

ANNUAL ADDRESS OF THE PRESIDENT.

AN INVESTIGATION OF APPLIED ENTOMOLOGY IN THE
OLD WORLD.

By C. L. MARLATT.

It became possible for the writer to spend some little time in Europe during the latter half of the year just passed (1897), and while the trip was, in a way, a private one, and taken primarily for personal instruction and recreation, it was the intention to combine with it an examination of matters connected with entomological work in Europe, particularly as an applied science. That the practical side of the science of entomology was of especial interest will be at once understood, and, in fact, the investigation of this phase of the subject was made a duty owing to official relations with the Department of Agriculture. It was felt that if personal acquaintance could be made with men themselves and their methods, and especially with the conditions under which work is done in Europe, it would be of decided value in connection with similar work being done in this country, and particularly as a basis of a more exact appreciation of the value and applicability of the methods of control employed in the Old World for the New. Special pains, therefore, were taken to go out of the line of ordinary travel, where necessary, to visit stations and see individuals to secure the information desired. A difficulty, which had not been unforeseen, was experienced, especially at the outset, in that, in a number of instances, the individuals whom it was desirable to meet were themselves absent on vacation trips. This was especially true of the curators and officials connected with the museums of London and Paris.

This account will be confined to the personal experiences and observations of the writer, and, therefore, in no sense lays claim to be a complete survey of the subject. A complete review of the applied or economic entomology of the countries visited is quite unnecessary in this place, since this subject has been very carefully and fully covered recently by Doctor Howard in his presi-

dential address before the Association of Economic Entomologists (August, 1894). In this address a general review of the work being done in various foreign countries is given, and changes and innovations are of such rare occurrence that this account is still correct in essential details. As an account of personal experiences, it seemed advisable to adopt the narrative style, and the countries, cities, individuals, and institutions are discussed in the regular sequence of travel, and often in a very general and fragmentary way.

At the end is given a brief summary of the impressions, from the point of view of the economic entomologist, but, in general, the reader is left to draw his own conclusions from the presentation of facts made.

Very little time was devoted to England, and the few days that were spent there were given to the city of London. The Secretary of the Board of Agriculture was visited, and the subject of economic entomology as carried on by the government of Great Britain was freely discussed. The condition of affairs at the present time is the same as described by Doctor Howard in the article already cited, and the work can hardly, in any sense, be compared with that which is being done in this country. The Board of Agriculture, as at present constituted, is itself of rather recent origin (1889), and there is no arrangement for continuous entomological investigation. Mr. Charles Whitehead, who comes nearest to being the official entomologist of Great Britain, is styled the "technical adviser" of the Board on this subject, and receives a retaining fee merely of some 200 pounds. He is a man of wealth, whose hobby is agriculture, and he has been able to do a great deal of good in disseminating knowledge of habits of, and the remedies for, injurious insects in connection with this Board. No research work whatever is done by the Board of Agriculture in entomology. Most of the inquiries which come into the office are answered by circulars prepared by Mr. Whitehead or others, and if any new insect pest of importance arises which is not covered by circulars in hand, it is sent to Mr. Whitehead, and his report is printed as a leaflet. There is a great deal of work done in the way of correspondence, the letters averaging frequently 30 a day, and during seasons of special insect prevalence as many as 400 letters are sometimes received in a single day. The writer

expected to meet Mr. Whitehead, and had some correspondence with him to that end, but, owing to the death, at the time, of a member of his family, the project had to be given up.

Formerly the Royal Agricultural Society attended to a great deal of the entomological work of the kingdom through Miss Ormerod, and latterly through Mr. Cecil Warburton. Mr. Warburton, who is also connected with the Zoölogical Laboratory at Cambridge, reports somewhat as does Mr. Whitehead, and is the technical adviser on all insect matters coming before the Royal Society. At present the Royal Society is doing very much less work in entomology than in the time of Miss Ormerod, and inquiries of this nature are going more and more into the hands of the Board of Agriculture.

It is to be regretted that it was not possible, with the time at command, to visit the veteran English economic entomologist, Miss Ormerod, who, as is well known, continues actively at work in the dissemination of entomological information by means of circulars, pamphlets, etc., much of it independently, and also through the agency of local agricultural societies.

The entomological department of the British Museum of Natural History, South Kensington, is also slightly related to the economic work in entomology in Great Britain. Mr. C. O. Waterhouse, in particular, is making a biological exhibit in entomology, and gives special attention to insects of importance to agriculture. He also, as he informed the writer, assists Mr. Whitehead in any matter with which the latter is unfamiliar or unable to work out for himself.

On account of its being the vacation season, it was possible to make the acquaintance of but few of the entomologists of the Department of Zoölogy of the Museum. In company with Mr. Waterhouse, however, a rather hurried examination was made of the collections and exhibits in entomology, and particularly the biological displays, in which Mr. Waterhouse takes considerable pride. The writer had the pleasure of meeting Mr. Austin, who is now doing some work on the Cuterebras, and saw Mr. Kirby for a few minutes only, as the latter was on the eve of departure for a vacation in Germany. Some little time, also, was spent in the examination of types of American insects. The main collections of insects, which are not open to the general visitor,

are in low basement rooms, lighted on one side only, and with south exposure. Work tables are placed before these windows, and the collections are along the rear and side walls. The specimens are kept in large glazed drawers, in low, closed cabinets. The condition of labelling and of the specimens themselves, judging from a very cursory examination, is not so good as one would expect from the elaborateness of the published lists.

The force in entomology, including Dr. Butler, the Assistant Keeper of the Department of Zoölogy, numbers some eight persons and some boy attendants. Mr. Waterhouse is the first-class assistant, and in charge of the Department of Insects, and such men as Kirby and Austin rank as second-class assistants.

