cision. A great deal of work has been performed since its initiation in 1905, despite the fact that the atmospheric conditions in Canada were found to hamper the observations considerably. Very careful investigations of the local, actual conditions have to precede the making of the standard observations. Observing towers—modifications of that designed by Sergeant Beaton—have to be employed, and range in height from 47 to 102 feet; they consist of a tripod upon which the theodolite is mounted, and a scaffold insulating the observer's weight from the instrument. One of these structures, 87 feet high, is illustrated on p. 160, and Mr. Bigger reproduces several other photographs illustrating the method of its erection. The large amount of country already surveyed, and under survey, is shown on the third large map accompanying the report.

In conclusion, it may be stated that the report indicates that astronomy and its allied sciences are being well looked after in the Dominion with an organisation that many workers in the British Isles might well envy, and that, when completed, the Dominion Observatory will properly take its place among the observatories of the world.

W. E. ROLSTON.

## A CONSPECTUS OF SCIENCE.

THE annual report of the Board of Regents of the Smithsonian Institution for the year ended June 30, 1909, has been received from Washington. The volume contains the annual report of the secretary, giving an account of the operations and condition of the institution for the year; a report of the executive committee exhibiting the financial affairs of the institution; the proceedings of the Board of Regents; and a general appendix. As in previous years, it is the appendix which gives the volume its unique value. It comprises a selection of scientific and other memoirs of wide interest relating chiefly to the year 1909. Many of these memoirs are translated into English from the languages in which they were written, and thus become much more widely available both in this country and America.

We note among such contributions to the appendix Prof. H. Poincaré's address on the future of mathematics, delivered at the International Congress of Mathematicians in Rome in 1908; Commandant Paul Renard's contribution to the *Revue des Deux Mondes* for November 1, 1909, on what constitutes superiority in an airship; M. L. Marchis' article on the production of low temperatures and refrigeration, in the *Revue générale des Sciences,* March 15, 1909; M. A. de la Baume Pluvinel's paper on solar-radiation researches by Jules César Janssen, from the *Astrophysical Journal,* September, 1908; Dr. Gaubert's essay on the formation, growth, and habit of crystals, which appeared in the *Revue scientifique* of January 15, 1909; M. Maurice Zimmermann's paper from the *Annales de Géographie,* March 15, 1909, on the Antarctic land of Victoria; M. D. Damas' paper on the oceanography of the sea of Greenland, from *La Géographie,* Paris, June 15, 1909; M. Romuald Minkiewicz's contribution to the *Revue générale des Sciences,* February 15, 1909, on the instinct of self-concealment and the choice of colours in the Crustacea; and M. G. Marotel's paper on the relation of mosquitoes, flies, ticks, fleas, and other arthropods to pathology, from the *Annales de la Société d'Agriculture, Sciences et Industrie de Lyon,* 1906.

The appendix also contains several important contributions from British men of science in the form of reprinted addresses. The numerous plates contained in the volume add greatly to its interest.

## INSECT AND FUNGOID PESTS.

PROBABLY the most important advances in agricultural and horticultural practice in the present day are in the direction of controlling insect and fungoid pests. Economic considerations generally compel the grower to aim at large crops; in consequence, losses caused by disease may be very heavy. All the conditions of modern cultivation tend to favour the pests; the distribution of seeds and of nursery stock from district to district facilitates the spread of spores and ova, whilst the dense planting and the continuous cropping provide a succession of host plants. Further, the high nitrogenous manuring invariably practised as agriculture and horticulture become more developed seems to increase the susceptibility of the plant to attack. In all countries where agriculture is progressing there is growing up an enormous literature dealing with these pests. A few of the more recent publications only are referred to in this article, but the list does not profess to be complete. Two general methods are in use for combating the pests: natural enemies are encouraged, and, if necessary, introduced into the country, and poisons are applied sufficiently potent to kill the pest, but not the infested plant.

