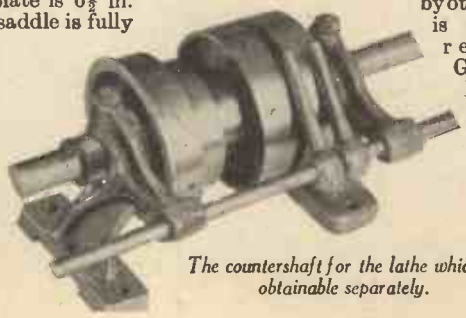
WE have had under test in the PRACTICAL MECHANICS workshop one of the Grayson 3-in. centre lathes which sells, including face plate, driver plate, and set of 10 change wheels, for £6 7*s.* 6*d.*, although it can be obtained in other models at £5 10*s.* 0*d.* (12-in. between centres), £5 19*s.* 6*d.* (20-in. between centres), and £5 18*s.* 0*d.* (12-in. between centres). The improved model which we have had under test takes 20 in. between centres, and it has a first rate specification.

The bed is a box casting having accurately-machined Vees with a flat top and hand-scrape finish. The headstock bearings are bored from the solid and adjustments are provided for wear. The lathe is back geared through the usual eccentric bush, and provides a ratio of 6½ to 1. The spindle is turned and bored, admitting bars up to ⅝ in. It is also provided with a square shoulder to ensure accurate mounting of the face plate or chuck. The spindle nose is screwed 1 in. by 12 threads per inch, and the drive is by means of a 3-step cone pulley for a ¾-in. belt. The tailstock has a hollow steel barrel allowing entry of material up to ⅜ in. in diameter, and a lever screw clamp for the square cut thread. The slotted face plate is 6½ in. in diameter. The saddle is fully compound, the slides having large bearing surfaces, and all traverse screws have square-cut threads fitted with lock-nutted ball handles. The traverse of the top slide is 3 in. and the cross slide 3¼ in. The apron carries a quick traverse handle operating through a pinion meshing with the lead screw whilst the clasp nut is of the double type working in adjustable Vee guides and is operated by an eccentrically slotted plate ensuring positive engagement. The maximum swing over the saddle is 4½ in. and the maximum swing over the gap 8 in. The centres are number 1 Morse. The catch plate 3¼ in. in diameter. The lead screw ⅝ in. by 8 threads to the inch. The 3-speed cone pulley diameters are 2¼ in., 3 in. and 3¾ in. Stands, treadles, counter-shafts etc., are all supplied suitable for the lathe.



*The saddle, tool-holder, etc.*

In spite of its very low price we found that the test pieces we turned (10 in. spindle, facing, boring, screw cutting, etc.), were extremely accurate, and the error in traverse from head stop to tail stop is almost immeasurable. The concenticity of the cylindrical pieces was within ·00025, and the screw threads are equal in every way to those produced on a more expensive tool. We can therefore recommend the Grayson lathe with every confidence that it will give satisfaction, whether used for model making or professional work. Everyone interested in practical work should own a lathe, for it is possible to do within a fraction of the time and in a more satisfactory way work which by other processes is seldom correct. The Grayson Lathe is an excellent job,—solidly built, and nicely made.



*The countershaft for the lathe which is obtainable separately.*

# QUERIES and ENQUIRIES

A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on page 411, must be enclosed with every letter containing a query. Every query and drawing which is sent must bear the name and address of the sender. Send your queries to the Editor, PRACTICAL MECHANICS, Geo. Newnes Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

## MURAL DECORATIONS

**"I SAW at an exhibition some time ago some photographic enlargements of portraits of film stars, etc., reproduced on what was apparently plaster or cement.**

**"These were about 18 in. square, and looked very effective as well as being permanent. Could you tell me where I could obtain the necessary liquid for sensitising, or perhaps the formula for same? I propose to experiment in this direction, and I understand that the chemicals are sprayed on, the exposure made, and the resulting picture washed and fixed in the usual manner. I should like therefore to know the formula for a suitable sensitising liquid (which would, of course, have to be used in a dark room). I thought that some interesting mural decorations could be devised with this process." (W. J., Enfield.)**

YOU omit to state whether the photographic representations which you saw were actually in relief, that is to say, raised above the surface of the material or whether they consisted of ordinary photographs impressed upon the plaster or cement base.

If the photographs were in relief, they will have been produced by some modification of the old bas-relief process of photography, a process which cannot very well be imitated by the home photographic worker, since the use of heavy and powerful presses is necessitated.

If, however, the photographs were not in relief on the plaster or cement they may have been produced by one of two methods, viz.:

(*a*) By the well-known carbon or "Carbro" processes, which give rise to an absolutely permanent photograph. Particulars of the working of such processes cannot be given here, but would be supplied to you *gratis* on application to The Autotype Company, Ltd., New Oxford Street, London, W.1.

