possible. As we obtain most of our natural products and with them our new insect pests from non-British countries, it was necessary, if the scheme were to be of use to us, and in our opinion of real use to the other Colonies, that its survey should not be confined to the British Empire, but should be world-wide. Such a more extended scheme was considered to be desirable by us. I conferred with the Colonial Office authorities in London in January and in August, after the International Entomological Congress, the Rt. Hon. the Secretary of State for the Colonies called another conference of the Government entomologists of the Dominions and Colonies and of the Entomological Research Committee of the Colonial Office to work out a scheme for inspection co-operation.

At this conference the more extended scheme which we proposed was unanimously adopted and an Imperial Entomological Bureau will be formed and will be maintained by financial contributions from the self-governing Dominions and Colonies and also from the Colonial Office. It will supply information on the subject of insect pests and will also identify insects sent in by those entomologists who have not access to large collections or who are unable to get their material identified. One of its most useful functions will be the publication of a journal containing abstracts of current literature relating to insect pests and their control.

The co-operation which will result from the formation of this Bureau will be of undoubted benefit to the Colonies concerned and will materially assist all parts of the British Empire in their efforts to control insect pests."

AFTERNOON SESSION.

"CARBON BISULPHIDE FUMIGATION."

During the last ten to twenty years many methods aiming at the destruction of insect pests infecting trees, shrubs, plants and grain, etc., have been put into practice.

The problem has always been: What is the most deadly to the insects, the least harmful to the stock they infect, and also within the bounds of economic practice?

The methods in use may be quoted as, Spraying, Dipping and Fumigating. All three of these have their special merits, according to the conditions under which they are applied.

Fumigation has been very extensively adopted by the Government Departments in many parts of the world, for the purpose of preventing the spread of insect pests from one country to another.

For this work Hydrocyanic Acid Gas, for nursery stock, trees and shrubs, and Carbon Bisulphide for grain, roots and bulbs, etc., are almost universally used. The action of these two gases accounts for their separate uses.

The Hydrocyanic Acid Gas is lighter than air and works upwards. It is generated by placing Cyanide Potassium into an earthen jar containing Sulphuric Acid and water. It is one of the deadliest gases known, and poisons the lungs instantly. Owing to its rapid action, the nursery stock is quickly treated and does not have to remain exposed to the fumes long enough to do it injury.

There are certain insects, such as Spiders, Root Borers, some Moth Larvæ, Aphis, etc., that are immune to the short exposure and are capable of withstanding the gas longer than might be good for some of the nursery stock.

Carbon Bisulphide Gas is heavier than air and works downwards. It is a colorless liquid, resembling water, and is formed by the union of two elementary particles of sulphur with one of carbon. (The chemical symbol is CS.) The commercial Carbon Bisulphide is now made on a large scale by a new electric process.

The fumes of burning sulphur are passed over red-hot charcoal and the resulting vapors are condensed to a liquid by cooling. This liquid gas is one-fourth heavier than water. Its specific gravity is 1.29 at the freezing temperature of water. The gas is generated by coming in contact with the atmosphere, and is 2.63 times heavier than air. For this reason, it is peculiarly adapted for the fumigation of solid masses of grain, roots or soil.

There are hundreds of tons of imported rice and grain treated at the Vancouver and Victoria Fumigating Stations each year, and the process is as follows:

The sacks containing the rice or grain are stacked two or four deep on the floor of the fumigation chamber. Soup plates are placed at equal distances on top of the sacks, all windows and doors are sealed, and the amount of liquid Carbon Bisulphide necessary to the cubic space measurement of the chamber is distributed in equal quantities in each soup plate. The chamber is then closed and sealed for thirty-six hours.

During the process of distributing the liquid in the plates, one naturally becomes acquainted with some of the peculiar effects of the gas, which commences to generate directly it is poured out.

The operator does not experience any disagreeable sensation, and has no desire to leave the chamber, but after a few minutes he may

begin to feel a cool, tingling sensation penetrating his clothes, and a little later may experience a slight congestion at the back of his head. This should be a sign for him to get out into the fresh air, otherwise, if no one were watching, he might sit down and go to sleep, which would be fatal if he were not rescued in time to resuscitate. A few minutes in the fresh air will usually dispel all effects of the symptoms just referred to, though some men may be slightly intoxicated.

I recollect on one occasion, the man who was helping to distribute the liquid, went home directly we were through, and upon his arrival there, his wife accused him of being drunk, and the poor fellow was a total abstainer.

Another precaution should be taken, to see that no one smoking pipe or cigar comes anywhere near the chamber in which Carbon Bisulphide is being distributed. The gas is explosive and highly inflammable, and a warning should be posted on any building where it is confined.

Cubic space measurement for deciding the quantity to be used does not always work successfully. If the charge by space measurement does not equal one pound of Carbon Bisulphide for every ton of grain confined in the space, sufficient chemical should be added to equal that quantity.