In output of literature the United States easily heads the list. Under the direction of Dr. Howard, the Bureau of Entomology of the Department of Agriculture has accomplished an enormous amount of work of both scientific and technical value. A recent bulletin by H. E. Burke deals with the flat-headed borers (Agrilus), causing damage to forest trees to the extent, it is estimated, of 100,000,000 dollars annually in the States alone. Methods of treatment are now known, and much of the damage can be prevented. The San José scale (*Aspidiotus perniciosus*) is shown by A. L. Quaintance to yield to treatment with petroleum or kerosene washes, or with lime and sulphur washes. "Brown rot" (*Sclerotinia fructigena*) and the plum curculio (*Conotrachelus nenuphar*) are described by W. M. Scott and A. L. Quaintance as causing great injury to peaches and plums respectively, but they can be kept in check by a lime-sulphur wash containing lead arsenate. V. L. Wildermuth writes on the clover-root curculio (*Sitones hispidulus*), which injures clover, although it is probably not a common pest. It is eaten by a number of birds, and, in the larval stage, is attacked by a fungus. W. M. Russell describes a cigar-case bearer (*Coleophora caryaefoliella*) attacking pecari trees; it is not yet abundant, and can probably be kept in check by lead arsenate washes. H. O. Marsh deals with the common Colorado ant (*Formica cinereorufibarbis*), which has fallen under the ban because it protects the melon aphis. It is said to be a common thing to see the ants busily engaged in killing and carrying off the syrphid larvæ which were destroying the aphides. Adults of a lady-bird, *Hippodamia convergens*, the nabid bug, *Reduviolus ferus*, and a species of Chrysopa were also carried away by the ants. The simplest method of extermination seemed to be watering the nests with a weak solution of potassium cyanide.

Not only at the Department of Agriculture, but also at the colleges, are investigations undertaken, and a large number of bulletins are issued. Many of these make no claim to originality, and are mainly of interest to us as showing how the American colleges try to educate the farmers. These bulletins are always well illustrated, pictures being given of typical infested plants and of the pest in its various stages, so that recognition shall be easy. Preventive and curative methods are described where known, and farmers are told where they may apply for further information. Admirable bulletins of this class are sent out by the agricultural experiment stations of the West Virginia University, the Purdue University, the Colorado Agricultural College, and others.

Turning to the British Dominions, good work is being done in India, and is published in the Pusa Memoirs and *The Agricultural Journal of India.* The Transvaal work appears in *The Transvaal Agricultural Journal.* In a recent issue of *The Agricultural Journal of the Cape of Good Hope*, Messrs. Laws and Manning discuss the eradication of ticks on the veld. Of the three methods in vogue, periodical dipping or spraying of the hosts, grass burning, and the enclosing of definite areas for a sufficient length of time to ensure all ticks dying off through the absence of hosts, they consider the dipping or spraying the best, but the other two are also effective. In another article the ostrich wire-worm (*Strongylus douglassii*), a worm found in the proventriculus of the ostrich, is described; the treatment commonly adopted is to give a strong dose of carbolic acid, insufficient, of course, to kill the bird. It is not considered, however, that this treatment is satisfactory, and others are discussed, but none can be depended upon as certain.

The scientific work of the entomological staff of the

West Indies appears in the West Indian Bulletin, and the more technical work in *The Agricultural News*. Mr. F. W. South deals in a recent issue of the Bulletin with the control of scale insects by means of fungoid parasites. The fungi can be introduced in two ways: material containing fructifications may be hung on the tree near to the scale-infested part, or the fructifications may be stirred up with water, which is then sprayed on to the tree. When the spores germinate, the hyphæ grow under the scales and destroy the insects. In every issue of *The Agricultural News* a section is devoted to insect and fungoid pests; the diseases of rubber trees have recently received considerable attention. Some of the islands, as Jamaica and Trinidad, issue their own bulletins, in which the staff publications appear. In the Trinidad bulletin Mr. Rorer deals with pod-rot, canker, and chupon-wilt of cacao in a well-illustrated paper; spraying is shown to be effective, but definite instructions cannot yet be given owing to the absence of local experience of the treatment.

The Circulars and Agricultural Journal of the Royal Botanic Gardens, Ceylon, contain accounts, by T. Petch, of root diseases of Hevea and of *Acacia decurrens*, which is extensively planted as a wind-break in tea plantations and also for green manuring. The brown root disease, caused by *Hymenochaete noxia*, is the commonest root disease of Hevea in Ceylon, although this fungus does less damage than *Fomes semitostus*. *Sphaerostilbe repens* is also recorded, but is as yet not common. Two diseases of Acacia are described, one caused by an agaric, *Armillaria fuscipes*, the other by *Fomes australis*. A remarkable plague of a large snail, *Achatina fulica*, is described by E. E. Green, which swarms in millions in one area of the island. On the whole, it is considered to do more good than harm, as it feeds on animal and human excrement, and does comparatively little damage to the vegetation. Besides the circulars and journal, a series of leaflets are sent out from Ceylon.

Much of the Japanese work is published in the Journal of the College of Agriculture, Tokio, a beautifully illustrated periodical brought out in English and German. Vol. ii., No. 4, contains a paper by Ichiro Miyake on the fungi attacking rice. The list is, the author believes, complete, and as full references and descriptions are given, it must prove extremely valuable to other workers. It is in the true scientific spirit that the Japanese have broken down the barrier of language and issued their scientific publications in languages that can be read in the West.

