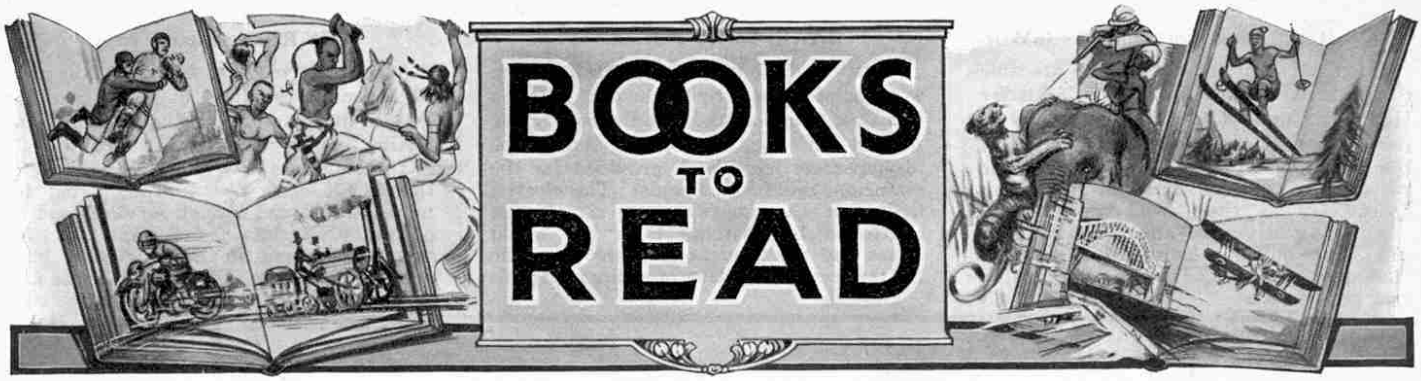


On these pages we review books that are both of interest and of use to readers of the "M.M." We have made arrangements to supply copies of any of these books where readers find difficulty in obtaining them through the usual channels.

Orders should be addressed to the Book Dept., Meccano Limited, Old Swan, Liverpool, and 1/- should be added to the published price of the book to cover the cost of postage. The balance remaining will be refunded when the book is sent, as postages on different books vary according to the weight and destination.

"Aeroplanes, Seaplanes, and Aero-Engines"

By Captain P. H. Sumner
(Published by Crosby Lockwood & Son. 25/-)

This volume, by a late staff-officer of the Air Ministry, is one of the "Science of Flight" series and it is uniform with the volume on "Airships and Kite Balloons" that was reviewed in our issue of October 1926. In this book, abstruse formula is avoided as far as possible in the text, and it has been the author's endeavour to combine the scientific aspect with that of practical flight. As the author points out, the mastery of the air places another aspect on the life and being of a nation. There arises now the necessity of an air sense behind the nation, in the same way as the sea and seamanship called the youth of this country in former days. There are to-day many opportunities for learning to fly and obtaining that air sense and mental alertness so necessary to control stability in flight.

Captain Sumner tells us in his Preface that one of the earliest records of attempted flight is that of an English monk, Oliver of Malmesbury who, in 1065, equipped himself with imitation wings and jumping from a high tower was severely injured. The development of flight was slow, and little progress was made until the 19th century, but the advance during the last 25 years has been extraordinarily rapid.

The historical side of the subject, however, is not dealt with in this volume, which is devoted solely to the practical application of science of flight. It includes chapters on such fundamental subjects as:—aerodynamics; the air-screw; the engine; types of aero-engines; general design and construction of aircraft; rigging and truing up of aircraft; types and performances of aeroplanes and seaplanes; and finally aeronautical instruments.

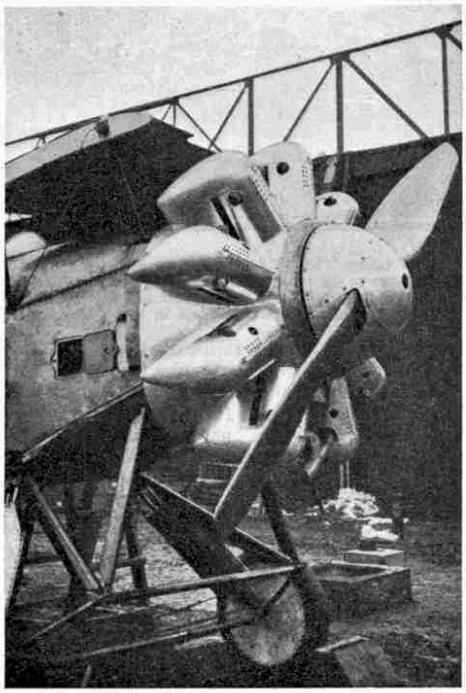
To those contemplating entering the Flying Services, the book will be of the greatest technical value.

* * * *

"Pioneers of Plant Study"

By Ellison Hawks. (Published by Sheldon Press. 12/6)

The beginning of things is always interesting but often difficult to trace. The course of a river may be accurately charted if we will but travel its length, but the way of the stream of knowledge in many commonly accepted things is not so easy. Therefore a patient, painstaking and accurate book on the history of plant study is a difficult task, and in this new book the author has given us of his best. I am told that the volume required seven years to write—it was commenced before the War—and the exhaustive index alone took six weeks to compile! Readers of the "*M.M.*" have wide interests and many among them will appreciate this book, in which the author has consummated the patient work of the late Professor G. S. Boulger, who as a botanist



Special helmet-cowling, covering the cylinders of a radial air-cooled engine

(This and the two illustrations on the next page are from "The Science of Flight—Aeroplanes, Seaplanes and Aero-Engines" reviewed on this page)

was well known to all students.

We are told of the plants of Ancient Egypt and learn that the plants of "there and then" are much the same as these "here and now," and fruits, flowers and seeds delighted taste and sight at the beginning of history as at the present day. The men who built the Pyramids possibly had salads at meal times just as do many wise engineers to-day! Weeds, too, worried gardeners in Egypt as they do now in England, and even the dodder flourished!

It is wonderful to think that the Chaldeans probably introduced to the Egyptians such plants as wheat, barley, and flax. The chapter on the plants of Assyria and China takes us back with ever-growing interest to days in the dim past. In every Chinese chemist's shop there is to-day an image of Chin-nung, who is said to have discovered seventy poisons and their seventy antidotes in one day. This interesting gentleman is said to have had a glass front fitted to his stomach so that he could observe the processes of digestion! His pharmacopœia (a standard in China) was not published until 4,300 years later—surely a record delay and enough to make any author impatient!

The plants of the Old Testament are very interesting to all Bible students, as is the story of Botany revealed in Phœnician commerce and Greek myth. Many of the great writers of the world successively show their knowledge of plant life and their interest in gardens. The father of Medicine was Hippocrates, of whose work there is here a fascinating summary, while Aristotle, whose studies in plant life are remarkable, is here spoken of as the father of Natural History. The names and records of great students of Nature follow in rapid succession—Pliny, Dioscorides, and Arab physicians mingle with a Frankish emperor, Marco Polo and Christopher Columbus, as scene after scene in the drama of plant study is shown

From the New World men brought maize, cotton, cacao, tomatoes, haricots, bananas, potatoes and tobacco, and showed for the first time the passion flower with all its symbolism. History tells of larger knowledge and workers everywhere welcoming new facts when Turner issued in London his famous "*Herball.*"

So the story is told, as history must always be told, in terms of its great men. They were all pioneers in this great field, and the pageant of these worthies becomes the history of plant study. We commend the book—a mine of information and learning—to all thoughtful readers.

REV. J. H. MARTIN.

* * * *

"The 'King' of Railway Locomotives"

By W. G. Chapman (G.W.R. 1/-)

This book is a welcome addition to the excellent series of railway handbooks "for boys of all ages," published by the Great Western Railway. It resembles its predecessors in being of a size convenient for the pocket, and will be found an ideal companion for a long railway journey.

