Post Office Wizards

Secrets of the Dollis Hill Research Station

By Edwin Haydon

A HEADLESS postman, dressed in regulation trousers and raincoat, is walking hundreds of miles a day at the Post Office Engineering Research Laboratory at Dollis Hill, to the north of London. His job is to discover how long different kinds of waterproof will last under the constant friction of the postman's bag rubbing against the side of his raincoat as he walks. This postman is just one of many ingenious devices invented by experts at the Postal Research Station, which was built at a cost of £100,000. It covers an area of eight acres, houses electrical and other apparatus to the value of £150,000, and was opened by Mr. Ramsay MacDonald, when Prime Minister, in the autumn of 1933.

The Post Office scientists—whose motto—"Research is the Door to To-morrow"—is inscribed over the entrance porch—have more than earned their keep and have completely justified the initial capital outlay. For not only have they improved the Post Office services, but also they have saved the organisation many thousands of pounds. For example, inside a telephone exchange are millions of tiny metal strips fitted with minute domes. On their efficiency much depends, and they must be made of the right kind of metal. At one time platinum was used for the contact. This meant spending about £3,000 in an exchange on contacts alone; and the experts at Dollis Hill wondered whether silver could be used instead. They found that it could, with the result that two noughts have been knocked off the foregoing figure, and a substantial saving has been effected in annual expenditure—thanks to the 400 technicians, chemists, engineers and physicists, who daily dream of and work for the perfect telephone, the perfect exchange, the perfect stamp, the perfect cable and perfect radio transmission.

Every week of the year 500,000 people in London and the provinces dial TIM for the right time. Since the Post Office scientists evolved this mechanical marvel and the service started, 42,726,287 people have telephoned TIM in London alone. How does TIM work? What is the fascinating secret of the mechanism that can tell 188 of you the time simultaneously?

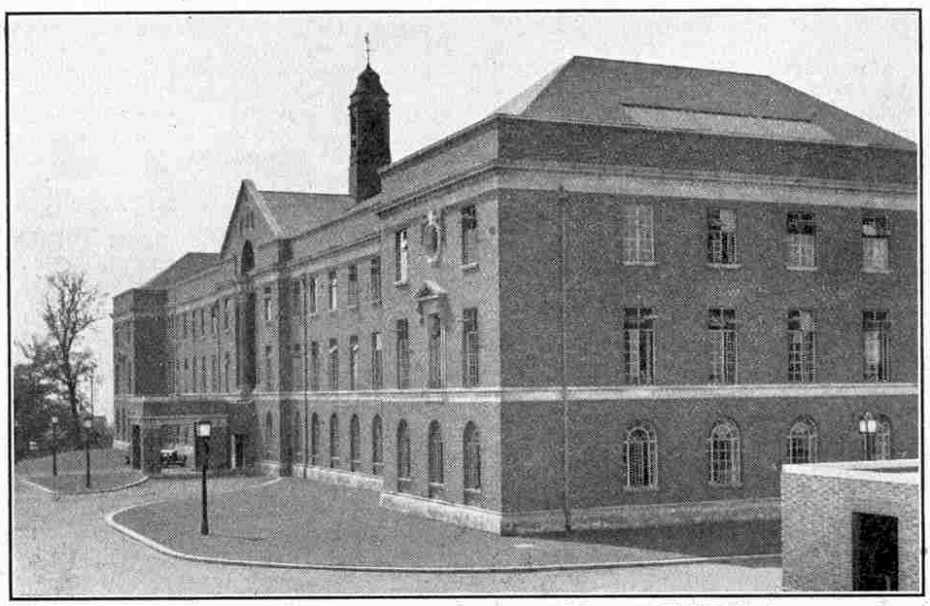
There are four glass records, through each of which is thrown a beam of light. Now the words spoken by the "Girl with the Golden Voice," when she tells you the time, appear on the glass as little black marks. Naturally, these interrupt or cause a break in the light beam before it reaches the photo-electric cell on the other side of the record. The variations the voice marks on the record cause—via the light beam and photo-electric cell—varying electrical impulses, which eventually are translated back into sound.

The experimental model of the talking clock, now known familiarly as TIM.

The principle is similar to the gramophone needle running in the sound track of a wax record. If it were running constantly, as the TIM machine runs, needle and record would wear out; but the beam of light does not wear out TIM'S glass records.

