

lines of double width and with single-width spaces, that portion exposed behind each colour may be alternately isolated as the key-plate is shifted. This adjustment is done mechanically, identification marks indicating which colour record is exposed, and as contact prints cannot be obtained, an enlarging lantern is used. The prints may be obtained "in any one of a dozen different ways," but Mr. Williams prefers the bromoil process, inking up with the three necessary colours and superposing the prints by transferring the ink images to drawing-paper. The lines are not obtrusive in the resulting pictures, and, if desired, they can be obliterated by putting the image slightly out of focus when making the exposures for the prints. The method of making the screens is also described in the *Photographic Journal* for March.

In an address to the Franklin Institute, Philadelphia, which is reproduced in the *Journal* of the institute for January, Mr. H. Leffmann shows that the pioneer experiments in aviation carried out by the late Prof. S. P. Langley were complete enough to form the basis for modern practice. In May, 1896, Prof. Langley launched from a small island in the Potomac an unmanned aeroplane driven by a steam-engine which ascended to an altitude of 60 ft. or 70 ft., and travelled at about twenty miles per hour for eighty or ninety seconds before descending. With the help of a grant from the Government and the mechanical assistance of Mr. C. M. Manly, he constructed an internal-combustion engine of 18 b.h.p. weighing only 108 lb., and in 1903 Mr. Manly made an experimental flight on a machine driven by this engine. Through some accident not clearly understood, the flight came to a premature conclusion, and the pilot narrowly escaped drowning. Prof. Langley died in 1907 without making any further experiments, but in 1914 the machine of 1903 was flown successfully by Mr. G. H. Curtiss. When the engine was replaced by one of 80 h.p. a number of flights were made which demonstrated that the principles of the Langley machine were sound and practical.

THE *Cambridge University Press* is publishing for Dr. A. E. Shipley, Master of Christ's College, and Vice-Chancellor of the University of Cambridge, an account of the author's experiences during his recent visit to the United States of America. It will be entitled "The Voyage of a Vice-Chancellor." "The Furniture Beetle" is in preparation for appearance in the series of Economic Pamphlets of the British Museum (Natural History), and "The Danger of Disease from Fleas and Bugs" for appearance in the Museum's series of Economic Leaflets. Mr. W. Heinemann is about to publish "Psychology and Parenthood," by H. A. Bruce, who aims at presenting to parents particulars of the discoveries in child-nature obtained by psychologists and others. Messrs. Longmans and Co. announce a book which should be of interest to educationists, viz. "The Manchester Grammar School, 1515-1915: A Regional Survey of the Advancement of Learning since the Reformation." The author is Dr. A. A. Mumford.

#### OUR ASTRONOMICAL COLUMN.

OBSERVED CHANGES ON JUPITER.—Some remarkable alterations in the surface-markings of this planet have been observed recently. The bay or hollow in the south equatorial belt, which has been almost uninterruptedly visible since Schwabe figured it in September, 1831, appears to have disappeared. Mr. F. Sargent, of Bristol, using telescopes of  $10\frac{1}{2}$  in. aperture (reflector) and 5 in. (Cook refractor), has been unable to see any distinct traces of the feature named during his very recent observations. It was an im-

portant marking as serving to show the position of the great red spot, which has been very faint during a long series of years. In 1901 a large dark mass made its appearance in the south tropical zone of Jupiter, and in about the same latitude as the red spot. This moved with greater speed than the latter, its rate of rotation being about 12 seconds less, and the marking had so greatly extended in longitude that in January and February of the present year it ranged over about  $180^\circ$ , or half the planet's circumference. This object seems also practically to have disappeared. Mr. Sargent saw the following end of it central on March 7 at 10h. 13m. in longitude  $60.3^\circ$ , but it was extremely faint, and regarded as near the vanishing point. Since that date observations have failed to reveal the object, though the disc has been carefully scanned at those times when it must have been presented to view had it continued visible.

DRAWINGS OF MARS.—*Popular Astronomy* for February contains an interesting series of comparative drawings made by five observers at the last opposition, according to a prearranged scheme organised by Prof. W. H. Pickering. On the whole, the accord of the different draughtsmen is satisfactory; thus of 131 canals appearing on the sketches, eighty-three are confirmed by at least one other observer. The Rev. T. E. R. Phillips noted that he could see nothing with the Greenwich 28-in. that was not visible in his own 8-in. Several observers mention the beautiful blue tint of Syrtis Major; the other maria tended to grey or brown.

