when he asks (ii., 361): "Ought not Protestant Western Christians to be willing to spend as much money annually in the missionary work in China as is annually made by Protestant Western merchants in China from traffic in opium?" we are not ready with our affirmative. "A few hundred individuals," he adds (p. 362), "actuated by the love of Money, are annually doing very much more to demoralize and destroy the Chinese than all the millions of Christians in Christendom, constrained by the love of Jesus, are doing to benefit and save them." It seems to us that these unprincipled devotees of Mammon are, then, the first objects of missionary labor, and, after them, the governments of Great Britain and the United States, which protect their citizens in importing opium into China. The present competition between trade and the Bible is manifestly (if Mr. Doolittle's statement be true) unequal and, for the latter, almost hopeless.

BOOKS RECEIVED.

THE WORKS OF THE RIGHT HON. EDMUND BURKE. Revised Edition. Vol. IV. Little, Brown & Co., Boston.

A NOBLE LIFE. By the author of "John Halifax, Gentleman." Harper & Bros., New York.

SIMPLICITY AND FASCINATION. By Anne Beale. Second Edition. Loring, Boston. (O. S. Felt, New York.)

A YOUTH'S HISTORY OF THE REBELLION. Fort Pillow to the End. By William M. Thayer. Walker, Fuller & Co., Boston. (A. D. F. Randolph, New York.)

ESPERANCE. By Meta Lander. Sheldon & Co., New York.

THE LOST BRIDE; OR, THE ASTROLOGER'S PROPHECY FULFILLED. By T. S. Arthur. T. B. Peterson & Bros., Philadelphia. (F. A. Brady, New York.)

MOSAICS OF HUMAN LIFE. By Elizabeth A. Thurston.—JEHOVAH JIREH: A TREATISE ON PROVIDENCE. By William S. Plumer, D.D., LL.D.—POEMS. By Annie E. Clark. J. B. Lippincott & Co., Philadelphia. (Sheldon & Co.; James Miller, New York.)

THE SHADOW OF CHRISTIANITY; OR, THE GENESIS OF THE CHRISTIAN STATE. By the author of the "Apocatastasis." Hurd & Houghton, New York; E. P. Dutton & Co., Boston.

MILITARY MEASURES OF THE UNITED STATES CONGRESS. 1861—1865. By Henry Wilson, Chairman of the Committee on Military Affairs. D. Van Nostrand, New York.

Science.

SCIENTIFIC NOTES.

MOTIONS in plants have been long recognized, some of them by all who have taken the trouble to use their unaided eyes, and others only by such as have had recourse to the microscope. Among the latter movements are those of the spores or seeds of some of the lowest members of the vegetable kingdom, produced by means of slender, vibrating filaments—movements by which such spores are driven through the water, just as are many of the infusorial animals, for which even Ehrenberg mistook some of them. Among the motions visible to the naked eye are the infinitely various movements seen in the slow opening and closing of the petals of most flowers, or the quicker motions of the stamens of the bearberry, of the leaves of Venus's flytrap, or of the sensitive plant, which follow so readily the touch of an insect or of the point of a pin; and, finally, the truly wonderful motions of the *hedysarum*, an East India plant, the leaflets of which, sometimes slowly and sometimes quickly, according to their condition and exposure to light and heat, revolve in ellipses occasionally, as observed by De Candolle, as often as once in a second. One can hardly look at such a plant without the feeling that its activity is closely akin to that of a voluntary movement.

The motions of the tendrils of some of the vines was noticed by Dutrochet, Mohl, and other botanists, and have recently been studied by Professor Gray. Mr. Darwin, who justly ranks among the best and most trustworthy of living observers, was induced by the observations of this last-mentioned naturalist to make a series of experiments of his own, which have led to very remarkable results, not only in regard to tendrils, but to climbing plants in general, showing that they are endowed with properties strikingly analogous to, if not of the same kind as, certain qualities of animals.

First of all, it may be premised that climbing is effected by a real motion in the plant and not by a continued growing around a support, as commonly believed, and that these motions may have their seat either in the stem, the leaves, or the tendrils. Only a few examples of them can be given here, but for full details the reader is referred to Mr. Darwin's admirable memoir (Nos. 33 and 34, Vol. IX., o the Journal of the Linnæan Society; Section, Botany).