When you ring up TIM in the provinces—say, from Edinburgh, Glasgow, Manchester, Birmingham, Newcastle, Leeds, Bristol and other important centres—your call goes through to London by trunk lines. Yet the call still costs you only one penny—or twopence if you are using a telephone kiosk.

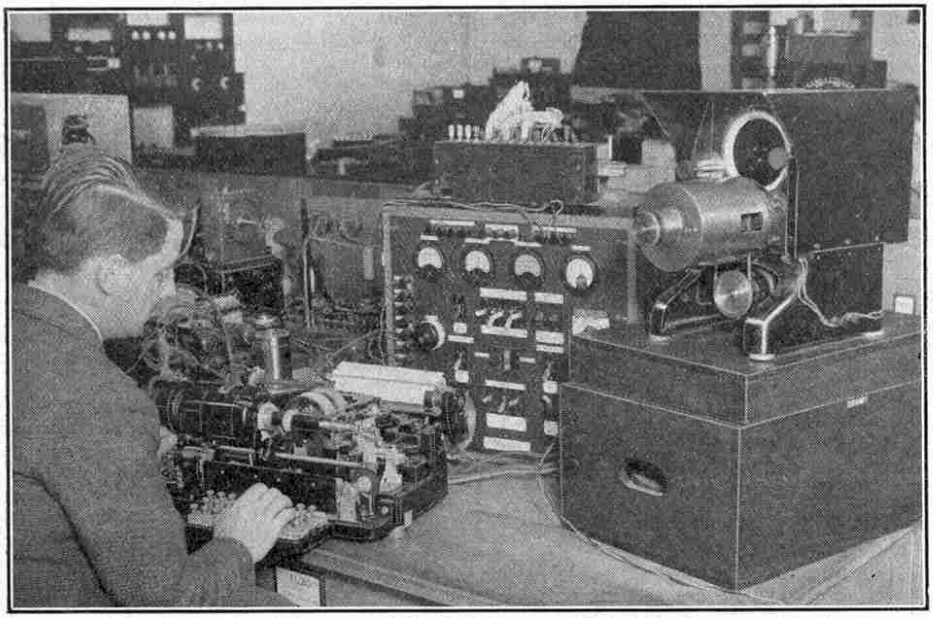
Within the walls of the Postal Research Station actual instruments and the materials from which telephones are made are subjected to exhaustive and rigorous tests. Inside the telephone mouthpiece, for instance, is a microphone, a very delicate instrument which, as you know, transforms sound waves into electric waves. You do not subject it to much strain when you talk into it, but the Dollis Hill experts insist that it shall be proof against even the most irate individual. Therefore, in one of the Dollis Hill laboratories batches of 50 transmitters and receivers are placed on a metal frame. Every minute a voice emanates from



The Engineering Research Station of the General Post Office at Dollis Hill, London.

a transmitter and "talks" a number into the receiver. The voice is produced on the "talkie" principle and is continuous.

For 12 weeks these transmitters and receivers are left to talk numbers unceasingly into each other, and receive numbers 24 hours a day. At the conclusion of this test period the results are examined and noted. In this way it is hoped to arrive at a type of receiver and transmitter that will give the best results and the maximum length of service.



The laboratory in which experiments leading to improvements in telegraphy are carried out.

In another laboratory, the dial you turn with a pencil or your finger when you need a number is "twiddled" by a mechanical finger. This finger falls into each hole in turn, spins the dial, and then lets it unwind again, just as though you were dialling a number. Fifty separate diallings a minute for three weeks is the continuous procedure.

Then there is "Galloping Gus," as this particular piece of test apparatus has been nicknamed by the experts. It is like a miniature roundabout, with telephone earpieces instead of horses. The earpieces hang face downward. Round and round goes the machine. As each receiver passes a certain spot it is automatically lifted an inch or so, and allowed to drop heavily on to a metal base. This rough treatment proceeds unceasingly for weeks, the object being to test the durability of the tiny magnets within. No separate test has been devised for the one-piece instruments that to a large extent have displaced the old-fashioned "candlestick" telephone. It is hardly necessary; if the magnets will stand up to "Galloping Gus" they will stand up to anything.

