falling and despairing, a helper and encourager of the useful and active; and she may be all this and more in a manner which no man, however able or gifted, can fully or effectually imitate. But to secure such fruits as these, she must have sown abundantly the good seed of mental and moral discipline in the sunny spring time of youth. Lastly, with reference to this branch of the subject, it may be maintained that liberal culture will fit a woman better even for the ordinary toils and responsibilities of household life. Even a domestic servant is of more value to her employer if sufficiently intelligent to understand the use and meaning of her work, to observe and reason about the best mode of arranging and managing it, to be thoughtful and careful with reference to the things committed to her charge. How much more does this apply to the head of the house, who, in the daily provisioning and clothing of her little household army, the care of their health, comfort, occupations and amusements, the due and orderly subordination of the duties and interests of servants, children, and friends, and the arrangement of the thousand difficulties and interferences that occur in these relations, has surely much need of system, tact, information, and clearness of thought. We realise the demands of her position only when we consider that she has to deal with all interests from the commonest to the highest, with all classes of minds from the youngest and most untutored to the most cultivated; and that she may be required at a moment's notice to divert her thoughts from the gravest and most serious concerns to the most trifling details, or to emerge from the practical performance of the most commonplace duties into the atmosphere of refined and cultivated society. But it would be altogether unfair to omit the consideration of still another aspect of this matter. Woman has surely the right to be happy as well as useful, and should have fully opened to her that exalted pleasure which arises from the development of the mind, from the exploration of new regions of thought, and from an enlarged acquaintance with the works and ways of God. The man who has enjoyed the gratification of exercising his mental powers in the fields of scientific investigation or literary study—of gathering their flowers and gems, and of breathing their pure and bracing atmosphere, would surely not close the avenues to such high enjoyment against woman. The desire to do so would be an evidence of sheer pedantry or moral obliquity, of which any man should be ashamed. On the contrary, every educated man and woman should in this respect be an educational missionary, most desirous that others should enjoy these pleasures and privileges, both as a means of happiness and as a most effectual preventive of low and pernicious tastes and pursuits.

*RECENT RESEARCHES ON FLIGHT**

OF late the perplexing problem of flight has received a greater amount of attention from physiologists and savants than has been bestowed upon it for years, and the result of their researches and experiences is in a fair way of becoming remarkable for its fruit-bearing character. Whilst abroad, such men as Borelli, Straus-Durckheim, Chabrier, Girard, and Marey, have severally given to the world the gist of their labours in this branch of science; at home, the Duke of Argyll and Dr. J. Bell Pettigrew have awakened our deep interest by their views on natural and artificial flight. To the latter is due the honour of giving birth to the celebrated "figure-of-8 wave theory," that is now attracting so much notice in our aeronautical schools.

As early as 1867, Dr. Pettigrew delivered, before the Royal Institution of Great Britain, a lecture, in which he propounded that novel theory, and in 1868 he published in the "Transactions" of the Linnean Society an elaborate memoir on "The Mechanical Appliances by which Flight is attained in the Animal Kingdom." The year after, Prof. J. E. Marey, in the "Revue des Cours Scientifiques," bore out Dr. Pettigrew's ideas, by the detail of his experiments with the sphygmograph, with which he succeeded in causing the wings of insects and birds to register their own movements. He says:—"But if the frequency of the movements of the wing vary, the form does not vary. It is invariably the same; it is always a double loop, a figure of 8. Whether this figure be more or less apparent, whether its branches be more or less equal, matters little: it exists, and an attentive examination will not fail to reveal it." An indefatigable worker, Dr. Pettigrew continued, without pausing, the task to which he had set himself—and that to him is indeed a labour of love; and in this year's "Transactions" of the Royal Society of Edinburgh, we have from his pen a complete monograph on "The Physiology of Wings," in which he treats with equal felicity of both natural and artificial flight. The mass of interesting fact brought to light by the author is too copious to allow of lengthened discussion, but from it we abstract the following items:—

"The wing is generally triangular in form. It is finely graduated, and tapers from the root towards the tip. It is likewise slightly twisted upon itself, and this remark holds true also of the primary or rowing feathers of the wing of the bird. The wing is convex above and concave below; this shape, and the fact that in flight the wing is carried obliquely forward like a kite, enabling it to penetrate the air with its dorsal surface during the up stroke, and to seize it with its ventral one alike during the down and up strokes. The wing is moveable in all its parts; it is also elastic. Its power of changing form enables it to be wielded intelligently, even to its extremity; its elasticity prevents shock, and contributes to its continued play. The wing of the insect is usually in one piece, that of the bat and bird always in several. The curtain of the wing is continuous in the bat, because of a delicate elastic membrane which extends between the fingers of the hand and along the arm; that of the bird is non-continuous, owing to the presence of feathers, which open and close like so many valves during the up and down strokes.

"The posterior margin of the wing of the insect, bat, and bird, is rotated downwards and forwards during extension, and upwards and backwards during flexion. The wing during its vibration descends further below the body than it rises above it. This is necessary for elevating purposes. The distal portion of the wing is twisted in a downward and forward direction at the end of the down stroke, whereas at the end of the up stroke it is twisted downwards and backwards. The wing during its vibrations twists and untwists, so that it acts as a reversing reciprocating screw. The wing is consequently a screw, structurally and functionally. The blur or impression produced on the eye by the rapidly oscillating wing is twisted upon itself, and resembles the blade of an ordinary screw-propeller. The twisted configuration of the wing and its screwing action are due to the presence of figure-of-8 looped curves on its anterior and posterior margins; the curves, when the wing is vibrating, reversing and reciprocating in such a manner as to make the wing change form in all its parts."

We may further point out that Dr. Pettigrew has not based his ideas on the structure of wings on mere theoretical considerations. Besides elaborate anatomical examination, he has entered with a true experimental spirit into a close study of the visible movements of most of the winged tribe. The very excellent diagramatic views with which his paper is elaborately illustrated convey at a glance much that it is difficult to express in words. In proof of this the reader need but compare those figures bearing on the wing movements of the butterfly, the dragon-fly, and the bird.

On these and similar deductions from the practical study of natural history, Dr. Pettigrew bases his elements of artificial flight.

J. MURIE

* Communicated by the Author from *Land and Water*.

INSTRUCTIONS FOR OBSERVERS, AT THE ENGLISH GOVERNMENT ECLIPSE EXPEDITION, 1871

SPECTROSCOPIC OBSERVATIONS

THE instruments used should, if possible, be of the following forms; and experience has shown that they should all be equatorially mounted and driven by clockwork (E of course excepted):—

Instrument A.—An analysing spectroscope showing the whole spectrum in one field, with reference spectra, or some means of rapid record, and with long slit and long collimator mounted at right angles to the axis of a reflecting telescope of large aperture and short focal length, with large finder, the slit of the spectroscope, of course, lying in the focus of the speculum. This combination enables us to obtain a small bright image of the corona, and by throwing this small image on the long slit, to observe the spectrum of the corona on both sides the dark moon—the long collimator permitting the slit to be as wide as possible, so that the maximum of light is admitted. The prism throwing the reference-spectrum into the collimator slides along a bar, so that the reference-spectrum may be made to occupy any part of the