THE GEGENSCHNITT OR COUNTERGLOW.—This phenomenon has a great fascination for Prof. Barnard, who in 1899 published his observations extending over sixteen years. Prof. Barnard made another series last autumn (which he states to be the best season to observe it), and gives the results in *Popular Astronomy* for February. As in the previous set, the longitude comes out exactly  $180^\circ$  from the sun, the latitude  $0.3^\circ$  N. The diurnal parallax appeared to be insensible. He favours the explanation that it is an atmospheric phenomenon, the earth's atmosphere acting as a spherical lens and concentrating the sun's light. He mentions two other explanations as possible: that of Evershed, that the earth has a tail like a comet; and that of Moulton, that there is an aggregation of meteoric bodies at the point opposite the sun describing periodic orbits under the combined action of sun and earth.

TYCHO BRAHE'S ORIGINAL OBSERVATIONS.—An article by Dr. J. L. E. Dreyer in *Scientia* for March states that the manuscript books in which Tycho's observations were entered night by night were sold to the King of Denmark, and are now in the Royal Library at Copenhagen. A contemporary fair copy of most of them is now in the Imperial Library at Vienna, and from this copy an edition was prepared by a Jesuit named Curtius in 1666. This is known to be very incomplete and incorrect, and a new edition is being prepared by Dr. Dreyer from the original observing books and from the copy at Vienna, which will form vols. x.-xiii. of the collected works of Tycho Brahe, now being printed at Copenhagen.

#### THE DEVELOPMENT OF AIRSHIP CONSTRUCTION.

AMONG the important papers read last week at the Institution of Naval Architects was one on airship construction by Mr. C. I. R. Campbell, who has been responsible at the Admiralty for the design of our airships. In British practice it is assumed for design purposes that the gas has a lift of 68 lb. per 1000

cubic ft. The author gives a curve showing the average lift per unit volume of gas at various altitudes as a percentage of the lift at ground-level. A dominating requirement in design is the provision of the longitudinal strength necessary to withstand the longitudinal shearing forces and bending moments, and the different means adopted to meet this requirement divide airships into three main types, viz. non-rigids, semi-rigids, and rigids. Particulars of three non-rigid airships are given in the paper, having gross lifts of 4690 lb., 14,100 lb., and 11 tons respectively; the disposable lifts when full are 1669 lb., 4655 lb., and 5 tons. For airships larger than 500,000 cubic ft. the non-rigid type can be, and has been, used, but its efficiency tends to compare less favourably with the semi-rigid type as size is increased. The author deals with questions of the gas pressures required to enable the envelope of the non-rigid ship to maintain its form under the distorting forces due to weights, and with the means for supporting the bow against the external air pressure in flight. He considers that non-rigid ships form a class of great utility, which can be given speeds of 45 to 60 miles per hour, with disposable weight percentages from 33 to 45 per cent. They are particularly suitable for short-distance flights and for patrol duties. Their chief merits are simplicity, ease and cheapness of production, and low cost of maintenance.

In semi-rigid airships a longitudinal keel girder is fitted to the underside of the envelope so as to constitute a rigid or slightly flexible backbone. The general effect of the keel is to relieve the envelope of all loads which in non-rigid airships have to be met by means of a relatively high internal gas pressure. As a result it is found possible to fly large semi-rigid airships of more than 600,000 cubic ft. with gas pressures at the axis little more than one-half as great as those required in non-rigids of equal capacity and speed. Particulars of four semi-rigid airships are given in the paper, having volumes up to 1,060,000 cubic ft.; the type in recent years has been developed by the Italians alone. Semi-rigid airships fill the gap between the largest efficient non-rigid and the smallest useful rigid airship.