The Post Office scientists are anxious that not only shall your telephone give long and efficient service, but that it shall be of lasting good appearance. For this reason the action of dust, grit and sunshine on the enamel is noted. The instruments are exposed to fierce sun-ray treatment. A dozen coloured telephones are placed in a box and given a stiff dose of ultra-violet rays to find out just how much the sunlight will cause their colours to fade. Specimen pieces are sprayed also for weeks on end with jets of carborundum dust. Now carborundum dust is the stuff used to grind-in the valves of motor cars; it will wear away solid metal. That gives you some idea of what the enamel on your receiver has to withstand.

A drum with a wire brush coating inside revolves to see how long the bakelite of hand microphones will stand wear and tear.

The pride of the Research Station is the perfect telephone; but, I am afraid, it will never be issued to the public. The small coil that is responsible for the perfection of this instrument weighs practically nothing, but it costs £120. The incidental apparatus for the perfect telephone would fill a garage or an outhouse, so that few people would have the space to spare; while the price is prohibitive.

With the perfect telephone you could speak to someone in Australia and hear every syllable—even the speaker's breath. But the experts converse only from one room to another some 10 yards distant.

The perfect telephone is used at Dollis Hill for testing. Suppose the engineers want to test a new type of switch. They remove the perfect one and insert the one to be tried. If there is any fault at all, they know it must be in the switch, because the rest of the circuit has been proved perfect. Similarly, if they are testing a new telephone, they know that if anything is wrong the wiring cannot be to blame.

The perfect telephone is housed in a sound-proof room, lined with special material to prevent any echoes. Not only is the instrument itself perfect, but so also are the wires and everything connected with the miniature circuit. The reason why the compartment is sound-proof and echo-proof is simply that in an ordinary room all sorts of extraneous noises would go wandering around, complicating matters.

The next link in the chain is the wire that goes from your telephone to the exchange. This wire is tested in a department where they spend all their time trying to break things. Specimen lengths of telephone wire are put into a machine; the machine is switched on, and the wire is subjected to severe strain. It is pulled about in every possible way, to make certain that it is able to stand up to heavy rains and shrieking gales.

Miniature automatic exchanges have been specially designed and constructed at Dollis Hill for country

A telephone demonstration in progress.

districts. Once a fortnight a Post Office engineer visits each robot exchange, but only to switch on the accumulator-charging dynamo. Very large generators and batteries are used, some of the batteries having a capacity of 10,000 ampere hours and weighing 62 tons. Within a few minutes the engineer is on his way; aware that the dynamo will run for a set period and then switch itself off automatically.

The construction park at the Dollis Hill Research Station, where outdoor equipment is tested.

These small country exchanges give the same facilities as the large ones, but there must be no risk of a breakdown in an exchange of this type. Exhaustive tests with a special mechanism take place at Dollis Hill and the apparatus is worked to death, 24 hours a day, until it has dealt smoothly and efficiently with millions of test calls.

All sorts of problems are investigated at Dollis Hill. For example, experts study the mysteries of insulation in a building resembling an architect's crazy dream, and known as "Heinz House" because it has at least 57 different varieties of slates, tiles and wall surfaces. They want to know the effect of wind on telephone wires; the precise stress and strain on a submarine cable in deep water; and, if you are interested in something really technical, "determination of the watt-hour output of cells on light intermittent discharge rates."

The loud-speaker telephone—the latest product of the Dollis Hill Research Station—is about the size of a small biscuit-box, but it dispenses with the need to hold a receiver. Like the radio, you can listen untrammelled, walking up and down if preferred. But, at the same time, you can speak back. In a few years' time it may well displace the present popular one-piece hand microphone.

When complaints were received—particularly from business men—regarding telephone congestion on long-distance lines and the difficulty of obtaining speedy connection, the Post Office scientists set to work to solve this problem. A cable was laid between Bristol and Plymouth, consisting of 19 pairs of conductors, weighing 40 lb. a wire to the mile, and carrying 228 conversations in one direction. A similar cable takes return direction speech. Later cables were 24 pairs, weighing 40 lb., and carrying 228 conversations in "go" and "return" cables. To-day there are cables of this kind operating between London and Birmingham, Birmingham and Manchester, and on to Newcastle.

This miracle has been effected by applying wireless principles to telephone wires. Each voice is given a different wavelength and is "tuned-in" independently of the others. It is like choosing one from 228 different broadcasting stations.