As an example of a stem-climber the common hop may be taken. When a young vine rises from the ground, or a new shoot pushes from a cut stem, the first three joints are straight and stationary; but the fourth, after attaining a certain size, begins to bend to one side, and then turns in succession to all points of the compass, moving with the sun, and describing a complete circle. The first motions are slow, but soon acquire greater speed, when an average revolution is completed in two hours and eight minutes. These motions are kept up for about five days, when the joint in which they began straightens up and becomes rigid. In the meantime other joints have been developed, and have in turn taken up the motion; and as long as the plant grows this process is repeated. Mr. Darwin has recorded his observations on more than forty species of stem-climbing plants, in which there is much variety, some moving slower and others quicker than the hop. A species of *phaseolus*, for example, finished its revolutions in one hour and seventeen minutes, while other species belonging to other genera required eight, ten, or even sixteen hours.

The most remarkable instance given of the distance traversed by a revolving stem was in a *ceropegia*. This was allowed to grow out free thirty-one inches from its support. Even after it had attained this length it continued to revolve at rates between five hours fifteen minutes and six hours forty-five minutes for each revolution. The tip thus described a circle more than five feet in diameter, or about sixteen feet in circumference. Assuming that the circuit was completed in six hours, it moved at the rate of about thirty-two inches per hour.

The end gained by these motions is as follows: The plant needs support; if it simply grew upwards it would soon bend by its own weight, and might fall upon what it needed, though the chances would be against its so doing; but by its revolutions it feels about, as it were, and thus secures the benefit of any support within a circle of which itself is the radius. While, however, its support may thus be secured, its motion onward is arrested; but the tendency to bend continues, and thus it is coiled around whatever it touches, somewhat as a rope swung in a circle coils about anything it strikes; only the plant coils through a property of the stem itself, and not by a momentum imparted to it from without, as in the rope.

The leaf-climbers, of which the different species of *clematis* are examples, not only have in some cases revolving stems, but, in addition, the leaf-stalk is irritable and moves when touched. Mr. Darwin found in one case that the pressure of a loop of thread weighing only the sixteenth of a grain was sufficient to excite it to activity. If the leaves come in contact with a support they immediately begin to bend so as to grasp it, and once they get hold, the leaf-stalk becomes rigid and thenceforth immovable. Thus we have here not only a revolving stem to increase the chances of contact, but pairs of leaves like outstretched arms, ready to seize upon anything which will serve to support the weight of the vine.

The tendril-climbers are the best known of all, since instances are to be found in many of our cultivated vines, as the pea, the grape, the Virginia creeper, etc. For the most part tendrils revolve in circles, ellipses, or spirals, always in search of a support; they have a high degree of irritability, contracting upon anything with which they come in contact, and always bending toward the touched side. All are familiar with the manner in which a tendril secures its hold by coiling its tip around whatever it touches. The motion, however, does not stop here, for it still continues to contract and is twisted into a close spiral which answers a double purpose, viz., to protect the vine by its spring against the effect of violent motions, and by its shortening to lift the vine, just as a man, in climbing, is raised by the bending of his arms.

In *bignonia speciosa*, Mr. Darwin observed a very remarkable movement, which, he rightly says, would be compared with the instinctive motions if it occurred in an animal. The tendrils of this plant continually feel about, as it were, in search of any dark hole into which they can thrust their tips. Into such holes they are sure to insert their tendrils, sometimes after having moved over a large surface. For this purpose the terminal portion, a half or a quarter of an inch in length, is bent at right angles on the barrel part very much as a man would crook his finger for a similar object. Sometimes he has seen a tendril withdraw from a hole it had occupied several hours, and seek and find a new one. While it appears from Mr. Darwin's observations that the light of the sun has some influence over the movements of plants, such as are noticed above, this influence is by no means so uniform as generally supposed, and certainly is not the immediate cause of them. Of about forty species of stem-climbers, more than two-thirds moved from left to right, or against the sun, while nearly all the others revolved in the opposite direction. One plant moved against the sun, while another of the same species moved with it. A species of *hibbertia*, on May 18, followed the sun, on the 19th and 20th moved against it, and on the 26th followed it for two-thirds of a circle, and then returned to its standing-point. In some cases the light seemed to retard, and in others to hasten, the movements. A *convolvulus* required fourteen minutes more to complete the half of its circle of revolution which was towards the light than that which was from it, while in an *ipomœa* the half of the revolution from the light required four hours and a half, and that towards it only an hour.