A brief stop in Paris, which followed, permitted of an examination of the *Museum d'Histoire Naturelle* in the *Jardin de Plantes*, and the entomological station under the Ministre of Agriculture (*Institute National Agronomique*). The same condition which characterized London was again experienced, viz., the absence of many of the persons working specially in entomology, and at the museum, with the exception of two or three *préparateurs*, none of the regular staff was present. The methods of work, however, of the Department of Insects were carefully examined. The main and systematic collection in the museum proper is in most excellent condition, and luxuriously housed as compared with our own National Museum in this particular. The systematic collections are not open to the general public, and are stored in low cabinets with rather large drawers or trays. There is, also, a popular display of insects of very considerable extent, partly surrounding the interior corridor of the upper floor. The quarters for the preparation of specimens, the library, and general work rooms are in a building apart. Émile Blanchard is the professor of entomology, and there are several assistants, such as Kunckle d'Herculais and Lucas, and also several *préparateurs*.

The Government Entomological Bureau of France, if it may be so termed, is connected with the *Institute National Agronomique*, 16, Rue Claude Bernarde. Dr. Paul Brocchi is the professor of zoölogy and director of the *Station Entomologique de Paris*. Dr. Paul Marchal, *Chef des travaux à la Station entomologique de Paris*, is charged with the practical workings

of the station. Some hours were spent in the laboratory of the latter discussing entomological matters and examining methods of work, and also arranging with him to assume charge, if desired, of the collection of predaceous beetles for shipment to this country to prey upon the gypsy moth. It was learned that all of the expenses of the office are limited to 2,000 francs per annum, which, of itself, is sufficient illustration of the meagreness of the opportunities for original work or necessary equipment. The methods followed in the rearing of insects and studying the life-histories are very similar to those employed in Washington, but rather simpler and on a very much smaller scale. There is little opportunity for field investigations. This entomological station is of comparatively recent origin (1894), but owing to the conditions which prevail in France, as in other portions of Europe, in the matter of comparative freedom from insect damage, it will probably never assume great importance. All information sent out from this station in reply to correspondents is given gratis. Occasionally posters are prepared on some special insect outbreak, and are displayed conspicuously in public buildings throughout the infested territory. The results of the work of the station are published in the various scientific journals of France, and sometimes in the bulletin of the Minister of Agriculture.

The necessity of a central entomological bureau is not very great in France—and this is also true, to a degree, of other European countries—from the fact that throughout the republic there are agricultural stations and school farms, with which are often connected professors of entomology and zoölogy who give immediate information to their respective districts about any local matters that may arise. Such information or advice is not, however, gratis, but a fee is taken therefor, as would be the case with any other professional man, such as a doctor or a lawyer. This applies to a man like Professor Noel, Director of the *Laboratoire Régional d'Entomologie Agricole* at Rouen, and Professor Valery Mayet, in charge of the department of entomology of the *École Nationale d'Agriculture* at Montpellier. The number of stations, laboratories, or schools in the interest of agriculture in France is very great, perhaps over 50 all told, and in many of them information about insects may be gained.

All the requests for information addressed to the Minister of

Agriculture, at Paris, are attended to by Doctor Marchal, as stated, without charge.

In France the great insect question has, for more than a quarter of a century, been the subject of the control of the Phylloxera, and this insect has for years been honored with a special commission. This commission, however, is not a permanent organization, but is simply a committee which meets from time to time, having no definite quarters, and subject to constant changes. Its work has been thoroughly explained on this side of the Atlantic and needs no description here. No attempt will be made to enumerate all the stations at which entomological work is carried on in France, but later an account will be given of a visit to the viticultural station at Villefranche, conducted by M. Vermorel.

Of insect damage in France the writer can speak of none from personal observations. It is a country of limited extent and with very small holdings, so that insect outbreaks are apt to be early discovered, and the depredators promptly stamped out by hand methods. Our insecticides, arsenical and other, are little known and less employed. Very little real damage of the disastrous sort often witnessed in the United States is ever experienced. Occasionally there will be an outbreak, as everywhere else, but it is usually short-lived. For example, the gypsy moth was quite troublesome about two years ago in the forests of Fontainebleau, but it seemed to have quite disappeared and has not been found at all the present year, and in riding through a portion of these forests I saw no evidence whatever of injury. This incident illustrates the fact, which was repeatedly impressed, that invasions like that of the gypsy moth or allied forest caterpillars, while they may at times be as severe as is now being experienced about Boston, are not lasting, and the insects disappear naturally of themselves. In northern Italy, for instance, the gypsy moth was reported to be quite abundant last year, but here, again, has apparently entirely disappeared—at least nothing could be heard of it; and in rather extensive traveling over this portion of Italy no indications of damage were noted.

Among the men who have become prominent in France in connection with applied entomology and vegetable pathology, there is no name so familiar on this side of the Atlantic as that of Vermorel, and this holds true, also, for France and southern Europe.

M. Vermorel has much of the American energy and push, and beginning as a poor man, a mechanic, has built up an immense establishment, employing some three hundred hands, chiefly for the manufacture of insecticide and fungicide apparatus. But he is a good deal more than a mere manufacturer of apparatus. He conducts a large private experiment station, the *Station Viticole*, at Villefranche, with attached vineyards and laboratories, and with a corps of entomologists, chemists, and other experts, at his own expense, and is, furthermore, a most enthusiastic student of the injurious insects as well as of the fungous diseases, methods of culture, etc., of the grape. He is also a most voluminous publisher, and a collection of his books and pamphlets and serial journals on the culture of the grape, its diseases and insect enemies, makes a small library by itself. He also publishes large charts of important injurious insects for use in agricultural schools, etc. The long trip from Paris to Villefranche was undertaken especially to visit this establishment, and a very pleasant and instructive day was spent there. Mr. Vermorel, himself, was absent attending a viticulture convention at Trient, Austria, but he had arranged with his assistants to have the shops and machines thoroughly exploited, and also the viticultural station, laboratory, vineyards, and wine-house, which are located on his estate a few miles out of town. Many of Mr. Vermorel's machines and ideas have been copied by American manufacturers, and it was stated that no benefit had been derived from his attempt to exploit his contrivances on this side of the Atlantic, and especially at the World's Fair, at Chicago, where he made a very large and creditable exhibit, donating the apparatus afterwards to the Department of Agriculture. Several of his later and more complex machines were put in operation, and exhibited a very flattering degree of efficiency. Some of his distributors of liquids and powders are much better than anything of a similar sort that we have here. In his immense factory, with hundreds of machines ready for shipment, one gets a better idea than elsewhere of the universality of the practice, in France and adjoining countries, of controlling insects and fungous diseases by spraying and dusting or the injection of poisons into the soil. Practically all of these machines and methods are for use in vineyards—the culture of the vine being the great predominating industry of France, Italy,

Switzerland, and upper Austria—and everywhere the foliage of the grape presents the characteristic bluish-white effect of the Bordeaux wash. Spraying for insects, or other treatment, does not often present any visible indication, and is, for the most part, at other seasons and diverse in methods, such as the treatment for the Phylloxera and the various vine and fruit worms.