An important telephonic aid to time and travel saving in industry and big business evolved by the Dollis Hill experts is the telephone conference. The conference call came into the news last September when Alexander Korda, sitting in his New York apartment, was connected with his American representative sitting in another New York apartment, Mr. Irving Asher at his home near Windsor, and another executive at Hampstead; and the four had as long and as intelligible a conference as if they had sat round the same table.

By means of another useful time-saving device designed at Dollis Hill for use in busy offices, firms are able to send typewritten letters over the telephone wire. The typist sending the letter gets through to the other end and then presses a key marked "Who are you?" At once the other typewriter automatically sends back its telephone number and the letter begins. As the typist taps out the letter it appears simultaneously on the machine at the other end of the line. In the beginning the Post Office scientists were faced with a ticklish problem; how to let the subscriber know that three minutes were nearly up without interfering with the letter being sent. Of course, they succeeded!

It is possible also to carry on a long conversation in the clearest possible way by means of the teleprinter. "A," instead of talking to "B" over the telephone, types his message, which is received simultaneously by "B." Then "B" types his reply to "A." So the conversation proceeds in print.

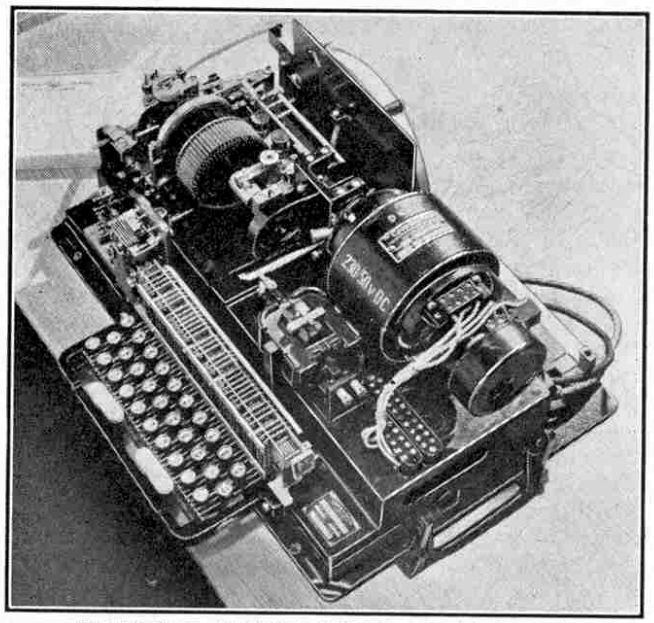
Another important invention sponsored by the Post Office scientists is a potted telephone operator, who can say only two things in loud, ringing tones—"Number engaged," and "Number unobtainable." She says one or the other over and over again at two-second intervals. This invention may replace the system by which two different kinds of buzzes tell you that the number you want is engaged or unobtainable. The necessary speech for this particular robot voice is recorded on a strip of film fastened round a revolving drum. Immediately you dial a line already in use a photo-electric cell sets this miniature "talkie" going.

By means of noise graphs and sound calibrations the Post Office experts can construct a telephone for the deafest person or one suitable for use under ear-splitting conditions.

If you paid a visit to Dollis Hill, you might hear a young man apparently speaking into a telephone in a foreign language. "Ree zer pun im merst!" he might be saying.

And if you asked him what it meant, he would not know! All he would know was that someone at the other end had been listening to him over the wire and writing down the message exactly as he heard it. And if the written words were not the same as those that had been spoken into the instrument, there was something wrong somewhere.

The young tester, you would be told, was trying out a new type of "whisper phone," which picks up quiet voices perfectly. In order to discover whether it transmits them clearly, no real words are employed. They used to have cards of made-up words to read off; but very soon even that strange language was memorised by the listener at the other end, and the test failed. They therefore introduced a machine which, at the turn of a handle, makes up words and (Continued on page 446)



The teleprinter, which types letters over the telephone wire.

New Dinky Toys

Two interesting French aircraft have been added to the Dinky Toys Series as announced on pages iv-v. The excellent model of the Bloch 220 air liner (Dinky Toys No. 64bz) is certain to become popular. This type of air liner is one of the fastest in the world, with a top speed of 220 m.p.h., and it carries 16 passengers and a crew of four. Air France have many of these twin-engined low wing monoplanes in regular service.