(*b*) By means of an ordinary silver emulsion laid on the base. You may imitate this mode of working at home. Prepare a 2% solution of gelatine and apply it liberally to the plaster surface. Allow it to dry and afterwards brush over the surface a 1% solution of formalin. Allow this to dry. Now take the prepared surface into a dark room and apply to it the following sensitising solution after having first brushed over the surface a 2% solution of common salt and allowed it to dry:

| | |
|---|---|
| Silver nitrate . . | 40 grains. |
| Citric acid . . | 10 grains. |
| Water . . . | ½ ounce. |

After drying, the prepared plaster surface will be sensitive to light. It may be printed through a negative and toned, fixed and washed in the usual manner. The process, however, at the best, is unreliable and you will get better results by working, say, the "Carbro" process above-mentioned.

Whether, of course, the photographs you saw were actually modern bas-reliefs or carbon-printed images, we cannot say without having inspected the pictures in question.

## COLOURING WOOD PRESERVATIVES

**"I AM interested in coloured wood preservatives, such as manufactured from coal tar products, but my experiments along this line have not been successful. The pigment, when mixed with the preservative, is only in suspension, and quickly settles to the bottom, and futhermore the pigment only adheres to the outside of the timber and does not penetrate with the liquor.**

**"Evidently a dye or stain liquid is the solution to the problem. Perhaps you could advise me of the names of the dyes or stains necessary to achieve these results. It is required to colour red, blue, green, grey, yellow, etc." (A. T., Ryton-on-Tyne.)**

IT is rather a pity that you have not given us more detailed information concerning the actual nature of the wood preservatives which you are experimenting with, for then we should have been in a better position to suggest suitable stains or colouring matters for your purpose.

Pigments, of course, are useless for colouring wood preservatives, since, as you point out, being insoluble they do not sink into the wood.

If your preservatives contain any proportion of spirit (that is to say methylated spirit or any other form of alcohol) any of the spirit-soluble aniline dyestuffs will suit your needs. On the other hand, if your preservatives are of an oily nature and contain materials such as creosote, mineral oils, carbolic acid, pine oil, etc., you will need an oil-soluble dyestuff.

Both spirit- and oil-soluble dyes can be obtained from Messrs. A. Boake, Roberts, & Co., manufacturing chemists, Stratford, London, E., who supply a large range of such colours. We are inclined to think that you will require the oil-soluble dyes, as, for instance, Oil Brown 501, Oil Green 504, Oil Scarlet 507, Oil Yellow 509, and Oil Blue 502.



## MAKING AN ASTRONOMICAL TELESCOPE

**"AS I wish to obtain an astronomical telescope, do you advise a reflector or a refractor?**

**"I cannot afford an expensive model. Would it be best to advertise for a second-hand telescope, or could I make one? I am an automobile engineer and have use of a good machine shop.**

**"What would it cost me to make say a ¾-in. refractor or a 4½-in. reflector?**

**"Where can I obtain instructions for making a telescope, and do you know of any paper devoted to amateur astronomy?**

**"Do you know of any astronomical society for amateurs?" (O. R. D., Whitstable.)**

REFRACTING telescopes are certainly almost trouble free, but compel an uncomfortable observing position when the celestial object is high in the heavens—its best situation. Moreover, to satisfactorily see Saturn's rings, Jupiter's "belts" and even the main markings on Mars, an aperture of at least 4-in. is required. Such an object glass of reasonably good quality is alone costly—anything from £5 to £20. A reflecting telescope, on the other hand, is very much less expensive and admits of observing in an easy non-tiring standing position, with no "craning" of the neck. The mirrors, of which there are two, admittedly need re-silvering occasionally, according to the normal condition of the local atmosphere. This is, however, a matter of only about £1; but can be done at home if some little risk of an explosion is taken, it being a chemical process. The cost of a 6½-in. reflector would be about the same as a 3-in. refractor and it would have considerably more "light grasp." An 8½-in. —a suitable size for amateurs in this climate—would be relatively little more. Some months ago one of the latter size made by the eminent maker Calver, was advertised by Mackett & Co., of Brighton, for £9 10s. complete with stand and slow-motion handles.

An altazimuth stand is recommended in preference to an equatorial. The former is simpler and costs less. It can be moved about; whereas an equatorial has to be accurately adjusted with the axis of the tube parallel to that of the earth, and has to "stay put." Unless this adjustment is perfect and immovable, the equatorial has no advantage over the altazimuth. With any instrument of over two inches aperture some form of diagonal solar eyepiece is essential; otherwise the heat at the focal point would be dangerous to sight. A 2-in. can employ a "dark" cap on the sun.

The cost of making a telescope would probably be more than a second-hand purchase and, of course, it might not be as efficient or so delicately aligned. The following are a few names of dealers in both new and second-hand reflectors. They might also supply "kits" or the mirrors. The latter would be difficult for an amateur to grind and "figure." Perfection of the final "figuring" is a *sine qua non*.