From France the writer passed rapidly through Switzerland into northern Italy, and thence through the Austrian Tyrol and Bavaria to Munich, and later to Vienna, making some stops between. Little, in an entomological way, was accomplished during this portion of the trip, excepting that derived from familiarity gained with the forest conditions and growth, the characteristic fruits and methods of culture in the districts passed through. As noted elsewhere, the summer of 1897 was an exceptionally unfavorable one for insects, and throughout this region no insect damage of any moment to either cultivated plants or forest trees was observed. Occasionally, especially in the Inn Valley, many trees were seen banded with insect-lime, and, later, similar applications were noted in some of the large royal domains or parks in Bavaria, but in no case did there appear any special reason for this banding, nor any evidence of damage from larvæ, and, furthermore, if there had been occasion for its use, the lime would have been utterly worthless as a protection against insects, because it had hardened and could offer no barrier whatever to the passage of larvæ over it. It was not surprising, therefore, to learn at Vienna that tree-lime is far from being generally esteemed, and that many intelligent entomologists deem it comparatively worthless, or a "mere fad." It is a new remedy, having been used to any extent in Austria only during the last three or four years.

At Innsbruck the writer had the pleasure of seeing Professor Dalla Torre, whose voluminous catalogues of the Hymenoptera have made him well known on this side of the Atlantic. He is connected with the K. K. Leopold-Franzens-Universität as assistant professor of zoölogy, and is a vigorous middle-aged man, most energetic in habits, and evidently a prodigious worker. A very pleasant half day was spent in his rooms, looking over his work and discussing entomological matters with himself and wife, who takes a keen interest in the science.

Munich, surrounded by its vast flat area of farmlands, devoted chiefly to the culture of annuals, has little to offer entomologically in the late fall. The region about Salzburg is interesting as a forest district, and as exhibiting the system of forest management. The trip from Linz down the Danube to Vienna, through the vast agricultural region bordering this river, marked here and there by little rural villages, was very interesting and novel to American eyes from the absence of scattered farm-houses—the village life predominating. This region was instructive as giving an idea of the agricultural and forestry conditions of the valley of the upper Danube.

In Vienna better fortune was had in finding in town most of the entomologists connected with the Kaiserlich Königlich Naturhistorisches Hofmuseum, and some very instructive interviews were enjoyed with several well-known students of insects at the Austrian capital. The "Imperial, Kingly Natural History Court Museum," a splendid, palatial edifice, just off the famous "ring strasse," and fronting and exactly duplicating the Art Museum on Maria Theresa Platz, is undoubtedly the most magnificent natural-history museum building in the world. The Department of Insects is most liberally provided for, having a number of very large rooms, amply furnished with large cases for the collections: There is no crowding, and ample space is present for immense additions of material. The collections seem to be well arranged and classified, and are perhaps in better condition than the similar collections in any other museum visited. It may be doubted if in any museum in Europe better conditions prevail or are the collections better housed and arranged. The value and character of the collections as depositories of types will not be discussed, but it may be merely mentioned that they contain Signoret's collection of 30,000 specimens in Hemiptera and most of his types, and in Diptera the collections of Schiner, Meigen, Low, Brauer, Rondani, and others.

To those who are more or less intimately associated with natural-history museum work in this country, a brief statement of the conditions governing the official staff and of the civil-service rules of this institution will be of interest. One sees here the principles of civil service carried out to their fullest legitimate extent. The higher positions of the museum are filled by regular promo-

tions from the lower places, and a man of ability entering at the very bottom, with a salary of perhaps 800 florins (\$320) a year, may ultimately reach the highest position in the museum, viz., that of "intendant" or official head. The officers of the museum are retired after forty years' service, on full salary, and if they choose to retire after twenty years' service, are paid thereafter one-half the salary received at that time of retirement. The hours of work are from 9 to 2 o'clock, and six weeks' annual vacation is granted.

The acting head of the museum at the time of my visit was Doctor Frederick Brauer, the famous dipterologist, who held the position in the absence of one or two persons still above him in rank. Unfortunately, Dr. Brauer was found very busy with an official meeting of the heads of different departments, and was able to see the writer but for a moment. Under the guidance, however, of Mr. Anton Handlirsch, one of the curators, a complete survey of the department of insects was made. In this museum the importance of the entomological work is fully recognized, and some six of the twelve men working in zoölogy are assigned to the Department of Insects, including such well-known names as Doctor Frederick Brauer, who has general charge and is Curator of Diptera and Neuroptera; Mr. Anton Handlirsch, Curator of Hemiptera; Doctor L. Ganglbauer, Curator of Coleoptera and Orthoptera; Franz Kohl, Curator of Hymenoptera, and Doctor H. Rebel, Curator of Lepidoptera.

The insect boxes employed here are of large size, nearly as large as the old boxes formerly employed in our National Museum, and are of very simple character, the glazed cover fitting with one flange into the bottom of the box, and the shoulders being lined with chamois skin to make a close joining. These trays or boxes are kept in large, low cabinets, arranged for the most part in the centre of the rooms. The collections are protected from pests by frequent inspections and the security afforded by the chamois-skin lining mentioned, and also by the inclosing cabinets, which are well made.

In Vienna there is no official entomological bureau charged with the economic phases of the science for the Austro-Hungarian Empire as a whole. Whatever information the government may desire, from time to time, relative to insects, is gained by direct

application to the museum by the Minister of Agriculture or other official.