The other new machine is an accurate reproduction of the Amiot 370 (Dinky Toys No. 64az) a high wing monoplane developed from the Amiot 340 long-range bomber. It is fitted with two 860 h.p. Hispano-Suiza liquid-cooled engines and is capable of the high maximum speed of 310.5 m.p.h. When flying at 248.4 m.p.h. it has a maximum range of 4,350 miles.

Other interesting additions this month are two models of well-known French motor cars, the Peugeot (Dinky Toys No. 24kz) and the Fiat Two-seater Saloon (Dinky Toys No. 35az). The Peugeot is a 12 h.p. four-door saloon and has a very attractive streamlined appearance, which is enhanced by mounting the headlamps behind the radiator grille. The Fiat two-seater is a sturdy baby car very popular in France, and the Dinky Toys model reproduces its external features very closely.

Work and Play at the Raleigh Factory

The May issue of the "*Raleigh-gram*," a journal devoted to the affairs of the Raleigh Athletic Club, is a special number that gives interesting details of the work and play of the employees of the Raleigh Cycle Company Ltd. In a pictorial tour of the factory at Nottingham every stage of production is followed, from the making of tubes in machines that form them and weld the joint in one operation, to the assembly of complete bicycles. The second part of the issue describes the activities of the Raleigh Athletic Club, which provides opportunities for almost every indoor and outdoor recreation that can be thought of. This section also is well illustrated, and altogether there are nearly 100 pictures of works processes and club activities.

Free Booklet for Photographers

"*Photographs from Exposure to Print*" is the title of a particularly interesting booklet issued by Burroughs Wellcome and Co. In it the various stages in the making of a photograph are explained fully but simply, so that they can be understood by the beginner. There are pages dealing with exposure, development by hand or in a tank, desensitisation, printing with P.O.P., gaslight and bromide papers, enlarging, with effects to be achieved by toning—two charming illustrations from toned prints are shown—and finally with direct colour work. The value of those well-known aids to the amateur photographer, the "Wellcome" Exposure Calculator and "Tabloid" Photographic Chemicals, is amply demonstrated. The cover takes the form of a novel wallet for prints, that will appeal strongly to all young photographers.

Readers of the "*M.M.*" can obtain a copy of the booklet from the publishers, Burroughs Wellcome and Co., Snow Hill Buildings, London E.C.1. The "*M.M.*" should be mentioned in the application.

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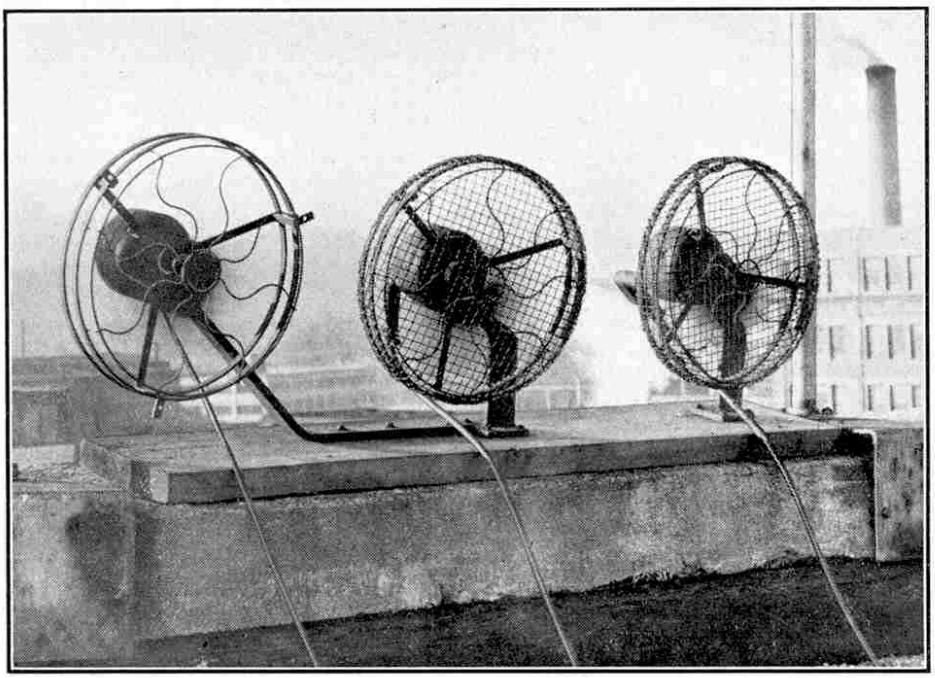
syllables quite by chance.