The book commemorates the introduction of the "King" class of G.W.R. engine, with special reference to "*King George V,*" the first of this class. Four chapters are devoted to a detailed account of the ancestry of the "Kings," and contain some very interesting references to the early G.W.R. engines. Subsequent chapters deal in a fascinating manner

with the building of the "Kings" and the outstanding features of this new class of locomotives. The historic visit of "*King George V*" to the Baltimore and Ohio Railroad Centenary Exhibition in 1926 is described, and the book concludes with an excellent description of a trip on the footplate of this famous engine.

The illustrations are very numerous and, especially those showing "Kings" in the making, are of unusual interest. Another valuable feature is the coloured frontispiece which shows "*King George V*" in his handsome livery.

This splendid little book may be obtained at any G.W.R. station bookstall, or direct from the Great Western Railway, General Manager's Office, Paddington Station, London.

* * *

"Stamp Collecting and How to Enjoy It"

By Stanley Phillips
(Published by Stanley Gibbons Ltd. 2/6)

This little book is written not only to interest those who are already collectors, but to interest also those who do not collect stamps.

As the author points out in his Foreword, present-day collectors have a tendency to run in narrow grooves. Each collector maps out his own path and keeps closely to it, with little knowledge of the other sides of the fascinating hobby. Often he has too little sympathy with those who are following other paths from which they derive equal pleasure. Such narrowness cannot be good for the individual and so Mr. Phillips has written this book in the hope that it may offer a wider vision of the hobby, or help in the choice of other paths if interest in a selected field is waning.

There are many illustrations throughout the book and the chapters include Postage Stamps as National Symbols; Stamps as connected with History, Religion and Charity. Postage Stamps and the Arts, Science, Invention and Engineering, Heraldry in the Stamp Album, etc.

In the chapter "Yarns from the Stamp Album" are many interesting facts, including the statement that Queen Victoria was very wrath about the portrait of Baden-Powell being shown on the Mafeking Seige Stamps. We are told also that there are many stamps that for one reason or another have never been on sale. A sixpenny stamp issued in Jamaica, showed the historic scene of the granting of freedom of the slaves in the island. Owing to political conditions in the island it was considered inadvisable to issue the stamp, and the whole stock was destroyed. In the same way, stocks of twopenny stamps bearing a portrait of King Edward, which was in preparation for issue in Great Britain at the time of his death, were destroyed.

Mr. Phillips' treatment of his subject and our own policy in the selection of our stamp articles are so closely in sympathy that we recommend this book to every reader, and particularly to those who have yet to sample the fascination of stamp collecting.

"Gilbert White"

By W. Johnson. (Published by John Murray. 15/-)

"White's Selborne for Boys and Girls"

Edited by Marcus Woodward
(Published by Blackwell, Oxford. 7/6)

Gilbert White, who was born at Selborne, Hants., on the 18th July, 1720, and died there 73 years later, was an explorer of note in the great realm of Nature. He passed through Oxford, where he was a fellow of Oriel College, and then obtained the curacy of Swarraton at a salary of £20 a year. Later, he became curate at Selborne, his birthplace, and he settled here in 1751.

In the surrounding district he had plenty of opportunities of studying Nature. Birds, flowers and rocks were his chief delight, and his patient and persistent search for first-hand knowledge of the mysteries of Nature brought him world-wide fame. "It is, I find," he wrote, "in Zoology as in Botany—all Nature is so full that that district produces the greatest variety which is the most examined."

Perhaps his most famous work was the "Natural History and Antiquities of Selborne," which is one of the most charming books in English literature.

White's life was placid and happy, and although he was a bachelor he had many family ties. He was delightfully modest, as is evidenced on one occasion when he mentions in his "Natural History" that two authorities—one of them the great Linnaeus himself—had described the water-rat as being web-footed on its hind feet. White asserted that if Linnaeus was right then he (White) had discovered a new water-rat, for these creatures in the district around Selborne were certainly not web-footed.

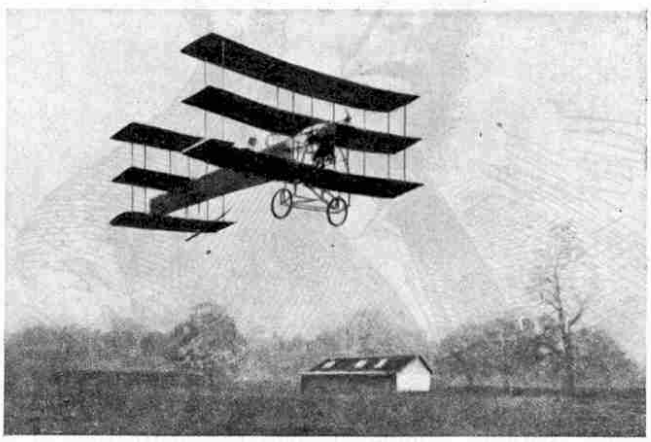
Although the study of birds and flowers were perhaps White's chief delight, he was interested in a multitude of other subjects. He was probably the first man to discover and describe the harvest mouse, and he spent much time in studying bats, one of which he tamed so that it would take flies out of his hand. He studied the little creature for hours on end and was rewarded by discovering many peculiarities previously unrecorded. One of the things he found was the fact that contrary to the general belief of the day, the bat can rise from a flat surface.

In his book Mr. Johnson not only shows us the extent of White's discoveries but, what is equally interesting, he tells us how near he came to discovering many things that since his day have been revealed by other workers in the same field. It is a remarkable fact that the observations recorded by Gilbert White, and the conclusions he arrived at, have emerged triumphant from the thorough tests and close scrutiny that they have been called upon to bear from those who lived after him. The book is a valuable addition to the library of all Nature students in general, and to those who hold in reverence the work of Gilbert White in particular.

It is interesting to note that a new edition of White's "Selborne," specially edited for boys and girls, has recently been published. This book, which is full of first-hand information concerning the wild life of England, has justly been numbered among the "hundred best books." First published in 1789, it has passed through more than 150 editions.

In the present edition the original text has been closely followed, but has been simplified and modern names—both popular and scientific—have been supplied in place of the ancient ones used in the original work. Many notes have been added to explain every difficult point and extra details are given about nearly all the observations. With these notes the book becomes a comprehensive natural history, not only of Selborne but of the whole English countryside. There are eight fine colour plates and numbers of figures in the text, and at the end of the book is a naturalist's calendar. A fine present for any nature student to whose library shelf it will be a treasured addition.

Orville Wright soaring and balancing a glider in an up-current **(see previous page)**

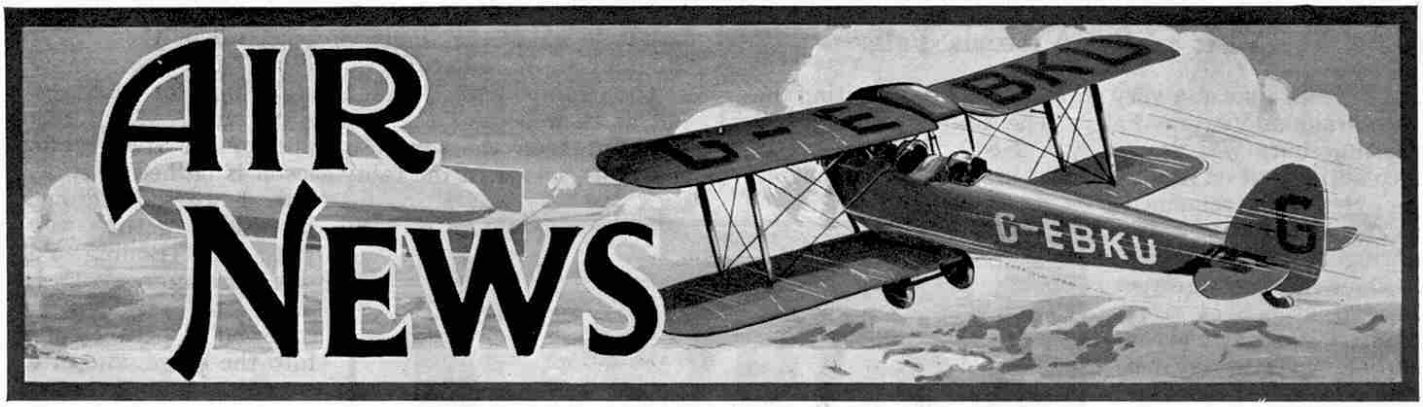


A. V. Roe on his first machine, constructed and flown in England **(see previous page)**

Two Interesting New Books

"Telegraphy and Telephony"
by Archibald Williams.
(Thos. Nelson & Sons Ltd. 10/6)