In conversation with the entomologists of the museum some facts of more or less interest were collected relative to the appreciation of the subject of applied entomology in Austria, at least from the standpoint of the systematic entomologists of the capital. Of interest to us is the gypsy-moth problem. The larvæ of this insect are stated to be present every year, as are other forest caterpillars, but never, or rarely, become especially abundant. No faith was had in the theory that this insect is controlled or kept in check to any considerable extent by large predaceous beetles, such as the Calosomas, for the simple reason that the infested districts are too rare or remain infested for too short a time for any extraordinary multiplication of predaceous enemies. In other words, the gypsy-moth takes a position in Austria, and this seems to hold good for Europe generally, with the other common leaf-eating species, and occasionally is destructive over larger or smaller areas, disappearing after a year or two, and perhaps not returning for many years. The same succession of periods of insect damage of various sorts occurs there as here, and they also find, as here, that newly imported insects are especially destructive for a few years, and then subside into a condition similar to that characterizing the insects indigenous to the country. This is true of the Phylloxera, which at first caused excitement and alarm, but is now much less feared than formerly, and, in fact, is under very satisfactory control. The little faith manifested in insect-lime has already been commented upon.

Applied entomology receives considerable attention in Austria, however, in the agricultural, and particularly the forestry, schools, and especially at the Forestry Institute at Mariabrunn, near Vienna. The forest insect of perhaps greatest importance is the "Nonne" (*Psilura monacha*), which is the cause, at times, of most serious damage to the forests of Coniferæ of the Empire. Opportunity did not, however, offer to see any districts where this insect was abundant.

Among the other students of insects in Vienna, the writer had a very pleasant experience with Professor Josef Mik, the well-known dipterologist. Professor Mik has charge of the instruction in natural history at the Akademischen Gymnasium, of Vienna,

and his classwork is very heavy, averaging 18 hours every week. Most of his entomological work, therefore, is accomplished during his two months' summer vacation. His collection and library, and much of the work now in hand, was inspected. He is preparing, among other things, a popular work on entomology for school use, illustrated with handsome plates drawn by himself in highly creditable style. On leaving him the writer was much surprised and not a little confused to be saluted with a most hearty kiss, a custom for which an American would hardly be prepared.

From Vienna to Budapest is only a few hours' trip, and is through a region devoted to agriculture and the growth of vines, the latter hugging the hillsides and rough country, and the former covering the broad, almost illimitable valley of the Danube, which is flat and uninteresting, and devoted chiefly to the growth of cereals, here produced over such vast areas of rich bottoms that it would seem possible for this region to serve as a granary for all of Europe.

At Budapest there is a national museum of very creditable standing, and in applied entomology Hungary duplicates more nearly than any other European State, perhaps, the system of government entomological investigation in vogue in the United States, although necessarily on a much smaller scale. The agricultural conditions of Hungary are very similar to those of the United States, and practically the same questions arise in the matter of destructive insects. The account of this bureau given by Doctor Howard fully brings out this condition of affairs. The place of government entomologist or director of the Royal State Entomological Station, formerly held by Doctor Geza Horvath, is now filled by Mr. Josef Jablonowski, who has two assistants, and carries on the work of the station in very meagre and poor quarters in a rented building near the palace of the Department of Agriculture. Two or three days were spent with Mr. Jablonowski in examining his methods of work and in running about the cities which have been combined under the modern name of Budapest. The work done in the Entomological Bureau is chiefly of an office character and largely by correspondence, which is systematized somewhat on the basis of the work carried on by our Statistical Division of the Department of Agriculture. A large

corps of field observers send in replies gratuitously on printed forms relative to insect outbreaks, and advice as to remedies are sent out wherever needed. In special cases field investigations are undertaken, but the means at hand are limited, and such work is not very large in extent. The hours of work are the same as at Vienna—from 9 to 2 o'clock. Although no inquiries were made on the subject, it is probable that the salaries are small, judging from the fact that in the army a lieutenant receives from six hundred to a thousand gulden, or from two hundred and forty to four hundred dollars a year. The work, good as it is, is often hampered by the ignorance in scientific and practical matters of the Minister of Agriculture. One example of the result of this may be noted: A rather more serious outbreak than ordinary of the well-known grape pest (*Cochylis*) was reported over a wide territory, and there were consequent fears that the vine industry was seriously threatened. Although this insect is a common one and well known to viticulturists and entomologists, and one which has been studied and the methods of procedure against which have been exploited for years, yet the statement of these facts had little weight with the Minister of Agriculture, and the entomologist, Mr. Jablonowski, was commanded to immediately exterminate the insect in question. On explaining that this was impossible with the means at his command, he was peremptorily told to destroy the insect and do it within a week.

In the laboratory of Mr. Jablonowski were seen a number of interesting insects not yet known in this country, the introduction of which would be attended with very serious consequences to our agriculture. Perhaps the worst insects appearing in Hungary in recent years are the clover-leaf Apions, represented by two or three species of this genus,* which scarify and defoliate the leaves of the clover to such an extent as to nearly ruin it for purposes of forage or cropping. These insects seem to be rather general feeders, and are often, for instance, very destructive to the foliage of the fig. The migratory grasshopper of southern Europe is also one of the principal destructive insects of Hungary, and the operations against it are very extensive, but are chiefly of the mechanical sort. The locusts are driven into temporary inclosures and there destroyed wholesale, as has often been illustrated

* *Apion trifolii*, *A. assimile*, *A. apricans*.

and figured in publications with which our American entomologists are familiar. In the large agricultural museum, a relic of the recent exposition at Budapest, is a relief model illustrating this method of work. The Phylloxera has become pretty well distributed throughout Austro-Hungary, but, as stated, is kept very well in check, and is no longer especially feared. The methods of control practiced are, in the order of their importance, as follows: (1) planting in sand or gravel; (2) use of bisulphide of carbon; (3) the employment of American stocks. It will be seen that the usual order in point of value of these remedies is reversed.

In the matter of forest and shade-tree insects, a great deal of indifference is exhibited which is surprising, as one is led to believe that in Europe such matters are carefully looked after. The maples along the principal streets of Budapest are being much injured and often killed by the attacks of *Zeuzera pyrina*, the maple borer, which has recently gained lodgment in this country, and although the attention of the authorities has been called to the matter repeatedly by Mr. Jablonowski, no steps whatever have been taken to check the damage. Among other insects which have recently proven very destructive in parts of Hungary, and which would be especially dangerous to our wheat districts, is a leaf beetle (*Lema melanopus*) which skeletonizes the leaves of wheat and other small grains.