W. Otway & Co. Ltd., Orion Works, Ealing, London, W.5.

C. E. Mackett & Co., 51 Millers Road, Brighton.

— Irving, 258 Kingston Road, Teddington.

— Slater, 56 Windsor Road, Gt. Harwood, Blackburn.

— Slade, Parkwall, Longwell Green, Bristol.

At least a fortnight's trial should be insisted upon so as to give the telescope a fair chance of showing its quality on at least one reasonably good "seeing" night. Advertising might be a good way of securing a bargain if you know anyone near by competent to test it on the stars.

A comprehensive book on telescope making by the Rev. W. F. A. Ellison is published by the Rolls House Publishing Co. Ltd., 2 Breams Buildings, London, E.C.4, at 7*s*. 6*d*. A Star Atlas and Telescope Handbook is published by Gall & Inglis at 12*s*. 6*d*. net.

We do not know of any English journal devoted to amateur astronomy; but the British Astronomical Society, 303 Bath Road, Hounslow West, Middlesex, cater for those who take astronomy seriously without being actually professionals. It might be worth joining them later on.

It may be added that, though a telescope house (or small observatory) is quite desirable, a heavy instrument can be left outside covered with only a tarpaulin or other waterproof covering. The mirrors of a reflector are provided with tin or brass covers to protect them. The tube and stand should be well painted with a weather-resisting paint.

## RESURFACING LINOLEUM

**"CAN you suggest something to resurface a square of linoleum floor covering." (W. H., Portadown.)**

THERE is nothing which you can do to give lasting satisfaction as regards the proposed resurfacing of your oilcloth or lino square and you would find it cheaper to purchase another piece of the material rather than to attempt to resurface it.

The surface of linoleum and oilcloths are formed by rolling the material through hot rollers, whereby a glazed or smooth matt effect is obtained. It is impossible to fill up areas of lino which have become abraded or worn away. The only thing you can do is to apply several coats of a good hard varnish, allowing each coat to dry thoroughly before applying the next. If, after the final varnish coat has been put on, the surface is too glossy or slippery, it can be matted-down by rubbing it over with fine sandpaper.

It is useless to put resin, wax, or similar materials on to an abraded floor-covering, since these are too soft and would wear away in next to no time. Careful varnishing of the lino on the above-suggested lines is the best treatment, but, of course, this treatment will not fill up holes due to the wear of the lino.

## POISON GAS

**"I AM interested in the chemical aspect of chemical warfare (more particularly in gas). Can you suggest any technical books or papers that deal with the manufacture, analysis, etc., of poison gases as used in warfare." (L. W., Kent.)**

THERE are no technical books published in this country which deal with the actual manufacture of poisonous gases and other lethal compounds, since many of these processes are highly specialised and much secrecy is observed about them.

Any comprehensive manual of organic chemistry will give you full information concerning the chemical composition and properties of the various poison gases. We would also recommend you to obtain the Air Raid Precautions Handbooks (Nos. 1 to 7), which are issued cheaply by H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2. These give much detailed information concerning the various war gases, their effects on the individual and the methods of combatting them. They also deal with rough analytical methods for testing the gases.

## HEAT-PROOFING A BODY

**"AFTER reading a book on fake spiritualists I tried a formula for a mixture which, when rubbed on the body, made it immune from heat. This is the recipe: ½ oz. camphor, 2 oz. aqua vitæ, 1 oz. liquid styrax, 1 oz. quicksilver, 2 oz. pulverized redstone.**

**"I have been unable to discover what pulverised redstone is, and I hope you will be able to inform me. Also, could you tell me whether it deadens the nerves or merely makes a fire-proof covering." (W. T., Bath.)**

WITH every respect to the author from whose work you take the recipe quoted, we feel bound to state that this is an entirely nonsensical formula and a perfectly meaningless one. It would certainly not bring about the desired results of heat-proofing the body when rubbed on the skin. "Aqua vitæ" (water of life), may mean anything. In the old chemical and alchemical writings, it usually referred to alcohol and we presume this is what it refers to in your formula. "Liquid styrax" is simple gum styrax dissolved in some suitable solvent. "Pulverised redstone" again, may be anything from powdered sandstone to cinnabar (mercury sulphide) or rouge (iron oxide).

It would be impossible to get the quicksilver (mercury) to mix with the other ingredients of the recipe. It would simply fall to the bottom of the vessel and remain there.

The mixture would neither deaden the nerves of the flesh or do anything else. It is merely a senseless concoction which was at one time typical of the old treatises on magic and alchemy.