The tendrils of *bignonia capreolata* seem to have an aversion to light, for if a dark surface was placed near them they turned to it, and when a plant, having three pairs of tendrils pointing in different directions, was placed in a box open only on one side, and that turned obliquely to the light, the tendrils all bent towards the darkest corner of the box. Mr. Darwin says: "Six tattered flags could not have pointed more truly from the wind than did these branched tendrils from the stream of light which entered the box."

—Much interest has been felt by chemists and meteorologists in the discussion of the many questions concerning the presence and functions of ozone in the atmosphere. Unfortunately, chemists are not all agreed about the trustworthiness of the tests which are used to determine the presence of ozone in the air. In spite of this uncertainty, however, systematic ozonometric observations are being rapidly multiplied. M. Le Verrier lately announced to the French Academy that the Minister of Public Instruction had authorized him to cause ozonometric observations to be made by all the meteorological commissioners of the department of France. Ozone is known to be destroyed by decomposing organic matters, and a large part of the interest which attaches to it is derived from its apparent antagonism to malaria and those insidious products of organic decomposition which are supposed to have something to do with epidemic diseases. Dr. Richardson, of London, has drawn up a list of "the most reliable facts known up to this time respecting ozone," which is interesting as presenting a physiologist's view of the matter, though many persons would demur at some of his statements. We make a brief abstract of his views, as follows:

Ozone is always present in minute proportions, say about one part in ten thousand, in natural air. It is destroyed in large towns, and with special rapidity in crowded, close, and filthy localities. When diffused through air in greater proportion than is natural, though still in minute quantity, it produces on inhalation distinct symptoms of acute catarrh—common cold. When animals are subjected to ozone in large quantities, at a temperature of 75°, the symptoms produced are those of inflammation of the throat and mucous membranes generally, and at last congestive bronchitis, which in carnivorous animals is often rapidly fatal. When animals are subjected for a long period to ozone in small proportions, the agent acts very differently on different animals. The carnivorous die after some hours, from disorganization of the blood; but the herbivora will live for weeks, and will suffer from no acute disease.

The question whether the presence of an unusual quantity of ozone in the air can produce actual disease, must be answered cautiously. Science has as yet no actual demonstrative evidence on the point. But the facts approach to demonstration that common cold—catarrh—is induced by this agent. All else is as yet speculative.

During periods of intense heat of weather, the ozone loses its active power. On dead organic matter undergoing putrefaction ozone acts rapidly; it entirely deodorizes it, and, at the same time, hastens the organic destruction.

There is an opposite condition of air in which the oxygen is rendered negative in its action, as compared with the air when it is charged with ozone. Air can be rendered thus negative by merely subjecting it, over and over again, to the respiration of animals. The purification of such air from carbonic acid and other tangible impurities, does not render it capable of supporting healthy life, but ozone restores the power. In this negative condition of air, the putrefaction of organic matter is greatly modified, and the offensive products are more abundant than is usual. Wounds become unhealthy and heal slowly in such negative air. There is no demonstrative evidence, as yet, that any diseases are actually caused by this negative condition of air, but the inference is fair that diseases which show a putrefactive tendency are influenced injuriously by a negative condition of the oxygen of the air. It is also probable that during this state decomposing, organic poisonous matters become more injurious. As ozone is used up in crowded localities, and as it is essential that this substance should be constantly supplied in order to effect the removal of decomposing substances and their products, Dr. Richardson urges that no mere attention to ventilation, or to other mechanical measures of a sanitary kind, can be fully effective unless the air introduced be made active by ozone. In his opinion, fever hospitals and other large buildings in towns should be artificially fed with ozonized air.