In the methods of controlling injurious insects, practically the same steps are followed in Hungary as are generally employed in this country. The arsenicals are not of the kind used here but are essentially the same. Soap and milk emulsions with petroleum are standard insecticides, but perhaps greater confidence is put in tobacco solutions, especially for the treatment of young forest growth as a protection from caterpillars. The confidence expressed in the protective action of tobacco solutions seems, however, hardly warranted by our experience with this substance. Mr. Jablonowski, differing from his compatriots at Vienna, spoke favorably of insect-lime, which he reported to be of value against travelling worms, and especially a brand manufactured at Prague, which retains its fluidity much longer than others.

The Royal National Museum of Budapest, already referred to, has, as custodian of the zoölogical section, Doctor Horvath, who

for a number of years was in charge of the State Entomological Station. Associated with him are some six other zoölogists, three of whom are working in the entomological section. The entomological collections, while not yet very extensive, and much cramped for space, are very creditable. Much zeal is also manifested in the collection of exotic insects, and at the present time the museum has a collector in New Guinea who is sending in a vast amount of material, most of which is undescribed, and represents the minuter forms of insect life. A good deal of careful scientific work is being done here, and, fortunately for the rest of the world, published, for the most part, in Latin. Mr. Alex. Mocsary, Custodian of Hymenoptera, who is remembered very pleasantly, has been especially active in the preparation of papers and monographs, notably a monograph of the Chrysididæ of the world.

Leaving Budapest, the writer passed, without stop, through the rather flat agricultural territory of Hungary, over the Hungarian National Railway, to Fiume, and thence to Trieste. The topographical features and the agricultural conditions of this part of Hungary present little that is distinctive, and strongly remind one of the similar districts in the States of the Mississippi Valley.

Fiume and Trieste are surrounded with broken, mountainous country, not differing particularly from northern Italy. The Italian race predominates, and the cultures are those of Italy.

More time was spent in Italy than in any other country, and the conditions, from an agricultural and fruit-growing standpoint, as bearing on the subject of affecting insects, were here more carefully studied than elsewhere. The same remarkable freedom from insect enemies noted elsewhere was found throughout Italy. In northern Italy, under the protection of the barrier Alps, and particularly in the region of the Italian lakes, olive and lemon culture is much in evidence. The latter is carried on most extensively, perhaps, on the sheer sides of the mountains rising from Lake Garda, under conditions which amount to house culture; in other words, winter protection of the trees is necessary for their safety. No more picturesque sight is to be seen anywhere in Europe than these steep mountain sides lined over large areas with curious lemon houses, open in summer and closed in

winter, and presenting conditions which would seem to be the very ones most favorable for the presence of injurious insects.

Southward of this region lies the valley of the Po, with the flat, open country of Lombardy and Piedmont, which has practically a continental climate—cold and windy in winter—colder even than England at some seasons—and with sharp changes of temperature and a very humid atmosphere, and hot, in summer, as Sicily. Beyond the Appenines Tuscany and the region about Florence is reached, which is again a great wine and olive district, with the lemon and orange growing safely out-of-doors. The Campagna of Rome and central Italy is devoted largely to the growth of cereals and to pasturage. About Naples the vegetation is somewhat more tropical, and the citrus fruits, and especially olives, are extensively grown. In January it frequently freezes, and the orange and lemon groves which stud the sides of the precipitous mountains along the coast from Salerno, Amalfi, and Sorrento to Naples have generally to be protected in mid-winter, usually by a hastily constructed shed covered with boughs of trees. The construction of these sheds was in progress everywhere at the time of my visit in November.

As careful examination was made throughout the region thus briefly described as was possible with the time at command for indications of presence of insects. With the exception of the olive-fruit fly, however, no insect damage of any moment was noted. Scale-insects were almost wanting, and this holds true even of the more neglected orchards and gardens where their presence would be manifest, if at all.

The principal entomological station of Italy is located at Florence, viz., the *Royale Stazione d'Entomologia agraria*, established in 1875. The director of the station, Prof. A. Targioni Tozzetti, was unfortunately absent during the week spent by the writer in Florence. The library, laboratory—if the meagre facilities provided may be so called—and the insect collections, both economic and systematic, are in the *Royale Museo di Storia Naturale*, Via Romana, 19, in connection with which Prof. Tozzetti fills the chair of Comparative Anatomy and Zoölogy of the Invertebrates, in addition to his duties as Director of the Entomological Station. Under the guidance of Prof. Tozzetti's museum assistant, Dr. Angelo Senna, a survey of the entomo-

logical rooms was made. The whole museum was being thoroughly repaired and refurnished, and the collections were not in shape to be seen to advantage. In the biological and economic series the display was not especially remarkable, and the systematic collections are also not of great interest, though containing Rondani's types of Italian Diptera. The practical experimental work is conducted by Dr. Giacomo del Guercio, who is the chief assistant in the entomological work of the Royal Station, and is also charged with the experimental work as well as the instruction in entomology, vegetable pathology, etc., which is carried on at the Royal School of Pomology and Horticulture, at Florence. This school, which was established in 1882, and has for its object the training of young men as experts in pomology and horticulture, was in session at the time of my visit, and was interesting as an Italian analogue, in a way, of our State experiment stations. A large tract of land, devoted to fruit and vegetable cultures of all sorts, is attached to the school building, and the students, some thirty in number, combine, in a three years' course, the study in the school-room of the practical and theoretical subjects relating to pomology and horticulture, with experimental and practical work in the garden and orchard. These students become experts in horticultural and allied matters, including entomology, and, on graduation, scatter throughout Italy to assume charge of work in the lines covered in the different provinces. This station, with its extensive grounds, affords a splendid opportunity for experimental work in entomology, and Doctor del Guercio has accomplished as much, if not more, work in this line than any other Italian investigator. One of the characteristics of this school farm is that all field operations are designed to be self-supporting, and are made to yield a reasonable profit, which gives it a decidedly practical character.