I do not know of any insect confined in grain, roots or fruit, which was properly charged with Carbon Bisulphide for thirty-six hours, that has ever survived. Some insects require heavier charges and longer exposures than others.

When Japanese Brown Rice commenced to arrive in Vancouver, the question arose as to whether the Carbon Bisulphide fumes would affect the flavour of the rice. To test this, a small quantity of rice that had been fumigated and a like proportion that had not been fumigated were cooked in separate vessels, and given to the Japanese importers and others to taste. All declared they could not detect any difference in the odor or flavour of the rice.

The same results were obtained in making tests of fruit, such as pineapples, oranges, apples and pears. The flavour or condition of the fruit was not affected in the least.

When treated with proper care, the germinating power of grain, seeds and bulbs is not injured, if they are perfectly dry.

The CS2. has been used very extensively in fighting *"Phylloxera"* in grape vineyards in France and California. For this work considerable allowance has to be made for the nature and moisture of the soil; otherwise the treatment may result in great injury to the vines.

The same care should be taken when treating the root system of other trees, vines, shrubs, plants or bulbs, any of which may require a different method of application, according to their susceptibility to injury.

Willis G. Johnson, State Entomologist and former professor at Maryland Agricultural College, is editor of a very useful book dealing with the different methods of fumigation of all kinds of stock. (This book is published by the Orange Judd Co., New York.)

Several years ago the orchardists in California commenced using CS2. very extensively, in order to rid their deciduous fruit-trees of the peach-tree root borer, *"Sanninoidea opalescens,"* but, as the result of careless application, many trees were killed outright and others injured.

The favorite practice was to make a trench about six inches deep around each tree, pour in one or two ounces of the CS2. liquid and cover up the trench with soil. This treatment was very effective in killing the borers within twenty-four hours, when the soil around the tree would be removed and the space aired before replacing it. But injury resulted from applying the liquid to the bark of the tree, instead of keeping it two or three inches away, or in some cases the soil was too wet for the operation. Too much moisture in the soil, or sudden rain within a short time of the distribution of the liquid, would always result in injury.

I shall never forget the sight of a whole ten-acre block of fine seven-year-old prune trees on almond root totally destroyed as the result of careless application of CS2.

Carbon Bisulphide is a valuable servant, when properly handled, but capable of doing untold injury when used by inexperienced people.

The insecticidal properties of CS2. were discovered in 1856, but it was not until twenty years later that it was brought into prominence in France, for use in fighting *"Phylloxera."* This commercial grade is now known as "Fuma."

W. H. LYNE,
Assistant Inspector of Fruit Pests.

MR. CUNNINGHAM—I want to endorse what Mr. Lyne has said in his paper. Carbon Bisulphide is a most satisfactory fumigant after we are used to it.

MR. ANDERSON—What effect would it have on the Codling Moth?

MR. CUNNINGHAM—Very good effect.

MR. LYNE—Directly we undertake to fumigate and pass infected fruit on consignment the moral effect on the shippers is reduced.

MR. BRITTAIN—Importers would be only too glad to import infected stock to be cleaned here. Has anyone had any experience in fumigation by dry heat?

MR. TREHERNE—Certain experiments in the States, where mill and grain insects have been subjected to 122 degrees of dry heat have shown that all eggs, larvæ, and adults have been killed.

MR. WILKINSON—My experience with the use of CS2. in Victoria has been that it is very satisfactory. I remember fumigating a carload of beef scraps from Chicago which was alive with predaceous beetles of all kinds. The gas was highly satisfactory.

MR. LYNE—The United States will not allow raw hides coming from Australia through Vancouver into their country unless accompanied by a certificate of ours certifying that the hides have been duly fumigated by CS2.

MR. DAVIDSON—How long do you expose to fumes?

MR. LYNE—Thirty-six hours is full exposure. Less will not guarantee to kill all eggs of all species and the Mediterranean Flour Moth is also not affected by a lesser time.

MR. TAYLOR—What effect in comparison would Hydrocyanic Acid gas have?

MR. LYNE—The two gases have opposite properties in many respects and the differences account for their respective uses. Hermetically sealed cocoons of the Brown Tail Moth are not penetrated by Hydrocyanic Acid gas and many borers in root or stem or larvæ confined in their coccoons are immune the same way.

MR. CHAIRMAN—I now take great pleasure in calling upon Mr. Brittain for his paper and at the same time introducing him and welcoming him to this Province. He has recently been appointed Provincial Entomologist and Plant Pathologist for this Province and we hope as years go on he will be able to further our knowledge on British Columbia insects.

BENEFICIAL INSECTS.

by

W. H. BRITTAIN,

Provincial Entomologist and Plant Pathologist.

If we look into the history of our insect enemies we find that as far back as our records go they have been a source of annoyance and financial loss to those who make their living from the soil. As to