In rigid airships the whole of the shearing forces and bending moments are sustained entirely by a rigid hull. A typical rigid airship has the following characteristics:—643 ft. long by 78 ft. 9 in. extreme diameter; gas-bag capacity, 1,950,000 cubic ft.; maximum speed, 60 to 65 miles per hour; total lift, 59.2 tons under standard conditions; disposable lift, 30 tons. The machinery weighs 8½ lb. to 9 lb. per brake-horse-power. The author gives curves of shearing forces and bending moments for an airship of this type, both in the fully loaded and in the light condition, and discusses the effects of these curves on the design.

The most striking improvement in the commercial value of airships is to be obtained by increased size. An airship of 2,500,000 cubic ft. capacity, maximum speed 70 miles per hour, would have a disposable lift of 50 per cent. of the total, *i.e.* about 38 tons. To enable this ship to cross the Atlantic at 55 miles per hour she should carry fuel and oil for 4500 miles, and an analysis of the disposable weights shows that there are 8½ tons available for carrying capacity for passengers, luggage, food, etc., which is about 11 per cent. of the total lift.

If an airship of double capacity, *i.e.* 5,000,000 cubic ft., be designed for the same length of voyage, the carrying capacity works out to about 28 tons, which is about 18½ per cent. of the total. The running costs of the larger ship will be less than double those of the smaller, and hence the larger ship is a far better commercial proposition.

There are, of course, many problems other than those of design to be considered in the commercial airship. Thus Lord Weir directs attention to the cost of accommodation, the handling facilities, and the gas-producing plant. The question of mooring airships in the open is also being investigated, and it is hoped that it will shortly be possible to bring airships successfully to rest in the open even in a strong wind.

### EXPERIMENTS IN PSYCHICAL RESEARCH.<sup>1</sup>

IN 1912 Mr. Thomas Welton Stanford, brother of Leland Stanford, and one of the trustees of the Leland Stanford Junior University of California, placed at the disposal of the University the sum of 10,000*l.*, the interest on which was to be applied to investigations in the field of spiritualism and psychical research, and Dr. Jordan, the president of the University, asked if the department of psychology was willing to assume the responsibility of applying the endowment to work in this field. After some natural hesitation and consultation with other universities, the offer was accepted. The endowment sufficed not only to refit and equip the laboratory rooms assigned to the work, but also to defray the expenses of a fellowship, to which Dr. Coover, a trained psychologist, was appointed. The present bulky volume constitutes his first report.

Part i. deals with the hypothesis of "thought transference" or telepathy, a subject on which much experimental work has been done, but more, and more carefully controlled, work was urgently needed. Three sets of experiments were carried out:—(1) On the guessing of lotto-block numbers; (2) on the guessing of playing-cards; (3) on the "feeling of being stared at." The playing-card experiments were very extensive, and deserve a longer notice than we can give them. The following was the method:—(i) The experimenter shuffles the pack (court cards discarded). (ii) He throws a die. If the number thrown is odd he holds the card in his mind, the form of content being: for 1, visual impression; for 2, kinæsthetic imagery (incipient pronouncing); for 3, combined visual impression, kinæsthetic image, and auditory image. (For even numbers, see below.) (iii) He turns over the pack, notes the bottom card, taps once to signal the reagent, holds mental content of card, and "wills" the content to be projected into the mind of the receiver. After fifteen or twenty seconds he taps twice to signal the close of the experiment, and, when he notes that the reagent has recorded his guess, himself records colour, number, and suit of the card and number of the die determining the form of the experiment. When the die threw an even number the experimenter ran off the rest of the experiment as usual, but *did not look at the card until the reagent had recorded his guess*, thus affording an effective series of control experiments. The results of 10,000 guesses with University students, favourably disposed, were entirely negative. No statistical analysis shows any deviation in the percentage of right cases exceeding the probable limits of pure chance, or any tendency for the guesses to be more correct when the reagent graded his answers high (indicating considerable confidence that they were right) than when he graded them low. A further set of experiments was made with ten "sensitives," five of them "spiritistic mediums," persons with a sincere faith who gave time and effort to the research without pay. The statistical

<sup>1</sup> Leland Stanford Junior University Publications. *Psychical Research Monograph No. 1*, "Experiments in Psychical Research at Leland Stanford Junior University." By John Edgar Coover, Fellow in Psychical Research and Assistant Professor of Psychology. Pp. xxiv + 641. (Stanford University, California, 1917.) Price, paper 3.50 dollars, buckram 4 dollars.