In the entomological work soap washes are most highly esteemed, and are used against nearly all insects, and particularly for the scale-insects and plant-lice. The usual time of application is in the spring, Doctor del Guercio stating that at other seasons the leaves are apt to be killed by the mixtures. To an American entomologist the soap solutions employed by Doctor Guercio appear very weak and inadequate. His principal wash is prepared by dissolving three parts of soap in one hundred parts of

water. Slight variations of this wash are made by adding to it one part of the extract of tobacco, or one part of potash. Another wash, which is recommended for such grape insects as the *Pyræle* and *Cochylis*, has also soap for its ingredient, and is prepared as follows: Soap, three parts, dissolved in one-half of one part of alcohol, to which is added one and one-half parts of benzine, and the whole combined with one hundred parts of water.

As already noted, the great crops of the region about Florence are the vine and olive. The former is grown throughout Italy, in rows, trained on trees or on very high trellis-work, and is rather carelessly cultivated and apparently very liable to insect attack, especially when trained on trees which furnish very convenient winter retreats for the chrysalids of the *Cochylis* or the larvæ of the *Pyræle*. The chief enemy, the *Phylloxera*, is kept in check by the use of American stocks, and planting in sandy or gravelly soils.

The olive finds its principal enemy in the olive-fruit fly, which Doctor del Guercio's experiments, he says, have demonstrated to be subject to control. Since this insect winters in the pupa state, either on the ground or near the surface, he has found that deep plowing at any time from January to May will very materially limit the pest. Nevertheless, this insect is present nearly everywhere, and the loss from it is necessarily great. Of other insects little account is taken, and not much damage is reported. Yearly examinations are made for such wood-boring insects as *Scolytids*, and the soap solutions mentioned above are used for the leaf-feeding insects. Egg-masses are carefully collected and destroyed in the winter.

In nearly all the principal towns in Italy are Royal Universities, most of which have a zoölogical section and museum, with a director or professor in charge. Prof. Carlo Emery, the well-known student of the *Formicidæ*, is thus connected with the Royal University of Bologna, and Prof. Achille Costa, for nearly forty years, has been similarly connected with the Royal University of Naples, and Director of the *Museo Zoölogica*. Unfortunately, opportunity did not offer to meet either of these men. The latter museum is chiefly interesting as containing the types of the genera and species described by Prof. Costa during the last half century in his "*Fauna del Regno di Napoli*."

There is little to be said of the economic entomology of Naples and vicinity. *The Royale Scuola Superiore di Agricoltura*, at Portici, a suburb of Naples lying under the shadow of Mount Vesuvius, was visited, but, unfortunately, both the well-known entomologist, Professor Antonio Berlese, who holds the chair of General and Applied Zoölogy, and his assistant, Dr. Leonardi, were absent, the former for an indefinite period, so there was no opportunity of adding to the writer's information by personal acquaintance or conversation with either of them.

The school is housed in the old Royal Palace, built by Charles III in 1738, and the somewhat neglected gardens and grounds attached furnish limited means for experimental work. There are comparatively few students.

Attention has already been called to the freedom of the olive and lemon groves, which abound along the Italian coast of this region, from injury by scale-insects.

An examination, also, of the fruit in the market, some of which comes from near-by sources, and also from more southern districts and from Sicily, failed to show any indication whatever of the presence of scale-insects. In other words, the same immunity from these pests was found at Naples which had been noted elsewhere.

Of interest, perhaps, to our lemon and orange growers were some of the incidents connected with our departure from Naples. On boarding our ship, one of the German Lloyds liners, we were delayed some hours by the loading of freight, which was almost exclusively lemons and oranges nicely boxed, and conspicuously labeled, "Queen of California," "Riverside," "Santa Barbara," and other equally familiar names, recalling our Pacific citrus districts. Much of this fruit, in fact most of it, was from Sicily, and was being transhipped at Naples for the American market. It included, among others, the "Naval" orange, which is now being grown considerably in Sicily and Italy, and which, as found in the markets of Naples, proved to be nearly, if not quite, equal in flavor to the California product.

Advantage was taken of the fact that the steamer touched at Gibraltar, to drop off, between boats, and spend a week in exploring southern Spain. From the standpoint of the entomologist, and especially for the writer, this region proved to be peculiarly

interesting, from its great similarity in every particular—climate, fruits, conditions of cultivation, etc.—to southern California. The region visited was limited to the ancient Moorish provinces of Seville, Cordova, and Granada, or what is generally known as Andalusian Spain. A brief reference to the climatic, cultural, and crop conditions of this part of Spain will facilitate an understanding of its status from the standpoint of the entomologist. This region is shut off from the colder northern table-lands by the Sierra Morena mountains, and most of it is subtropical in character. The climate is much finer than that of Italy, cooler and more bracing, especially in the higher districts about Ronda and Granada. The richer parts of this district are represented by the great valley of Guadalquivir and the Vegas of Granada. The olive, grape, and citrus fruits are the staples, the latter being best represented in the southern and eastern coast region from Malaga northward. The methods of culture have changed very little from a time much antedating the Roman period, and to-day, very generally, implements are seen in use in the fields closely resembling those described in the ancient writings of the Egyptians and Hebrews. Since the time of the Moors, much land formerly in a high state of cultivation has gone back to a state of nature, and this is especially true of the region about Gibraltar and Algeciras. A prominent feature of the landscape everywhere is the agave, which is grown in dense rows as a hedge plant. In recent years there has been somewhat of a revival in agriculture, due to the breaking up and distribution of the church lands and the building of railroads, and some modern methods have been introduced. English machines, and even steam-plows, have been experimented with. The country, as one travels through it, seems to be uninhabited by the farming communities. There are vast cultivated fields, but no dwelling-houses or other signs of human habitation. Village life is the predominant one, and little assemblages of tile-covered cottages dot here and there the vast regions devoted to the olive, grape, and cereal cultures. The climate, like that of California, presents a hot, dry summer, during which the rivers become dry ravines, but in the rainy season, in winter, are converted into torrents. Much of the land is cultivated only by means of irrigation, and this is seen, in its best form, in the vegas of Granada. Irriga-

tion, however, is not necessary for the growth of the olive and the vine. The system of pruning adapted for the latter, so far as observed, is what may be called the stump plan; that is, as soon as the grape is gathered the vines are cut away, leaving a mere stump which projects only a foot or so above the ground, and resembles, more than anything else, a big-headed bludgeon rooted in the earth. This system of culture is particularly unfavorable to the multiplication of injurious insects, because all of the vine and leaf growth is yearly removed, leaving nothing but barren stumps, which furnish little or no protection for, or means of harboring, injurious insects over winter.