"The Golden Age"
by K. Grahame.
(John Lane, The Bodley Head Ltd. 7/6)



Pick-up Apparatus for Air Mails

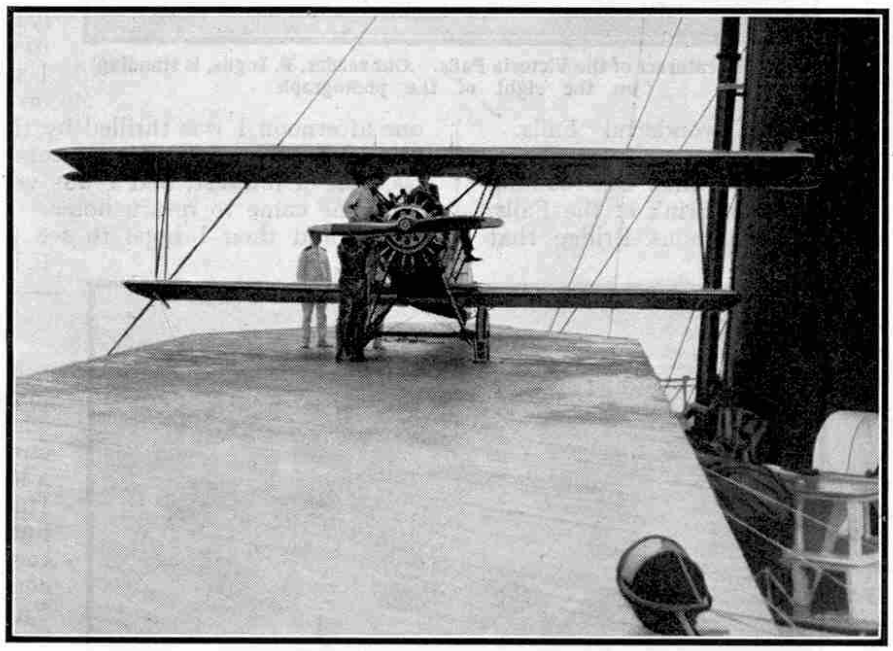
An apparatus by means of which an aeroplane may either pick up or deliver mail bags and articles of a similar nature has been subjected to a series of experiments in America. The tests have proved remarkably successful, for the device never once failed to operate perfectly.

The apparatus consists of a trap that resembles the bow section of a boat, the wide end of which has been left open. The deck is made in two sections which slope downward toward the centre line and are separated by a narrow slot. A pilot who wishes to pick up a mail bag lowers a steel cable, to the end of which a heavy ball of the same metal is attached, and flies low over the chute in such a manner that the steel ball enters the open end. The cable automatically finds its way into the slot between the two halves of the deck and the further flight of the machine drags the ball to the apex of the trap. There it engages a coupling arrangement, which is lifted out of the slot by the cable as the aeroplane continues on its course.

Attached to the coupling is a mail bag. A sudden jerk when the cable took the weight of this would make the aeroplane difficult to control, and therefore a catapult is incorporated in the device. This shoots the mail bag forward into the air at the moment when the coupling is lifted, with the result that the strain is applied gradually. The pick-up is built on a turntable in order that the aeroplane may fly into the wind while approaching the device.

The cable is raised and lowered by means of an electrically-operated reel that hauls up a heavy mail bag with great speed. If the steel ball were to become jammed while the device was in action, the result would be disastrous to the aeroplane. In order to avoid this an automatic release is fixed, the use of which ensures that the cable is pulled loose from the machine before it is possible for any damage to be done.

The chute is ingeniously arranged so that one lot of mails may be delivered and another lot picked up in the same operation. When this is to be done the mail bag for delivery is carried into the chute at the end of the cable, along with the steel ball. The coupling unit then releases the bag as the ball enters it. Provided this pick-up apparatus proves sufficiently reliable for every-day use, it should play a prominent part in the development of air mail services. Many more trials will be necessary, however, before a final decision can be made.



Clarence Chamberlin, the famous Trans-atlantic pilot, entering his machine on the deck of the U.S. liner "Leviathan" prior to a successful pioneer effort in ship-to-shore mail-carrying

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Aerial Tour of 3,000 Miles in Seven Days

The Queensland and Northern Territories Aerial Service have completed the longest and most important tour yet organised by them, in conveying Air-Marshal Sir John Salmond, on a seven days' aerial tour of over 3,000 miles. Special arrangements were made for petrol and oil supplies in Central Australia, and some idea of the isolation of certain points at which petrol had to be provided, may be gained from the fact that at one point the price charged for petrol was 7/4 per gallon!

The machine used for the tour was a Bristol "Jupiter" D.H. 50, capable of a cruising speed of 105 m.p.h. This type of aeroplane forms an ideal taxi machine, its cabin seating four passengers comfortably.

The Karachi Airship Shed

The new airship shed at Cardington, an illustration of which was published in these pages in January last, is the largest airship shed in England, and is wide and high enough to house either the London Olympia, the main building of the Crystal Palace or the Nelson Monument. In spite of its vast size, however, this shed is eclipsed by one that has recently been constructed at Karachi. This is claimed to be the largest single building in the world, and it would be capable, with very little modification, of housing the whole of St. Pancras Station, which is the largest station in the United Kingdom, under a single span.

The shed, which was built by the Armstrong Construction Company Limited of London, is situated about 13 miles east of Karachi. It measures 890 ft. in length, 230 ft. in breadth and 200 ft. in height. It is constructed entirely of steel, and in such a manner that, if the necessity ever arises, it may be dismantled and re-erected at some other place in a very short time. It lies in an approximately due east-to-west position. The east end has two sliding doors each 171 ft. in height and 91 ft. in width, and the west end is faced with a blank wall.

* * * *

Lady Bailey's 18,000-Mile Solo Flight

Lady Bailey recently completed a remarkable 18,000-mile solo flight from London to Cape Town and back. The trip was made in her own de Havilland "Moth," fitted with a Cirrus engine developing a maximum of only 30 h.p. Lady Bailey is thus not only the first woman to accomplish this journey by air from London to Cape Town and back, but has the distinction of having made the longest solo flight on record.

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The International Aeronautical Federation have awarded the Gold Medal for the finest air exploit in 1928 to Sqdn.-Ldr. Hinkler, for his England–Australia flight in an Avro "Avian."

The Blackburn " Bluebird " Mark IV

The Blackburn " Bluebird " Mark IV, which is the latest product of the Blackburn Aeroplane and Motor Company Ltd., promises to prove an extremely useful and popular machine. It is of the all-metal construction type, fitted with side-by-side seating arrangements to accommodate two people, and it is confidently expected that its maximum speed will considerably exceed 100 m.p.h. It will be available either as a land machine or as a seaplane, and a choice of three engines will be available—the de Havilland " Gipsy," the A.D.C. " Cirrus III " and the Armstrong-Siddeley " Genet." The design follows in general that of the earlier wooden construction type. According to a description of the machine that appeared in " *Flight*," " forms of metal construction have been evolved which are so amazingly simple as to remind one irresistibly of the well-known Meccano ! "

The " Bluebird " has a wing span of 30 ft. and a total wing surface area of 246 sq. ft. The total length of the machine from end-to-end is 23 ft.

Performance details of this interesting machine are not yet available but we shall publish photographs and further particulars at the earliest possible moment.

* * * *

Interesting Features of New British Air Liners

The three new Armstrong Siddeley Argosy air liners now being built at Coventry for Imperial Airways Limited, will be equipped with an interesting type of servo lateral control which when combined with the anti-stalling automatic slots will make the machines still safer and easier to fly. The new liners will be fitted with more powerful Jaguar engines of the geared type and as the propellers turn slower in consequence and are situated farther away from the cabin their noise will be less noticeable. An improved arrangement of exhaust pipe will also decrease the noise, while the comfort of passengers has been further studied by the perfection of a new type of ventilating system and a very attractive interior colour scheme designed by a well-known artist.