In addition to the work going on at some of the larger agricultural colleges and departments in Great Britain, the smaller colleges are also studying the pests and diseases that occur in their districts. Mr. G. T. Malthouse recently, in a bulletin issued by the Harper-Adams Agricultural College, dealt with the wart disease of potatoes (*Chrysophlyctis endobiotica*), which has been doing much damage in Shropshire and Staffordshire. Accounts of the various diseases are also circulated as leaflets by the Board of Agriculture, as well as in their Journal.

## TECHNICAL INSTRUCTION AND SECONDARY SCHOOLS.[1]

TECHNICAL instruction, in particular, has too long been looked upon as having little relation to the elementary or secondary schools. The schoolmaster has perhaps been too apt to view the technical school or college as an upstart and an interloper, the title of which to the name of an educational institution rests on a very insecure foundation, and the utilitarianism of which gives a somewhat unfair advantage in the competition for students. On the other hand, those engaged in technical work have in some cases looked upon the schoolmaster as an unpractical person, from whose clutches the student should be rescued at the earliest possible moment.

We have, however, now emerged from this stage, and are ready to discuss the relationships of our various schools with a better knowledge of the necessities and limitations of each, and taking as the basis the requirements of the scholar and not the supposed benefit to the school.

[1] An address read to the Annual Congress of the Secondary Schools Association, held at Bradford on February 24, by Prof. Walter M. Gardner.

The scholar's work, from entering the elementary school to the end of his studentship, whenever that may be, should appear to him as an unbroken progress, during which he can see gradually unfolding a definite scheme leading eventually to his life's career. In so far as the various grades of education form a series of detached schemes without proper interrelationship, and to the extent to which the student's time is wasted when he passes from one grade to another by reason of this, to that degree our educational administration is defective, and we, as administrators, are lacking in skill or in our duty to the students and to the public. The solution of this problem proves to be very difficult, and even now the matter hardly receives the attention which it deserves. To provide in a sufficiently economical manner courses throughout the school suited to the different needs and capacities of various scholars is *the* educational problem. At what stage to introduce differentiation, and when to begin specialisation, and at what age a scholar should pass from one school to another—these are important but minor matters incidental to the main problem.

Keeping to the front the thought of the ultimate benefit of the student, and making this the determining factor, many details will settle themselves. Difficulties, of course, at once arise, due to the uncertainty or to differences of opinion as to whether a particular course of action is or is not for the benefit of the scholar. Here ideals will probably at once clash with practicabilities, and, as the head of a technical institution, I am perhaps predisposed to lay stress on the latter.

The problem presents itself to me in this form:—"How can we make the best use of the student's time up to the age when experience shows he will, in all probability, leave school, and what portion of this should be allocated to technical instruction?" Others may state it thus:—"In order to acquire a thoroughly trained intellect and well-stored mind, a student should pass from the elementary school at twelve or thirteen years of age to the secondary school, and should remain at the latter for at least four or five years. He cannot, therefore, enter a technical school under the age of seventeen or eighteen." How are we to reconcile these views?

Whilst it is, of course, true that all of us, men and women alike, and whatever our avocation, are of greater service, are more efficient, if we have received some training which may legitimately be termed "technical," we are not concerned with this general aspect of the subject on this occasion, but with that specialised technical instruction provided in the technical institutions. The students we wish to get in such institutions are those who will pass into the great industries of the country; and in investigating this matter we are at once confronted with the fundamental point that, of a thousand boys who pass through the elementary schools and who ultimately take positions as workmen, foremen, or managers in industrial concerns, probably not more than forty pass through a secondary school, and not more than three or four enter a day technical college. There is, therefore, a problem of enormous magnitude still requiring solution relative to the further instruction of the 950 out of every thousand boys who do not proceed beyond the elementary schools.

Before the advent of steam-driven machinery, when industrial conditions were much simpler, the personal instructions which the boys received under the apprenticeship system sufficed to produce the necessary skill and training, though in a very unequal degree. The personal association of the craftsmaster and the learner cannot, however, be relied upon under modern industrial conditions, and therefore the technical schools are called upon to provide a substitute for the apprenticeship system. Boys leaving the elementary schools are not, however, sufficiently mature to reap the full benefit of the advanced specialised instruction provided in day technical schools, and for these boys, most of whom will eventually become industrial operatives, I strongly advocate the establishment of what are known as trade preparatory schools, with a two years' course comprising, roughly, two-thirds general subjects and one-third handicraft work. The majority of the boys should then go to work and attend evening technical courses, but those who show special promise should be drafted into the day courses of the technical school by means of scholarships. A necessary and