The great fruit crop, however, throughout Andalusian Spain is the olive, and for hours, even days, the train passed through mile after mile of olive orchards in unending succession, covering plains, hills, and mountains; all in excellent state of cultivation; all trimmed and low-headed in the same manner, and presenting a most pleasing appearance, and an efficiency in methods and care not witnessed elsewhere in Europe. The most celebrated olive orchards are in the province of Cordova. The harvest begins in November or earlier, but at the time of my visit, at the end of this month, much of the fruit was still ungathered, and many of the trees were almost black with the ripening olives. Everywhere the trees presented the same beautiful appearance—low-headed, like the basket willow, so that the fruit may be easily gathered, and contrasting markedly with the Italian and California method in this respect, which allows the trees to grow as they will. Many of these orchards, most of them in fact, are of great age. The immense old gnarled trunks gave sufficient indication of this when they remained entire; but often they had split and divided into three or four trees, which, in centuries perhaps, had grown apart until they looked like miniature groves. Everywhere the same brilliant, clean appearance was presented, and there was no indication of the chief scale enemy of the olive (*Lecanium oleæ*), with attending sooty discoloration of the branches and foliage. These old orchards, some of them perhaps dating from the time of the Moors, if not earlier, have never received any treatment to protect them from scale insects, and their immunity is solely to be explained by the peculiar conditions of the climate, particularly the extreme dryness of the long

summers. The only important enemy of the olive throughout all this region is the olive fruit fly, already noted in Italy, which, at times, is a very grievous pest, and vastly injures the crop. Nevertheless the olive industry is a profitable one, as shown by the care given the existing plantations, their vast extent, and also the fact that new plantings are constantly being made. The Spanish olive oil, however, has not the reputation of the Italian oil, and as a result much of it is shipped to France and Italy, and there, perhaps, after some slight special treatment, is sent out as Italian oil. Locally it brings about 1 peseta per pound for the best oil, and the pickled olives bring about the same price per pound; the peseta, at the present rate of exchange, representing a value of 15 cents. In view of the immense quantities produced this seems a good price. Italian oil, in this country, ranges from 40 cents per pound upwards, and our California oil is much dearer.

The chief citrus districts, which border the east and south coasts, were not visited, but throughout the region traversed were numerous orchards of lemons, oranges, and mandarins, and in all the old gardens and the grounds of the palaces were miscellaneous collections of semi-tropical plants, including many oranges, mandarins, etc. A very careful examination was made of the trees in the gardens of the Alcazar, at Seville, and the grand court of oranges of the mosque of Cordova, the trees in which date from the sixteenth century, and also the gardens of the Alhambra, and, to the writer's amazement, in none of these gardens, many of them neglected and often presenting conditions particularly favorable for scale insects, were there any special indications of injury, either at the moment of examination or at any previous time, by the common scale pests of these trees.

WORST INSECTS.

In referring briefly to the worst insect pests of Europe, only those species which come under personal observation, or about which information was personally gained, will be noted. This section will therefore be a brief one, as it is not proposed to draw on the literature for matter.

In the portions of Europe where opportunity was had to make

anything like a thorough acquaintance with the conditions, the grape was the chief fruit crop, and this includes France, northern Italy, and much of Spain. Throughout all this region the grape has three important insect enemies; all the rest, and there are many, are seldom especially injurious, and are more often interesting as rarities than as possessing any economic importance.

The three species in question are the Phylloxera, the Cochyliis, and the Pyrale. Owing to the lateness of the season there was little to see of these insects, but many of the entomologists met had something to say of them.

More need not be said of the Phylloxera than has already been given in the foregoing pages. Their possible importance to grape growers in this country warrants devoting a few words to the other two species. The Cochyliis (*Tortrix ambiguella*) is the European representative of our grape-berry moth (*Eudemis botrana*). The first generation attacks the flowers, and if the blooming season is delayed by cold weather much damage is often done; the later generations attack the grapes—one larva destroying several, and in some seasons the loss amounts to three-fourths of the crop. In the hibernating season only would this insect be apt to be brought to this country, and the habit of this insect during this season greatly diminishes this danger, and perhaps accounts for our apparent freedom from it so far. About the end of October the last generation of larvæ spin up and transform to the chrysalis state on the old vines or in cracks of the vine posts, and, wintering there, are little likely to be transported on cuttings or young stock. The remedies are, gathering the fruit early while it still retains the larvæ; wetting the vines and stalks with hot water, which, to be successful, must be done in October, before the transformation to chrysalis takes place; and for the first brood, spraying the flowers or fruit only with pyrethrum and soap solution.

The Pyrale (*Tortrix pilleriana*) is another small Lepidopteron, very destructive in Europe but not known in America—perhaps here, again, on account of the hibernating habit not favoring its transportation. In July the eggs, to the number of 60, are deposited in a small mass on the upper surface of the leaves. The larvæ hatching in August swing down by a thread against the vine stalks and make a slight burrow and cocoon in the bark, in

which they pass the winter, very much as does our peach-twig borer. In the spring the young larvæ emerge, also like the last, and burrow into the young leaf-shoots, and feed on the leaves and young growth and fruit.

It is against this insect that the winter hot-water bath is most successfully employed, and excellent apparatus are constructed by Vermorel and others for the heating and application of the water. The treatment is on warm days in January or February after pruning, and with the water at a temperature of at least 92° Centigrade. In the south of France, about Montpellier, the pruned vines are covered with a zinc vessel and submitted to the fumes of burning sulphur for five to ten minutes. The egg-masses may be collected as a summer procedure. The cost of the water bath is about 17 francs per hectare (2½ acres), and of fumigation about 30 francs.

I have mentioned these two grape insects particularly because of the great importance of preventing their introduction into the United States. It is, however, true that many of the other grape insects of Europe might act altogether differently over here, and become quite as serious pests as the ones especially mentioned.