The effect of various improvements in design has been to increase the cruising speed from 90 to nearly 100 m.p.h. The radius of action has also been increased from 350 to 500 miles owing to the larger supply of petrol carried. If more attention was paid to streamlining on these large machines it is very probable that an extra 60 m.p.h. could be achieved with a similar engine to the one being used at present.

R.A.F. Apprentice Clerks

The Air Ministry announce that 60 vacancies exist in the Royal Air Force for well-educated boys between the ages of 15½ and 17 to enter as apprentice clerks. Approximately 30 of the positions will be filled by means of an open competition that will be held by the Civil Service Commissioners in April at various centres, and the remaining 30 by direct entry of boys who have obtained an approved school certificate. Successful candidates will be required to complete a period of 12 years' regular Air Force service after reaching the age of 18, in addition to the training period. At the age of 30 they may return to civil life or may be permitted to re-engage to complete time for pension.

Boys entered under this scheme undergo a two years' course of training in clerical duties, during which time their general education is continued under graduate teachers.

The apprentice clerks are paid 1/– a day for the first year, and 1/6 a day afterwards until they have both attained the age of 18 and been posted for duty after passing their final examination. The subsequent commencing rates of pay, varying from 3/– to 4/6 a day, depend upon the degree of success achieved at this examination. In addition they receive free board and lodging.

Detailed information regarding this scheme may be obtained from the Royal Air Force, Gwydyr House, Whitehall, London, S.W. 1.

Courtesy] [*Imperial Airways, Ltd.*

The Air Port of London, after its extensive reconstruction, is the most efficiently equipped and most up-to-date aerodrome in the world. Our illustration shows a section of the new buildings photographed from the air, and in the foreground will be seen two of the giant air liners used on the London-Paris air service

Short Service Officers for R.A.F.

The Air Ministry announce that about 100 officers will be required by the Royal Air Force for flying duties during the next few months under the short service commissions scheme. Applications are invited from well-educated young men of sound physique and between the ages of 18 and 25. From these applicants candidates will be selected to appear for interview at the Air Ministry in London, and if accepted they will be granted short service commissions for five years on the active list and four years on the reserve. During their period of service, short service officers are afforded facilities for study with a view to preparing themselves for civil life, and assistance is given them in finding employment when they pass to the reserve.

Accepted candidates enter as pilot officers on probation with pay of about £273 per year, increased on promotion to flying officer, normally after 18 months' service, to about £343. Officers receive also free quarters, rations, fuel and light, etc., or where these are not available, cash allowances instead amounting at present to about £141 per year. On joining for duty officers with no previous service in H.M. Forces receive an outfit allowance of £50. Gratuities of amounts varying according to length of service are payable on termination of such service.

Application forms and full details may be obtained from the Secretary, Air Ministry, Kingsway, London, W.C.2.

* * * *

Proposed Seaplane Service to Norway

A scheme to establish a regular seaplane service between Harwich and Oslo is under consideration, and if this materialises Harwich will become the first English air-seaport. The scheme provides also for a motor coach service between London and Harwich. The total length of the journey to be covered by seaplanes is approximately 950 miles, and the machines will fly direct from Harwich across the North Sea to Rotterdam, from where they will proceed to Oslo by way of Amsterdam, Hamburg and Copenhagen. It is estimated that the service would enable a passenger to travel from London to Norway in the remarkable time of 9 hours.

* * * *

The United States Army contemplate carrying out a number of improvements, costing approximately £400,000, at their Military Air Port at Wheeler Field, Honolulu. The improvements will mainly consist of the construction of new living quarters for the officers and men stationed there, providing accommodation for an extra 82 officers and 1,082 men.

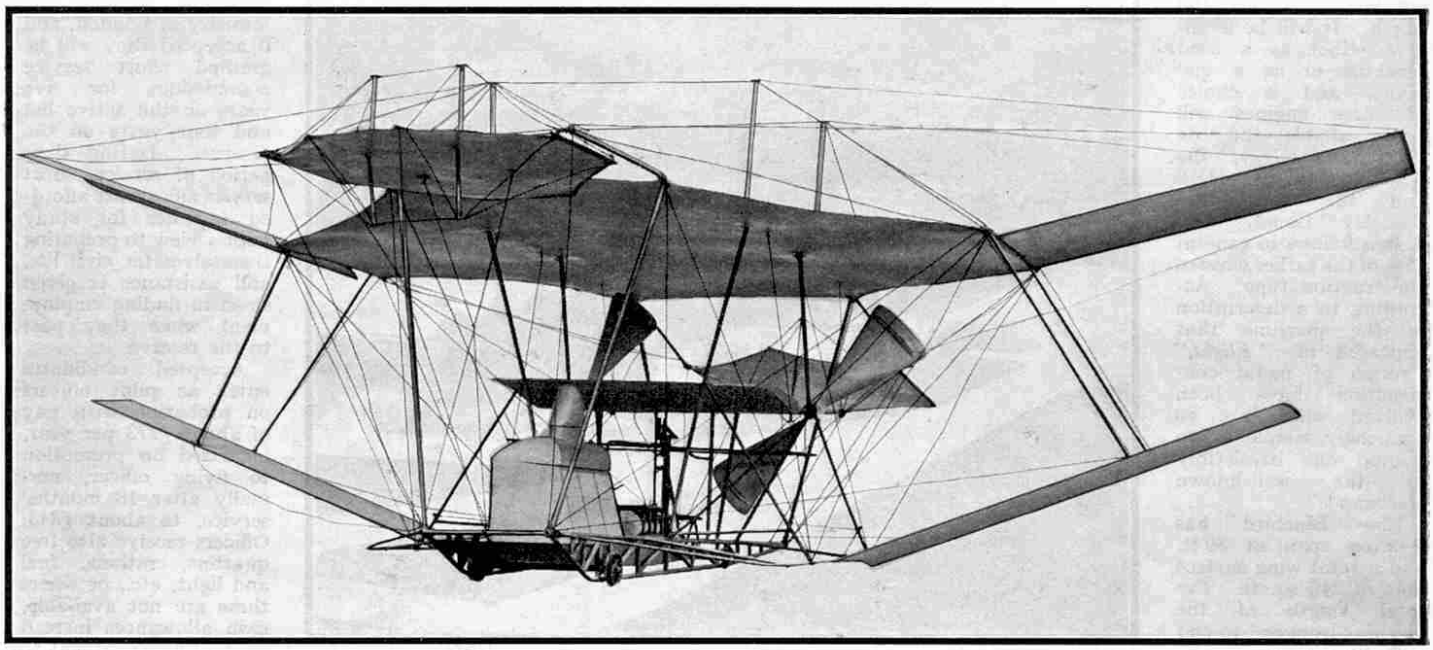
THIS MONTH'S AIR STORY

Lady (inspecting Service machine) : " What do you do if your parachute fails to open when you have jumped from the aeroplane ? "

Flying Officer (very bored) : " Oh ! We just go back and get another one."