## AUTOMATIC MUSIC STOP

**"AS an organist and pianist I have always thought that there was room for an automatic music stop on the music rests of these instruments.**

**"The failure of the ordinary right-angled hook is that one has to push it down before turning it over, otherwise a torn page is the result, and then push it up again after the operation.**

**"I have invented an automatic stop on the counterweight principle and have found that it works excellently on my own piano.**

**"I should like to know your opinion of this idea, and whether it is worth patenting with a view to marketing same. I enclose drawing." (L. M., Holloway, N.7.)**

THE improved music rest stop is thought to be novel, but it appears doubtful if it contains sufficient invention or subject matter over analagous known devices to support a patent. However, a certain measure of protection could probably be obtained by registering the stop as a design by which protection may be obtained for a first period of five years extensible for further periods of five years each.

## AUTOMATIC GEAR CHANGE

**"I SHOULD be very glad if you would give your opinion on an idea of mine, the idea is for an automatic gear change for automobiles. I am enclosing a rough sketch showing the main principles of the mechanism.**

**"There are three positions of the gear lever, in gear, for all forward speeds, neutral, and reverse. To get away from a standstill, bottom gear would be engaged in the usual way by depressing the clutch and engaging gear with the hand lever. Once the clutch was released and the engine gained sufficient speed the centrafugal governor would engage second gear automatically by drawing the small cone clutch into engagement, against the resistance of the spiral spring which would normally keep the two cones apart; third and top gears would be engaged in exactly the same manner, as shown in the diagram.**

**"If the car came to a steep gradient the engine speed would decrease, causing a loss of power to the last governor, and the spiral spring would force it apart disengaging the clutch and cutting off the fourth ratchet drive. The drive is now taken up by the third ratchet drive, and should the gradient become still steeper, the third drive would come out of engagement bringing in the second drive, the same applying if the car has to slow down in traffic as the engine speed decreased. The engine clutch (an ordinary type of clutch) would only have to be used if the car came to an absolute stop in traffic, and had to start off from a standstill.**

**"Another thing would be that if the car were going down a steep hill, the rear wheels could not overrun the engine, and the pawl and rachet drives would act as a freewheel. The ratchets (the driven members) would be fixed on the mainshaft, and the pawls (the driving members), fitted around the gear wheels. They would be spring-loaded and free to lift up and down if the ratchets revolved inside them, but when they are driving they engage the ratchets. The reverse drive would be set in the opposite direction on the shaft, so that when reverse gear is engaged, the forward drives are not brought into commission but remain idle, and when the car is going forward the reverse drive would merely be running backwards.**

**"This system appears rather complicated at first, but I do not think that it would be more so than epicyclic gearing. Also changing up and down would be entirely automatic except for engaging bottom gear to get away.**

**"Would you give me your advice and let me know if you think it would be worth taking out a patent for the invention." (H. A., Kent).**

THE improved change gear for motor road vehicles forms fit subject matter for protection by letters patent provided the invention be novel.

The broad idea of automatically changing gear according to the load is not novel, see for instance the "Hayes Gear" fitted by the Austin Company, and you are advised to make a search amongst prior patent specifications dealing with the subject as much attention has been given to change gears for motor road vehicles. There are a vast number of patents dealing with the subject.

## LATEX RUBBER

**"I HAVE been working for some time on a surgical appliance of revolutionary design. Part of the appliance is made of rubber but I should like to use a heavy**

**quality sterilised latex rubber instead of the ordinary rubber.**

**"1. I do not wish to make latex, although I have the formula, as I know it is protected by patent, but I was wondering if I could use the manufactured sheeting without infringing the patent, and, if so, where I could obtain the sheeting?**

**"2. Would I have to get permission to use this substance in my first model and if so, from whom?**

**"3. Is latex sheeting made in sheets or rolls?**

**"4. Can I obtain latex rubber sponges?**

**"5. Can you give me the formula for an extra powerful adhesive or cement to join the latex rubber and celluloid (or similar compositions) together?" (W. L., Scotland.)**

1, 2. YOU would not have to get permission to construct articles out of ordinary rubber latex. This material can be obtained from many sources according to the variety required. In your case, you will find it best to communicate with the Secretary of the Rubber Growers' Association, Inc., 2, 3 & 4, Idol Lane, Eastcheap, London, E.C.3, stating exactly what type of latex material you wish to use.

3, 4. Latex material may be procured in sheets and also in blocks, but not in sponge formation.

5. The best cement which you can use consists of a thick solution of scrap celluloid in amyl acetate to which a very small quantity of castor oil (one drop of the oil per ounce of cement) has been added. It is also possible to make cements of this purpose by dissolving latex rubber in naphtha. For the cements to attain their greatest "holding" power, the rubber and celluloid articles should be slightly roughened on the surfaces which are to be cemented together.