After the vine the fruit of greatest importance in southern Europe is the olive, and this, in the writer's experience, presented but one serious insect pest, viz., the fruit fly (*Dacus oleæ*). This insect occurred everywhere, often infesting every fruit, and while, in Italy for example, it was asserted that it could be controlled, it was very evident that it was far from being kept in subjection, and it was admitted that very little was attempted in this direction on the part of the ordinary grower. In exported olives, for sale in our stores, fruit absolutely free from this pest is rare, and in the cheaper grades frequently every olive will be pierced with the small hole made by the larva of this insect or eaten about the pit.

The olive fruit fly, as already stated, winters in puparia on or near the surface of the soil, and it is affirmed that deep cultivation between January and May will bury it beyond escape.

Very fortunately for our California olive growers this insect has also, so far, failed to reach our shores, nor does the likelihood of its introduction seem great. The thing to guard against most zealously is not to bring cuttings with soil from about living trees or plants with soil from infested localities.

Of the citrus fruits and their enemies in the regions visited, the general results of the examinations made have already been given. Of insects affecting cereal and forage crops, the lateness and the exceptional character of the season prevented any observations being made. This applies also to vegetable and truck crops. Attention may again be called, however, to the insects especially noted in the remarks on Hungary, and the work of some interesting species which were seen in the laboratory of the Government Entomologist at Budapest.

CONCLUSIONS.

In reviewing the foregoing notes one feels a considerable hesitancy in drawing general conclusions, so hastily was the trip taken and so fragmentary were the observations. The season was also exceptional, and, furthermore, it is a trite fact that insect damage or abundance is subject to extraordinary yearly fluctuations. With other years, or more normal seasons, the conditions might have been somewhat different; but, nevertheless, in the main, I believe the conclusions are just, and represent a fair, average condition.

It is to be borne in mind, however, in the reference to the little need or absence of efforts to control injurious insects, that the grape is always to be excepted, for throughout southern Europe it is subject to more or less careful treatment to protect it from both insect and fungous enemies, and is the one fruit in connection with which the European and American meet on the same terms, or with the advantage rather on the side of the latter.

The fact, often pointed out, that the need of entomological investigation, from an economic standpoint, is not felt in Europe to anything like the same degree as in the United States, received notable confirmation in my personal experience, for with the exception of the damage from the olive fruit fly in Italy and Spain, I did not see a single marked case of insect injury during my trip. It is true the season was particularly unfavorable for insect abundance. There was a great deal of rain, and it was unusually cold, and, what is more, the winter set in much earlier than is the rule. The freedom from insect damage was especially noteworthy in the olive orchards from northern Italy southward to

Naples, and also throughout southern Spain, and, so far as the foliage and twigs of the trees were concerned, a clean, bright, and healthy appearance was uniformly noted, as though they had never been subjected to any insect attacks whatever, and this notwithstanding the fact that many of the trees were seemingly several hundred years old. In other words, there was no indication of special damage by scale or other insects. This is certainly in strong contrast to conditions noted by the writer in California, where, under similar circumstances, the olive and citrus trees are often infested and blackened by the presence of *Lecanium oleae* and other scale insects. The excellent condition of the olive and citrus groves, particularly the former, of Europe is not due to any special care given them. In fact, it is to be doubted if any of them, in the regions visited, have ever been treated in a general way for insect pests. Their freedom from scale is also not explained by the absence of the insect itself, because the discovery of rare examples here and there, and especially in old gardens, was sufficient to prove its occurrence, if the fact were not otherwise well known. What has been said of the olive applies with equal force to the citrus fruits, and, in a general way, to other fruit and forest trees.

For most of Europe the conviction is forced upon one that climate has more to do with this immunity from insect enemies than any other agency. The cooler and shorter summers of middle Europe, comparable to our fall or early winter, almost, do not foster the multiplication of insects as do our longer and very hot summers. This can hardly apply with equal force to Spain, at least to the olive and citrus districts. Here, however, it may be inferred that the extreme dryness and heat of the summers may have the effect of keeping scale insects in check, as do the same influences in exceptional seasons in California. On this side the Atlantic it may be that the greater moisture, in connection with the long, hot summers in Florida, the West Indies, and the coast region of California, is the predisposing cause which leads to our serious affliction with scale insects.

The writer is rather inclined to doubt, also, the belief, frequently expressed, that parasitic and predaceous enemies are extraordinarily important in Europe, at least so far as the enemies of fruit trees and cultivated plants are concerned. That they are more

efficacious in preventing excessive damage by insects affecting forests may be true, but even here it is to be questioned if the results are much more favorable than often occur on this continent under similar conditions.

That there are insect outbreaks of a serious nature in Europe goes without saying, but, in the main, they are local, and usually die out naturally after two or three years. These remarks do not apply to the two great insect scourges of southern Europe, viz., the Phylloxera and the locusts, the former now infesting most of the vine regions of Europe, and the latter being often destructive to crops in southern Europe and northern Africa. Nevertheless, the general effect, and a very strong one, which the examination of the conditions made on the writer was that Europe is singularly free from damage by insects. For example, where a few scale insects were discovered or pointed out by local entomologists, they were so few in number and insignificant altogether as to be hardly worth considering, except as an indication of their actual presence, with attendant possibility that they might become destructive at some future time.

In the matter of the treatment of destructive insects it would appear, also, that we have little to learn or to gain from a study of the European methods, for the simple reason that injury is so much less frequent and less serious that wholesale and radical methods of control, such as are often necessary here, are seldom or never employed. This applies especially to the scale insects.

In estimating the value of this hurried examination of the condition of affairs in applied entomology in southern Europe, the writer personally sees the greatest benefit, perhaps, in being able to more correctly appreciate the facts of climate, forest growth, and methods of culture of fruits, etc., obtaining there, or, in other words, to exchange the hazy ideas formerly had of European conditions for more accurate knowledge. Without personal acquaintance it is out of the question, except in a general way, to get an intelligent grasp of methods of work followed in Europe, or to determine their applicability to our own conditions, which, while apparently often similar, are frequently altogether different.

In discussing the address, Mr. Fernow said that in his opinion the retiring president had taken too optimistic a view of the insect