The Conquest of the Air

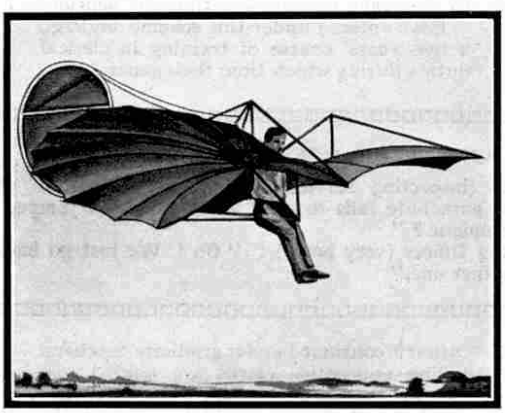
Development of the Aeroplane



Courtesy] [*Board of Education*

The flying machine built by Sir Hiram Maxim in 1894. It is of great historical importance as being the first machine to lift itself, with engine, boiler, fuel and passengers, completely off the ground. It is of interest to compare the massive construction of this monster with that of a light modern machine such as the de Havilland "Moth"

DURING the 19th century it was commonly believed that the problem of flight by means of heavier-than-air machines could only be solved by the creation of some type of huge artificial wings. Inventors studied the movements of large birds in flight and endeavoured to imitate them by means of gliding machines. One of the most thorough investigators of bird flight was Otto Lilienthal of Berlin. After a prolonged study of the subject he constructed a flying machine in 1895. This had a span of 22 ft. and embodied two concave wings arranged horizontally with an aperture between them to accommodate the pilot. Their degree of curvature had been carefully calculated so that they should bear the same relation to the body of the pilot as the wings of a bird do to its body. The wings were made of linen stretched over a willow framework, and had an area of approximately fourteen square yards.



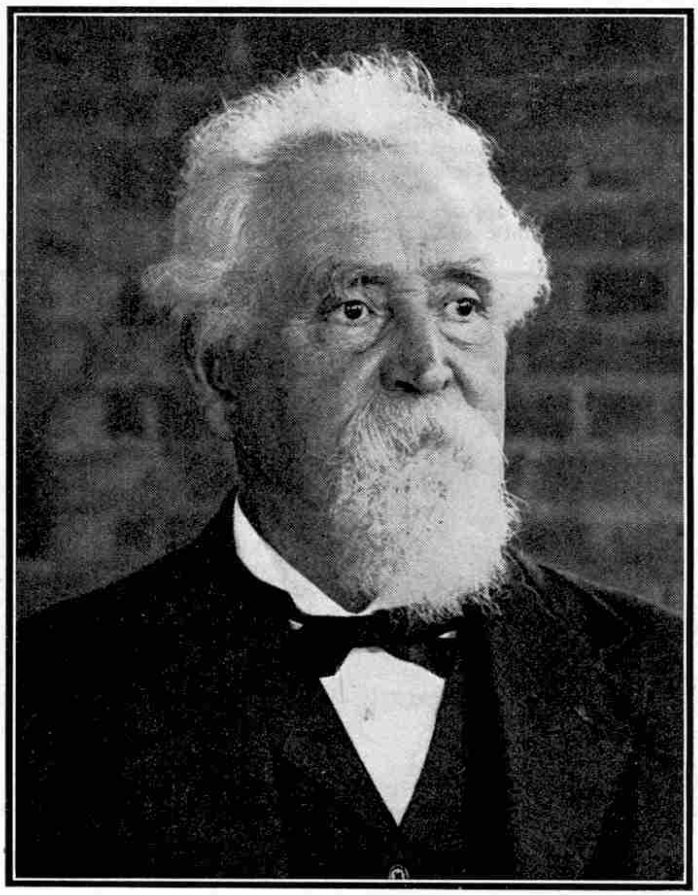
Lilienthal making a flight in his glider

The body of the machine consisted of a circular horizontal hoop of willow, to the left and right of which were the wings, and of two long willow rods one on each side of the hoop. These rods extended in a fore and aft direction and converged to a point some distance to the rear of the wings. The main frame terminated in a tail portion consisting of a small horizontal wing hinged separately to a vertical plane that was attached rigidly to the body of the machine. A main beam or strengthening bar, of X shape, extended from wing to wing across the front of the hoop, while immediately behind the beam was the aperture that accommodated the upper part of the pilot's body. To ease his position two small bolsters were attached one on each side of the hoop to serve as shoulder rests, while rests for his arms were provided in the corners of the main beam.

Lilienthal's machine was of the glider type, and as he was unable to discover a suitable elevated area of land from which to carry out his attempts at flight he built up, near Berlin, a large earthen mound almost 100 ft. in height and conical in shape. In practice, the machine was hauled to the summit of the mound, Lilienthal assumed the pilot's position, and having made himself secure ran downhill against the wind. As he gained speed the upward pressure of the wind on the under side of the wings increased until it overcame the weight of man and machine and Lilienthal was lifted off his feet and carried through the air until the machine lost speed and descended to earth again.

In this manner the glider attained an altitude of 75 ft. and sailed more than 100 yds. in one minute. Lilienthal depended upon his instinct to maintain his equilibrium, and controlled the machine by shifting the position of his body to counteract any deviation from the level position.

Experimental flights were made in the direction of the wind as well as against it, and when backed by the wind the machine travelled much farther before descending to earth. On one of these occasions Lilienthal accomplished an aerial voyage of 400 yd. When flying with the wind he regulated his descent by means of some braking arrangement by which an increased surface of wing could be offered to the air, and the velocity of the machine reduced. Later he fitted a series of feather sails to the extremities of the wings. These sails were connected to a small machine driven by carbonic acid gas and situated adjacent to the pilot's accommodation. The engine, and with it the sails, could be set in motion by the pressure of a finger. He found that the engine greatly increased the weight of the machine, however, and rendered it considerably more difficult to handle.



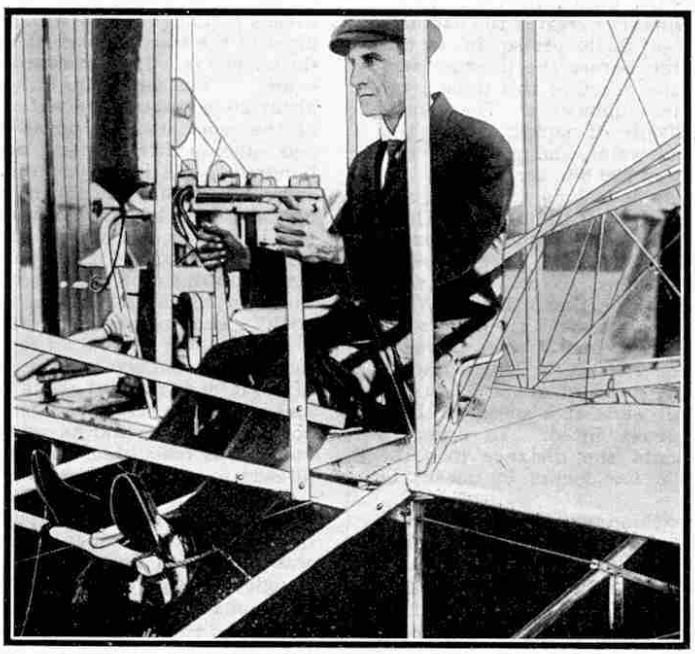
Sir Hiram Maxim

The success that Lilienthal attained with his experiments attracted considerable attention and won him praise and admiration from scientists and aeronauts both in Europe and America, where experimenters soon began to emulate him.

Lilienthal now became desirous of carrying out experiments in winds of such strength as to carry him long distances. For this purpose he constructed a second machine, consisting of two smaller wings placed one above the other, instead of two large wings side by side as in his first machine. He found that with the new glider he could take off from the hilltop in a wind with a velocity of 18 ft. per second without having to make a preliminary run downhill as before.

Sometimes during these flights the machine would remain poised in the air at a higher altitude than that at which it had taken off from the mound. Speaking of these occasions Lilienthal once declared: "I feel very certain if I leaned a little to one side, and so described a circle, and further partook of the motion of the lifting air around me, I should sustain my position. The wind itself tends to direct this motion; but then it must be remembered that my chief object in the air is to overcome this tendency of turning to the left or right, because I know that behind or under me lies the hill from which I have started, and with which I would come in rough contact if I allowed myself to attempt this circle sailing. I have, however, made up my mind, by means of either a stronger wind or by flapping the wings, to get higher up and further away from the hills, so that sailing round in circles, I can follow the strong up-lifting currents and have sufficient air-space under and around me to complete with safety a circle, and lastly, to come up against the wind again to land."