### CANVAS SWIMMING POOL

**"CAN you advise regarding the making and proofing of a canvas swimming pool, size about 15 ft. diameter.**

**"I have a lot of good quality canvas and I am almost certain that it can be used for this purpose. If possible I should like the pool to be about 12 ft. wide by 18 ft. long, but I understand that the circular ones are more successful." (W. B., Retford.)**

IT is somewhat difficult to advise you as regards the actual layout and construction of your proposed swimming pool, since you do not give us any details concerning the nature of the soil and surroundings of the projected pool. It is very doubtful whether a swimming pool constructed entirely of canvas would prove satisfactory over any prolonged period, since all proofed material, when subjected to water action over protracted periods, degenerates.

We would suggest, therefore, that, for the making of your pool you excavated the necessary space in the ground and that you lined its sides and bottom with well-puddled clay. Over this might be placed a lining of proofed material and such a lining would be advantageous in that it could be removed for cleaning purposes and, also, for storage during the winter-time. Any slight faults in the proofing of the material would be of very little consequence, since the puddled-clay base-lining of the pool would render the escape of water into the deeper layers of the soil a very slow process.

Regarding the proofing of your fabric, we feel bound to state that such a strong degree of proofing as you would require is difficult (and, perhaps, almost impossible) for an amateur to attain. This is mainly in view of the fact that strongly-proofed fabrics undergo hot-roller and calendering treatments which an amateur cannot hope to imitate on a small scale.

However you might try out experiments in proofing your material by soaking it in a 1 in 7 solution of aluminium sulphate, and then, after drying the material, immersing it in a strong solution of ordinary soap. This will produce insoluble aluminium stereate in the fibres of the fabric. The cloth may be additionally proofed by soaking it for some hours in a 6 per cent. solution of glue or gelatine, drying, and then immersing it in a 5 per cent. solution of formaline for some hours which will insolubilise the gelatine.

If you do not wish to do any excavating in the making of your swimming pool, it will be necessary for you to construct a rough "frame" (sides and base) upon which the proofed material may be stretched and securely fastened. For this purpose, no home-proofed material will suffice. You will need a semi-tarpaulined fabric for the purpose.

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It will cover exploration from the very earliest times to the present, and in the modern sphere contributors will be, wherever possible, the very men and women who themselves took part in the expeditions.

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Other authorities who are writing for THE STORY OF EXPLORATION AND ADVENTURE include Rosita Forbes, Bertram Thomas, Dr. Hamilton Rice, Sir Denison Ross, Capt. Kingdon-Ward, Sir Leonard Woolley, Evelyn Cheesman, Sir Chas. Close, Sir William Gowers, Hans Helfritz, Lady Hosie, Viscount Kelburn, Dr. H. R. Mill, J. A. Williamson, and many others.

This publication will not be confined to the achievements of British explorers—the subject is too vast for that—and it is the aim of Sir Percy Sykes to present to the public a work which, while authoritative in the highest degree, will appeal to old and young alike.

THE STORY OF EXPLORATION AND ADVENTURE will be complete in about 32 fortnightly parts at 1*s.* each.

# NEW INVENTIONS

(*Continued from page* 396)

book. An inventor maintains that this sheath, through constant use, tends to become enlarged, so that the pencil is apt to slip out and to be lost. To obviate this disadvantage, he provides the usual accommodation for the pencil, but fits the receptacle with a helix or spiral for gripping the pencil.

This device would have appealed to Dickens's character, Captain Cuttle, whose slogan was, "When found, make a note of."

### Milking Cow Toy

THE toy farmyard has increased its stock in the shape of a milch cow. Fitted with a perforated udder, this animal has within its inmost recesses a reservoir for milk. And the milk is exuded when the tail is used on the principle of a pump handle. This method reminds one of the alleged practice of dishonest dairymen who milk what is termed "the cow with the iron tail."

Why not a full-sized mechanical cow for milk bars? Such an animal would undoubtedly interest the young and might allure them to imbibe more nutriment via the straw.

### Lawn-edging Shears

THAT miniature edition of the Garden of Eden behind each house of villadom invariably includes a patch of verdant lawn. This, the modern Adam keeps as neatly trimmed as his well-brushed locks. With shears of the ordinary pattern, the operator is often caught bending—a posture detrimental to his faultlessly pressed trousers. An improved clipping instrument will now enable him to trim his lawn in a comfortable and dignified attitude more or less perpendicular.

The invention has one blade relatively stationary, upon which a movable blade is pivoted. Attached to each blade is a moderately long handle, and the movable blade works up and down vertically to effect the cutting.

The blade of this portable guillotine will snappily snip the blades of grass.

### Handy Squeeze Tube

THE cap of a squeeze tube is sometimes obstinate; it won't come off. Nature's pincers—the fingers—often fail to twist it. Therefore, any invention which makes for the easy exit of the contents of the tubes is heartily welcomed By the way, it may prevent the use of much unparliamentary language.