These Post Office scientists even manufacture their own weather. What effect, for instance, has fog on metals used for outdoor constructional work? Specimens are suspended from the roof of immense glass tanks. One is filled with a dilute solution of sulphuric acid spray, of which yellow town fogs mostly consist; the other with clammy sea mist—nothing more astonishing than a solution of common salt. To obtain reliable results by outside exposure of telegraph poles, for example, might take several years. But artificial results, equally reliable, may be obtained in the tanks in a few weeks.

The Post Office scientists can make their own lightning, too! They stage synthetic thunderstorms that assist in the evolution of more efficient devices to protect telegraph poles and overhead wires. With their "storm machine," a fantastic-looking affair of shining copper and nickel-plated brass balls, they unloose 250,000-volt "lightning flashes" on model telegraph poles. Then they gather up the fragments and find out how it all happened.

Several safety-first devices have been invented by the Dollis Hill experts. One gadget evolved has been installed in cable tunnels. It detects the presence of harmful gases, lights up a warning lamp on the exchange switchboard, and automatically starts an electric fan to clear the tunnel.

If you were a manufacturer of electric light bulbs, and you wanted to sell a quantity to the Post Office, you would be requested to submit samples to the Dollis Hill wizards to be tested. Two bulbs are first plugged on to a bar that moves swiftly backward and forward at such speed that the filaments are a mere blur. That is a vibration test. Then each test bulb is plugged into another machine, and a heavy metal bar is pulled out on a pivot and released. It swings back and hits the holder of the bulb very hard. If the light remains, the bulb is passed.



Weatherproof transformer fans left to run to destruction on the roof of a laboratory at Pittsfield, in the United States. The one on the left has already run for over nine years, and the other two for eight years. Photograph by courtesy of the General Electric Company of New York.

Once Upon a Time there were Three Fans

Once upon a time, without a chance in the world of coming through intact, three transformer fans were left to run to destruction on the roof of a laboratory building in the Pittsfield (Mass.) Works of the General Electric Company. For more than nine years, day and night, summer and winter, with temperatures ranging from a shivering –40 to a sweltering 115 F, these poor little waifs have fought their losing battle. The tragic fact is that, no matter how valiantly they wage their battle against time and the elements they will be vanquished. They are to be sacrificed to research, so that somebody will know more about transformer fans. They are to be run until they wear out, if it takes till doomsday and all the electricity in Massachusetts.

The fans are designed primarily for cooling outdoor oil-insulated power transformers. One of them, after just a paltry nine years' continual striving, raised the white flag for a moment recently. The insulation of the incoming cable, also exposed to the weather, had cracked, and the resulting short circuit had stopped the fan. But G-E engineers replaced the cable, disassembled the unit, greased it, reassembled, and placed it under test again. "That's not destruction" they said. "It isn't even ten years yet! We're going to run these babies until they wear out, not just faint for a minute."

Very discouraged about the whole thing, the three little fans wish nobody had ever thought about improving power transformers!

Purely by way of statistics, each of the fans has worked up some pretty good sized numbers. Revolving at a rate of 1,500 r.p.m., each motor's armature has rotated more than 7,500,000,000 times. Further, each set of fan blades has an output of 1,600 cu. ft. of air per minute, and over the portion of the test period that has elapsed to date this air totals at least 562,500,000 lb.

Looking Through Motor Tyres

An American tyre company has introduced a device to enable owners of motor cars to look through their tyres in order to detect hidden dangers. The tyre has not to be removed from its wheel for this test. Instead the wheel is lifted a few inches and X-ray apparatus is rolled under it. Then the wheel is rotated and inspection of an X-ray picture of the tyre thrown on a screen shows where foreign objects have lodged in the rubber. Tests with this X-ray apparatus on 2,000 worn tyres showed the presence of more than 2,000 nails and tacks, with equal numbers of pieces of glass and fragments of stone embedded in the treads.