After further experiments Lilienthal considered that he had learnt all that gliding machines could teach him and he turned his attention to perfecting a self-propelled or power-driven flying machine. The internal combustion engine as adapted to motor cycles was at that time just becoming popular, and Lilienthal decided to instal a petrol-driven motor in his next machine. This was completed by August 1896, and on the morning of 9th August that year he indulged in a last flight in his glider before venturing aloft with the power-driven aeroplane. He commenced his flight in the glider from the village of Rhinow, in the province of Bradenburg, and had sailed through the air for a distance of approximately 200 yds. when a sudden gust of wind caught the machine and carried it swiftly upward. Lilienthal failed to maintain control of the wings and the machine crashed to earth from a height of 50 ft. His spine

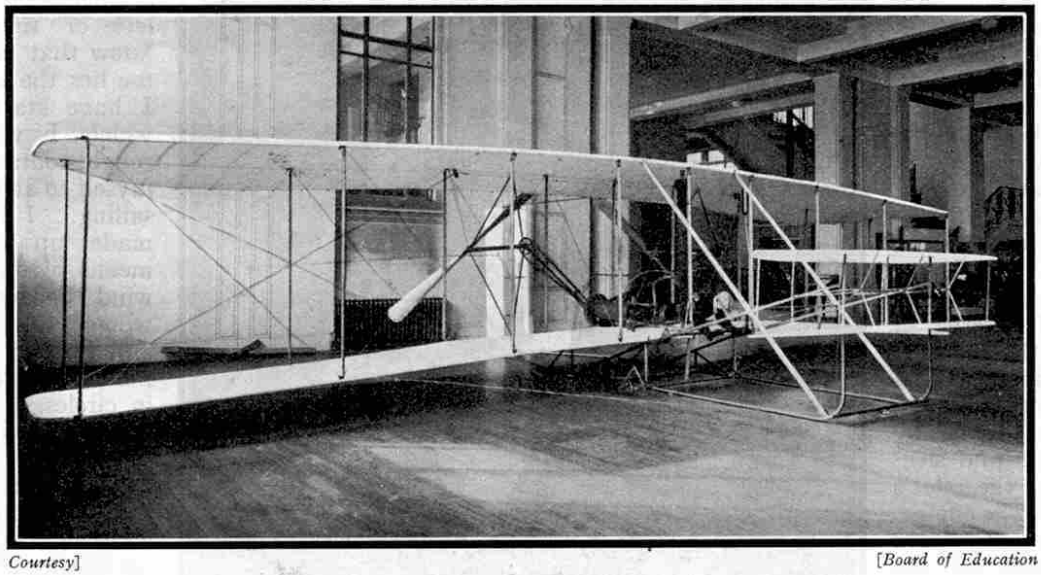


Wilbur Wright in his power-driven aeroplane. The rough-and-ready nature of the fittings and controls is very noticeable

was broken and he lived only for a very short time.

At the period of Lilienthal's early experiments in Germany, Mr. (afterwards Sir) Hiram Maxim was busily engaged in England designing and constructing a mechanically-propelled heavier-than-air machine. Maxim had achieved fame by his invention of a machine gun, as related in the "*M.M.*" of December, 1927, but for many years he had been interested in the problems of aviation. When he had practically retired from active business and had settled at Baldwyn's Park he devoted himself seriously to experiments with lifting surfaces and propellers, and to ascertaining the air resistance of struts of various section. When he had solved these problems to his satisfaction he commenced the construction of a heavier-than-air machine designed according to his theories, and completed the work in 1894.

Maxim's flying machine presented a very striking appearance, bearing considerable resemblance to a kite of gigantic size. It consisted of a braced structure of steel tubes and wires connected to extensive horizontal wings, or planes, having a total surface area of 5,400 sq. ft. The huge central plane had a surface area of 1,400 sq. ft. and a spread of 120 ft., and in addition there were one fore and one aft steering or elevating planes, and at each end of the central wing two extensive side planes inclined upward at an angle of 7.25 degrees. The far-reaching side wings were strongly suggestive of half-raised arms.



Courtesy] [*Board of Education*

The original Wright Biplane, now in the South Kensington Museum

The machinery was carried on a platform suspended in a central position from the principal plane. The 350 h.p. compound steam engine weighed about 600 lb., and by its situation on the platform was roughly 8 ft. above ground. The "Thornycroft" boiler included a multitude of small copper tubes having a total heating surface of 800 sq. ft., and had a capacity of approximately 40 lb. of water. It was heated by a naphtha burner having a flame surface of 30 ft. A naphtha-heated vaporiser created the naphtha gas, which was passed at a pressure of 50 lb. per sq. in. to the burner jets, numbering 7,650. At the burner the pressure was brought down to 1 lb. per sq. in., one effect of this drastic reduction being to draw in air to assist combustion. The plant's capacity was 600 lb. of water and 200 lb. of naphtha, while the total weight of the engine, boiler and water, and generator was 1,200 lb., almost the weight of a modern 700 h.p. aero engine.

The machine possessed two formidable-looking propellers, the blades of which were 5 ft. 2 in. in width and of 16 ft. pitch. These propellers were driven by compound engines with cylinders of 5 in. and 8 in. dia. respectively, by 12 in. stroke. Each propeller had a diameter of 17 ft. 10 in. and weighed 135 lb. They were capable of 375 revs. per min. and exerted together 360 h.p. When started up the propellers were allowed to develop a thrust of some 1,500 lb. before the machine was released and it then travelled along a specially prepared steel track 1,800 ft. in length and of 9 ft. gauge. It was found that at a speed of about 30 m.p.h. the load on the track was very small while at a speed of about 35 m.p.h. the machine was completely lifted. In order to ensure safety during the experiments the distance that the machine could rise was limited to a few inches by means of inverted rails.

On 31st July, 1894, the flying machine was started up for a trip with three people on board, and on being released sped forward somewhat faster than usual. In his account of the subsequent happenings Sir Hiram says: "The machine was lifted clear of the lower rails and all of the top rails were fully engaged on the upper track when about 600 feet had been covered. The speed rapidly increased and when 900 feet had been covered, one of the rear axeltrees, which were of 2-inch steel tubing, doubled up and set the rear end of the machine completely free. . .

"The rear end of the machine, being set free, rose considerably above the track and swayed. At about 1,000 feet the left forward wheel also got clear of the upper track, and shortly afterwards the right forward wheel tore up about 100 ft. of the upper track. Steam was at once shut off, and the machine sank directly to the earth, embedding the wheels in the soft turf without leaving any other marks; showing most conclusively that the machine was completely suspended in the air before it settled to the earth . . ."

This was the first time in history that a flying machine, carrying passengers, engine, boiler, water and fuel, had risen entirely unfettered into the air.

Two years after Maxim's notable experiment, Professor Samuel Pierpoint Langley, of the Smithsonian Institute, Washington, U.S.A., announced that he had constructed a machine that would prove the practicability of mechanical flight. The "Aerodrome," as he called his machine, differed in construction from any previous machine and it might be described as resembling a double monoplane. There were two pairs of wings, one a short distance behind the other, the front wings being slightly larger than the rear ones. A tail portion consisting of an arrangement of vertical and horizontal plane was attached to the rear of the second pair of wings. The machine measured approximately 14 ft. from wing tip to wing tip and had a total weight of about 30 lb. A steam engine of between one and two horse-power was accommodated in the machine body beneath the framework. The body was boat-shaped in order to enable the machine to alight upon or rise from water.

The "Aerodrome" was launched from the roof of a house-boat on the River Potomac on the 6th May, 1896. Among the many friends of Langley who witnessed the launch and the subsequent flight of the machine was Alexander Graham Bell, the inventor of the telephone. Bell afterwards described the event in the following words: "The aerodrome at a given signal started from a platform about 20 feet above the water and rose at first directly in the face of the wind, moving at all times with remarkable steadiness, and subsequently swinging around in large curves of perhaps a hundred yards in diameter and continually ascending until its steam was exhausted. When at the lapse of about a minute and a half and at a height which I judged to be between 80 and 100 feet in the air, the wheels ceased turning, and the machine, deprived of the aid of its propeller, to my surprise did not fall, but settled down so softly and gently that it touched the water without the least shock and was in fact immediately ready for another trial." Langley was very gratified at the success of the experiment.