There has recently been patented in this country a tube with a gadget which relieves one of the necessity of taking off its cap. An easily moved slide, covering a hole in the cap, permits the goods to be promptly delivered.

### One Ring for All

IN these days of breach of promise cases and divorce suits, a newly devised adjustable ring will be acceptable to the fickle heart. This ring accommodates itself to any sized finger. Split at the back, the tiny band has an arrangement enabling it to be adapted to various diameters. Therefore, in the case of those whose love is constant but its object changes, when the ring is returned with the presents, it can be offered to some other charmer and still be found fitting.

DYNAMO.

## SIMPLE STROBOSCOPES

(*Continued from page* 368)

This stroboscopic effect is due to the fact that an electric lamp fed with 50-cycle alternating current flashes at the rate of 100 times per second. Each flash, therefore, illumines the rotating disc for 1/100th of a second. The number of black segments or radial lines on the gramophone stroboscopic disc is so calculated that, when the disc is revolving at its correct speed (78 r.p.m.), each line or segment moves exactly to the position of the preceeding one in the interval separating the flashes. Thus, in accordance with general stroboscopic law, the lines or sectors on the disc appear to be stationary.

We can, by utilising this principle, check the speed of rotation of any shaft, disc or wheel. All we have to do is to mount on the shaft or wheel a similar "stroboscopic disc" containing the calculated number of radial lines. If the shaft is revolving at its correct speed, the radial lines on the disc, when viewed under alternating current illumination of given frequency, will appear stationary.

To calculate the requisite number of radial lines on a disc for the checking of any speed of rotation, use may be made of the following straightforward formula:

$$\text{No. of radial lines on stroboscopic disc} = \frac{\text{Frequency of A.C. Supply} \times 120}{\text{Correct speed of rotation.}}$$

Thus, if we desire to make a stroboscopic disc whose black radial lines will remain stationary when the disc is rotated at 150 r.p.m. and viewed under 50-cycle A.C illumination, we calculate as follows:

$$\text{No. lines on disc} = \frac{50 \times 120}{150} = 40$$

Our disc, therefore, must have 40 equally-spaced black radial lines. Thus constituted, its lines will appear stationary when it is mounted upon a wheel or shaft revolving at 150 r.p.m. and when viewed under the illumination of an electric lamp fed by a 50-cycle alternating current supply.

## STORING SPEECH AND MUSIC

(*Continued from page* 366)

duplicate, thus providing a spare head for each of these functions. The heads are very similar in construction, but they are used in different circuits.

The "wipe-out" and "reproducing" heads employ a single pole piece only, and no critical adjustment is therefore necessary.

The "recording" head has two pole pieces and is provided with a micrometer adjustment so that the longitudinal separation of the pole pieces can be accurately adjusted. All the heads have a micrometer for adjusting the pressure of the pole pieces upon the tape.

The heads of the machine are connected by screened twin leads to their appropriate places on the amplifying and control rack, which comprises the following units:

The amplifier employs two push-pull stages, the output of which is coupled to the Recording head via a transformer and impedance equaliser. Upon this panel are also provided adjustable potentiometers for controlling the current through the "wipe-out" head and the auxiliary D.C.

(*Continued overleaf*)

(*Continued from previous page*)

current which magnetically sets the tape at the right part of the magnetisation characteristic for recording. Frequency correction is employed to suit the characteristic of the recording medium and a 60 ohm check point is provided for measuring the gain and frequency response of the amplifier.

The programme meter, is a standard unit designed for broadcast studio work. During the recording process it is normally connected across the input circuit of the recording amplifier for monitoring the recording level. It is calibrated directly in decibels and by means of the auxiliary calibrated potentiometer on the instrument the total measuring range of the instrument is from — 30 to + 30 db. with reference to 1 milliwatt in 600 ohms.

Fig. 3 shows a typical overall frequency response curve for the system taken with a constant input voltage. It will be seen that it is uniform within ± 2 db. from 50 to 6,000 cycles.

## MODEL AERO TOPICS

(*Continued from page* 386)

The Skybird range of constructive model aeroplanes was one of the first of this type to appear on the British market, and was actually the first to adopt the now almost universal, one-seventy-second scale. The models have been appearing at regular intervals for the past six years, and the makers have tried, while always keeping a floating list of about twenty-five current models, to cover the history of aeronautics for the past twenty-five years by producing as diverse a series as possible. To appreciate the extent to which this end has been achieved, it is only necessary to glance at the current price list, which includes the "300 m.p.h. plus" Supermarine "Spitfire 1" multi-gun single-seat fighter, the Fairey "Hendon" heavy-bomber, the American Grumman F.2.F. fleet fighter, the wartime French Nieuport single-seat scout, and the German Hannoverraner, to mention only a few.

Parallel with the development of the actual models a wide range of accurate scale accessories and figures has been built up. These include, not only the actual aeroplane items, such as engines, cowlings, guns, wheels and airscrews; but also airport buildings, hangars, flood-lights, petrol tenders, also figures of pilots, mechanics, ground staff and every form of aerodrome accessory.

All interested, who desire information in regard to this fascinating hobby, should write to The Secretary, The Skybird League, 3, Aldermanbury Avenue, E.C.2.

* * *

The Premier Aero Model Supplies, of 2A, Hornsey Rise, London, N.19, is another company whose goods I can recommend. I select two of their models for special mention, The Cruiser Pup, which is an ideal beginner's model, easy to build, easy to fly, and with a good performance, at 6*s.* 6*d.*, including a full-size blueprint, finished air screw, rubber, lubricant, wheels, balsa wood, etc.; and the Northern Star, which has already been reviewed in these columns, and is a super duration high-winged monoplane, the complete kit costing 14*s.* 6*d.* It is of 37¾ in. span, 27 in. long, and weighs 4 oz.; it may be flown under S.M.A.E. rules. The Cruiser Pup, by the way, is 19 in. span, 18 ⅝in. long, and total weight between 1½ and 2 oz.

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PRACTICAL MECHANICS, APRIL, 1938.

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**10,000 Taps,** Whit.; B.S.F.; 5/32" to ¼"; also B.A. 0 to 8, in Tapers; Seconds and Plugs, usual price 6d. to 9d. each, clearing at 3s. per doz., any sizes.—Below.

**3,000 High Speed Twist Drills,** 1/32" to 1/2", actual value from 5d. to 8d. each. Bargain 2s. doz.—Below.

**Bright Mild Steel,** round, square, hexagon, flat, thirty to forty feet assorted to 1" diam., and 2" wide. 5s. bundle. Carriage 1s. 6d. extra. Very good bargain.—Below.