After a short interval for re-fuelling, the machine again ascended, following a circular course as before. It attained an altitude of 100 ft. and travelled about 1,000 yd. before steam was exhausted and it again gently descended. Of this flight Bell said: "I had occasion to notice that its course took it over a wooded promontory, and I was relieved of some apprehension in seeing that it was already so high as to pass the tree tops by 20 or 30 feet."

The aeroplane accomplished these brief but successful flights without any pilot or other person on board, and the all-important question as to whether a man-carrying power-driven aeroplane was capable of flight still remained unanswered. At this time Langley appears to have felt inclined to leave the solution of the problem to others, for he said: "I have brought to a close the portion of the work which seemed to be peculiarly mine, and for the next stage, which is the commercial and practical development of the idea, it is probable that the world may look to others. The

world, indeed, will be supine if it does not realise that a new possibility has come to it and that the great universal highway overhead is now soon to be opened."

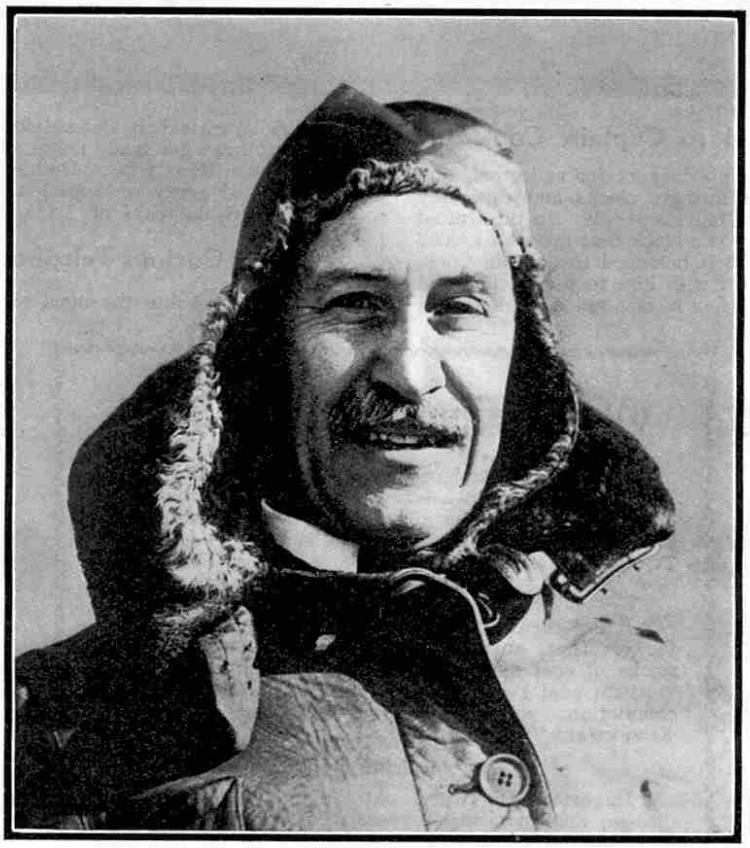
Subsequently, at the request of the American military authorities, Langley continued his experiments, and eventually constructed a full-sized aeroplane similar to the one launched in 1896, but considered capable of carrying a passenger. The launching ceremony was fixed for 8th December, 1903, and on the appointed day a vast crowd of spectators lined the banks of the Potomac River. The machine was hauled to the roof of a house-boat and when all was ready an assistant climbed into it. The starting signal was then given and as the engine began to roar the aeroplane lurched forward. By some means it fouled the launching gear, however, and with a crash fell backward off the roof of the house-boat and into the water. The machine was fished out of the river and again hauled up to the platform. The launching ceremony was then repeated but with precisely the same results as before, and as the aeroplane plunged backward into the river the great crowd jeered loudly. The newspapers reported these mishaps in most contemptuous terms and referred to the machine as "Langley's Folly."

By this time Langley had exhausted his funds and, bitterly disappointed, he was obliged to abandon further experiments. Three years later he was taken seriously ill and died. During his illness he received a copy of a resolution passed by the Aero Club of America expressing "appreciation of his labours as a pioneer in the important and complex science of aerial locomotion." The dying man smiled feebly as the message was read to him, and he requested that it should be made public as a reply to the press that had scorned his experiments.

How near this unfortunate inventor had been to achieving success was demonstrated in 1914 when one of his old pupils took Langley's machine from the United States National Museum at Washington and conveyed it to the River Potomac. After fitting the machine with floats the pilot took his seat and started up the engine. The machine sped across the water for a short distance and then rose into the air. A short flight was made and afterwards a successful descent on to the water was effected. The success of this trip proved that if it had not been for some fault in the launching gear on that fateful day in 1903, the machine would have flown then equally as well as in 1914. Langley would then have been honoured as the inventor of the first man-carrying machine capable of flight, instead of being scorned as a crank.

The first experimenters to achieve a successful flight in a power-driven machine were Wilbur and Orville Wright of Dayton, Ohio, U.S.A. At the time when they became interested in aeronautics, in 1896, they were joint proprietors of a small cycle store in the city. Their interest was aroused by reading of the tragic death of Lilienthal, and they were soon perusing all the books they could obtain dealing with the science of flight, including the works of Lilienthal and Professor Langley. When the brothers considered that they had acquired sufficient knowledge they commenced building and experimenting with model gliders that resembled giant box kites.

Their first small glider was a failure, and it convinced them that much of the information they had studied was incorrect. "It seemed to us," said Wilbur Wright at a later date, "that . . . no-one had been able to obtain any adequate practice. We figured that Lilienthal in five years of time had spent only about five hours in actual gliding. If some method could be found by which it would be possible to practise by the hour instead of by the second there would be hope."



Orville Wright

The Wright brothers then entered upon a thorough investigation of the technical side of the problem. By 1900 they had evolved a satisfactory gliding machine and a full-sized example was constructed. The machine was of the biplane type adopted by Lilienthal in his later experiments and had a total wing surface of 165 sq. ft. It embodied several original features, one of which was that the pilot had to lie flat in order that the minimum of body surface might be exposed to the air. In this position it was difficult for him to move his body about in order to maintain the equilibrium of the machine, and stability was obtained by means of a horizontal rudder in front of the main planes. The most important innovation was the "warping" of the wings in order to maintain the equilibrium of the machine and to prevent side-slipping during turning movements. The warping took place along the rear edge of the wings and was effected by the pilot by means of cords.

The brothers carried out their experiments and tests at Kitty Hawk, an isolated locality on the sandy coast of North Carolina, where they were able to work without exciting curiosity. More than a hundred successful flights, or glides, varying in duration from a few seconds to a minute, were made with their machine during 1900-1. The numerous defects in the first glider were carefully noted and a bigger and better machine having a total wing surface of 308 sq. ft. was built during 1901. For this machine the inventors built a wooden shed, or hangar, at an elevated place known as Kill Devil Hill, about eight miles from Kitty Hawk. Numerous experimental flights were carried out from this hill during 1901-2.

Month after month the Wright brothers experimented with their machines. They were harassed by lack of capital and sometimes funds were very low. Their father was as enthusiastic as themselves in the development of the glider and he readily gave all that he could spare of his limited earnings to help to defray their expenses. Their sister also gave generously of the meagre salary she obtained as a school teacher.

When they had learned all they could of the behaviour and control of gliding machines, the brothers turned their attention to constructing a mechanically-propelled flying machine. By that time the petrol motor had become very popular for automobile use because it combined high power with comparatively low weight, and inventors realised that it was the ideal type of engine for flying machines. The Wright brothers failed to find a suitable petrol motor, however, and they set to work to construct their own, basing its design upon the most approved type of engine then in vogue for motor cycles.

Their first power-driven aeroplane was built in 1903 and in appearance resembled the gliders with which they had experimented. The horizontal front elevator, the vertical steering rudder at the rear of the machine and the warping of the wings were controlled by the movement of levers situated on each side of a seat provided for the pilot centrally in the front of the machine. There was no wheeled under-carriage, but two skids, or runners, were fitted beneath the machine to enable it to make safe landings. There were two large propellers driven at a speed of approximately 500 r.p.m. by a 25 h.p. motor weighing about 250 lb. The propellers were fitted in the rear of the machine and revolved in opposite directions. The absence of an under-carriage necessitated the use of a launching device to start the aeroplane off on a flight. An initial push was all that was needed, however, for the propellers soon took effect.