**Finest Quality Tool Steel,** Round, Bright, ¼" to ⅞" diam., 4 lb. 2s. 6d.; larger sizes 8 lb. 4s. Cost 2s. lb.—Below.

**1s. 9d. any lot. Wonderful Value.**

**One Gross Bright Steel Hex. Bolts with nuts.**

**One Gross Bright Steel Whit. screws,** assorted, ⅛" to ½".

**One Gross Bright Steel Chamfered Washers,** ⅛" to ⅜".

**Three Gross Wood Screws** to 3" long.

**Dozen Assorted Files,** 4" to 6".

**Six Assorted Files,** 6" to 12".

**Three Assorted Files,** 12" to 14".

**Six Assorted Grinding Wheels,** 2" to 2½" diam.

**Dozen Twist Drills,** 1/16" to ¼" diam. Best quality.

**Three Dozen Assorted Springs** to 3" long.

**Grinding Wheel,** Carborundum, about 6" by 1" wide, 1" hole.

**Three Hex. Die Nuts,** Cycle Thread, 3/16", ¼", 5/16".

**Three Slitting Saws,** 2¾" diam., 1/32" to ⅛" thick.

**Every item of guaranteed quality.**

**Four M.M. Dies** 11/16" diam.

**Dozen Assorted Taps.**

**⅜" Square Tool Holder,** with H.S. Tool.

**Dozen Fine Emery Wheels.**

**2 Doz. Hack-saw Blades,** 9", 10", or 12".

**Two H.S. Tap Fluting Cutters,** 1¼" diam.—Below.

**2s. 9d. any lot.**

**Set Five 1" Round Dies,** ¼", 5/16", ⅜", 7/16", ½". In Whit., B.S.F.; Brass 26 Thread.

**Set Five Taps** any above Thread.

**0 to ½ Drill Chuck,** Morse Taper or half-inch Straight Shank.

**Doz. Tool Makers' Needle Files.**

**Box 500 Brass and Steel Screws, Nuts, etc.**

**Doz. Drills,** 1/16" to ⅜".

**Three Pieces ⅜ Sq. H.S. Steel.** 3½" long. Hardened.

**One each** ¼", 7/16", 1" Whit. Taper Taps.

**18 Assorted Flexible Shaft Grinding Wheels,** ¼" to 1" diam.—Below.

**4s. any lot.**

**16 Lengths Silver Steel,** 1/16" to ⅜" Round.

**Dozen Superfine Swiss Files.**

**2 Doz. Files,** 4" to 10".

**1½ dozen** ⅛" to ¼" **Whit. and B.S.F. Taps.**

**Taper, 2nd and Plug Taps,** Whit., 1/16", ⅛", 3/16", ¼".

**8 lb. Best Tool Steel Pieces,** ½" to 1" diameter, Bright. —J. BURKE, 30 TRIPPET LANE, SHEFFIELD.

## TOOLS (*continued*)

**Set Hex. Die-Nuts,** ⅜", ½", ⅝", 1", Whit. or B.S.F.

**Eight Files,** 12" to 14" Bast. Assorted.

**Dozen Flat Files,** 8" to 12".—Below.

**Power Hack-saw,** 1" wide, 12", 2s. 6d.; 14", 3s. 6d. dozen.—Below.

**Carborundum Grinding Wheels,** 9" diameter, 1" wide, 1" hole, General Tool Use, 5s. each; 1½" wide, 6s.; 1½", 8s. 6d.; also ¾" wide, ½" hole, 3", 9d.; 3½", 1s.; 4", 1s. 3d.; ditto, ½" wide, 3½" diameter, 10d., with ½" or ¾" hole. Also Coarser Wheels, 1" wide, 1" and 1½" hole, 5", 1s.; 6", 1s. 9d.; 7", 2s. 6d.; 8", 3s.—Below.

**Mild Steel Pieces** to 3 ft. long, ¾" to 3½" diameter, 28 lb., 7s.; 56 lb., 12s. 6d. Carr. For.—Below.

**£1 Orders Carriage Paid.** Delivery ex-stock.—Below.

**400 dozen Tool-makers' Needle Files.** An absolute necessity for small work. Clearing at 2s. 9d. per dozen assorted shapes.—Below.

**600 Morse Taper Sleeves,** 1-2, 1s. 6d.; 2-3, 1s. 10d.; 3-4, 2s. 6d. Best quality, ground finish, British made. —Below.

**7,000 Boxes Small Screws, Nuts, Bolts** from 1/4" to ½", in Brass and Steel. These are really a wonderful assortment, including Plated Screws and Bolts, Castle Nuts, etc., approx. 500 parts; a necessity to every repairer or builder of small mechanical parts. A bargain worth snapping up, 2s. 9d. per box.—Below.

**1,000 Fine Emery Wheels,** 2" to 4" dia., ⅜" hole, ⅛" to ¼" thick, slightly used, but quite serviceable, 1s. 6d. per doz.—Below.

**2,000 Adjustable Tap Wrenches,** capacity 0 to ¼", polished finish, usual price 1s. 6d. each, clearing at 6d. each, post 2d.; low prices for gross lots.—Below.

**1,700 Die-stocks** to take 11/16" diam. Round Dies, all bright finish, usual price 1s. 3d. each, clear at 6d. each, 4s. 6d. per doz. Why bother changing Dies?—Below.

**50 Bundles Best Quality Silver Steel,** precision ground to size, not bright drawn; 16 assorted standard sizes, 1/16" to ⅜" diameter round, 4s. per bundle, for making Punches, Cutters, Drills, etc.; easily hardened.—Below.

**New Sheffield Files,** 6" to 12". Three Doz. Engineers' assorted, 10s.; wonderful value; carr. for., or paid with £1 order.—Below.

**Special Large Purchase of Tungsten Steel Hack-saw Blades,** 8", 9", 10", 12", with 14 to 32 teeth per inch; the cost of these blades in the ordinary way is from 16s. to 22s. per gross. Secure a stock now 8s. 6d. per gross, 7s. 6d. per gross in three-gross lots; sample orders, 10d. per doz. Guaranteed superior Sheffield quality.—Below.

**Power Hack-saw Blades,** 1" wide, 12", 2s. doz.; 14", 3s. doz.—Below.

**Please Note: £1** orders and above only are post paid; small orders please allow for postage. Steel Bars, Carriage Forward.—Below.

**800 Sets 1" Circular Dies,** Screwing ¼", 5/16", ⅜", 7/16", ½", Whitworth and B.S.F. Clearing at 2s. 9d. per set. Both sets 5s. Die Stocks to suit, 1s. 9d. each.—J. BURKE, 30 TRIPPET LANE, SHEFFIELD.

**GRAYSON'S** Glass-boring Outfits and Tube Cutters avoid risk.—Below.

**DRILLS,** Taps, Dies, Files, Chisels and Punches. Best quality at keenest prices.—Grayson & Company, 300 Campo Lane, Sheffield.

**BRAND NEW POWER TOOLS** of quality. 10" Bandsaws, 54/-. Jigsaws, 22/6. Planing Machines, 80/-. Bench Drills, 11/-. Circular Saws, from 25/-. 3", S.C. Toolroom Lathes, from £4 16s. New 1" Chromium Plated Micrometers, 12/6. Electric Drills, 32/6. Grinders, Spray Plants, Guns, Air Compressors, etc.—John P. Steel, Clyde St. Mills, Bingley.

**3" AND 3½" CENTRE LATHES.** Finest value ever offered. List stamp.—QUEEN'S ENGINEERING, 60, Queen's Road, London, S.W.8.

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**WATCH AND CLOCK REPAIRS.** Everything for the watch, clock and model maker. Large stock of watches, clocks, and clock movements, etc. Wholesale prices. List 3d.—Blakiston & Co., Ainsdale, Southport.

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