The machine was tried out on 17th December, 1903. The inventors issued many invitations to witness the flight, but owing to the coldness of the day only five people,

(Continued on page 261

Loading a Ton of Coal per Second

(*Continued from page 187*)

belt while the main belt runs faster than the feeders so that there is never any danger of flooding either the main or the shuttle belts. The master control of the whole pier is located in the Superintendent's office.

Each of the four loading piers is equipped with a Lane-Galloway mechanical trimming machine. This machine eliminates completely the necessity for manual labour in connection with the loading of coal into vessels and has very considerably increased the operating efficiency of the pier.

In order to maintain the pier's operation in wintry weather, thawing sheds were built to cover the tracks leading to the car dumpers. These sheds have a capacity of 22 cars and a temperature of 180 degrees applied for 30 minutes thaws the coal sufficiently to allow it to free itself.

As stated in the second paragraph, the Curtis Bay Coal Pier periodically sets up a new record for the fast loading of coal into vessels. The present record in this respect was achieved on 13th April, 1926, when, by means of the plant, the S.S. "*Lemuel Burrows*," was loaded with 11,353 tons of coal in 3 hrs. 1 min.—an average of 3,763 tons per hour, or just over one ton per second! The record for volume of traffic handled at the pier during one week was set up in 1920 when the total of 182,000 tons of coal was attained by the close of the first week in November. These figures convey some idea of the immense capabilities of the plant.

The machines have been in constant use since they were erected 12 years ago and to-day they are as efficient as when first operated. Their great strength is further demonstrated by the way in which they successfully cope with any foreign material that accidentally enters the chute with the coal. Sometimes these undesirable objects are of such size and shape as to test severely the power of the plant. On one occasion a piece of iron, 3 ft. in length by 2 ft. in width, and about 500 lb. in weight, passed through the machines without causing any damage. In two other instances, large pieces of stone weighing 500 lb. and 600 lb. respectively, passed in with the coal and were delivered without any injury to the plant.

Meccano Planimeter

—(*continued from page 225*)

centre line.

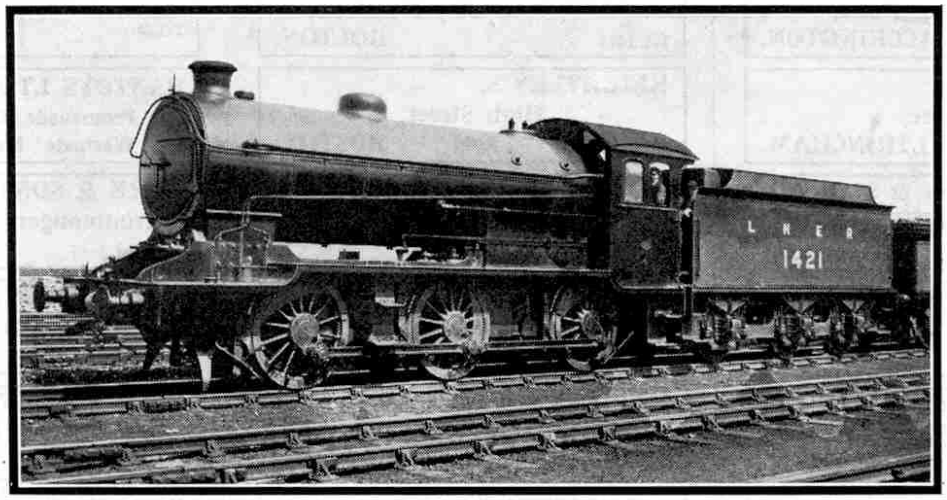
As already explained, the tracer 8 must be run round the perimeter of the figure and the number of divisions noted on the Flanged Wheel. The latter should be at zero to start with, of course.

It is impossible in this article to give the correct calibrations of the dial so that areas may be read off from it direct, for any particular machine will have a different scale as the result of slight variations in the exact relative position of the wheel. Each constructor therefore should calibrate his own instrument. The best way to do this is to draw squares or other simple figures, the areas of which have been calculated previously, so that by comparing the reading on the wheel 6 with each calculated area a table may be prepared, which should be somewhat as follows :—

Area of figure	Reading on Wheel
36 square ins.	4.2
16 square ins.	1.8
9 square ins.	1.
61	7.0

Dividing 61 by 7 we get approximately 8.7, which is the value in square inches of one main division. Each of the subdivisions will have 1/10th of this value, of course, namely .87 square inches. Knowing the values of the scale, it is now a perfectly simple matter to find the area of any figure, however irregular.

To obtain the best results from the instrument, it should be placed on a good smooth surface drawing paper, so that the wheel 6 may roll quite smoothly and easily.



This photograph, by our reader R. D. Stephen, shows a L.N.E.R. 0-6-0 locomotive of the J.38 class. It is No. 1421 and was built in 1926, to the design of Mr. H. N. Gresley, Chief Mechanical Engineer of the L.N.E.R.

Conquest of the Air

—(*continued from page 219*)

including three coastguards from the Kill Devil life-saving station, turned up to witness the event. Both of the brothers were eager to win the distinction of piloting the power-driven machine on its first flight and they settled the matter by tossing a coin. Orville won the toss, and climbing into the pilot's seat he started the engine. With a roar the aeroplane moved slowly forward, Wilbur keeping pace with it until it ascended into the air. The machine rose to an altitude of 120 ft. and remained aloft for only 12 seconds, but it proved that heavier-than-air machines capable of carrying a person on board could be successfully flown.

Three further trips were carried out that day, the last being of 59 seconds duration and covering a distance of 852 ft. All the four flights on 17th December were carried out against a 20 m.p.h. wind, but in every case a safe landing was effected. Shortly after the last flight, and before the aeroplane could be returned to its hangar, a sudden gust of wind overturned it and damaged it seriously.

From 1904 until 1908 the Wright brothers continued to experiment with power-driven machines, continually effecting minor improvements as the need of these became realised. In 1908 they visited France, and this visit and the work of the French airmen with whom they then came in contact will be dealt with in the next article in this series.

Largest Underground Tube Railway Station

(*Cont. from page 223*)

has been adopted at the new station, but the general effect is none the less pleasing and harmonious. The floor of the booking hall is paved with large white tiles, while the ceiling, of white fibrous plaster, is divided into rectangular coffers. Showcases with bronze framework, and frieze and skirting of Travertine marble, are ranged along the boundary walls on the east, west and north, while the telephone cabinets on the south are of polished teak. The booking office, on the west side of the hall, is also of Travertine marble and bronze, while the patent ticket machines that are to be installed later will be encased in similar marble, so that the harmony of the design and colour scheme may be preserved. The walls of the lower hall are faced with silver-gray tiles, while the lighting is by means of concealed lamps. The arches of the escalator tunnels have been decorated in matt white distemper to assist illumination, which is by means of lamps mounted on bronze pedestals, set at intervals along the balustrades.

Automatic ticket machines are an important feature of the new station. For the time being, the standard electric type, delivering pre-printed tickets are being used, but these will be replaced at an early date by a group of A.E.G. special ticket printing and delivering machines. The first batch of machines to be installed will number 26, and will be arranged so that they form portals to the passenger circulating area of the booking hall. They will include two machines for issuing 1d. tickets, two for 1½d., eight each for 2d. and 3d., four for 4d., one for 5d., and one for 6d. Tickets of greater value or of a special character will be obtained at an auxilary booking office, equipped with three A.E.G. ticket printing and issuing machines.

An interesting feature of the booking hall is a set of six train recording clocks. Each of these clocks automatically records the working of the service of one of the London Underground Railways.

Sets of similar clocks are installed at the Company's head office, in the traffic controllers' offices, at Westminster Station on the District Railway, and in the various signal boxes. We hope to publish a description and illustration of these remarkable clocks in an early issue.