Some Diseases of Cotton as seen in the Plantations.[1]

IN order to facilitate research work being carried out in the University of Manchester, for the Empire Cotton Growing Corporation, a visit was paid to some of the cotton states of America in the summer of 1924. The diseases of cotton described were observed in the plantations of North and South Carolina. In that season, according to recently published estimates by the U.S. Department of Agriculture, fungal and bacterial diseases of cotton reduced the crop in the U.S.A. by 1,900,000 bales. The extent of these losses in what was a relatively favourable season for cotton-growing indicates the importance of these diseases.

In the United States some diseases are more important than others, but, at the present time, all of them may be important to Great Britain in view of the considerable extension of cotton-growing in progress in various parts of the British Empire. In some of these countries a new crop plant is being introduced; we have little knowledge how it will react to its new environment and we do not know what diseases will appear. It is certain, however, that some diseases will occur, and it is well known that a disease which is relatively harmless in one country may become destructive in another. This may be illustrated by some of the diseases seen in the United States. *Bacterium malvacearum* causes the angular leaf spot and a boll disease on Upland varieties of cotton (*Gossypium hirsutum*), the leaves and bolls usually being the only parts of the plant affected. The Sea Island and Egyptian varieties of cotton (*G. barbadense* and *G. peruvianum*) are much more susceptible to the attacks of the organism, which also affects the leaf-stalks and branches, causing the "black arm" form of the disease. This "black arm" disease is already causing serious concern in the Sudan on Egyptian cotton, although in Egypt, presumably on account of the different climatic conditions, it is not troublesome. It is now known that infection may be carried on the seed, and seed-disinfection has proved successful in preventing the disease in the United States.

Again, in the U.S.A. several root-diseases of cotton occur. Of these the Texas root-rot (Ozonium) and the wilt disease caused by *Fusarium vasinfectum* are of most importance. In the latter case the disease was studied in South Carolina on badly infected soils. The fungus present in the soil passes into the conducting tissues of the plant and, excreting poisonous substances, leads to dwarfing, wilting and killing of the whole plant. In the Sudan a root-disease (the Tokar root-rot), undoubtedly different from the Fusarium wilts or Texas root-rot, but capable of stunting and killing the plant by progressive infection, is also causing trouble. Work at present in progress on this disease should ultimately determine its cause and probably provide for its control.

Diseases of the immature or opened bolls are commonly caused in the U.S.A. by *Glomerella gossypii* (anthracnose disease), Fusarium, Diplodia, and by *Bacterium malvacearum*. The cotton lint is destroyed, weakened or discoloured by such organisms. Similar boll diseases occur wherever cotton is grown, and recent studies by Mr. R. W. Marsh on discoloured cotton from Nyasaland have shown that the yellow discoloration is due to a species of Nematospora, a fungus. In the West Indies this fungus has been shown by Nowell to be inoculated into the bolls by cotton stainer bugs, which puncture the bolls as they feed. Stainer bugs were observed feeding on cotton bolls in South Carolina, but up to the present the Nematospora fungus is not known to cause disease of cotton in the U.S.A.

Other diseases of cotton studied were those caused by species of Alternaria and *Ascochyta gossypii*. These have not hitherto been of serious consequence in the United States, but the latter is now spreading and both diseases may prove much more harmful in other countries.

Of the diseases to which reference has been made, several have as yet been imperfectly studied, and only by extended work on such diseases and on the organisms responsible for them will it be possible for the growers and plant pathologists in cotton countries to guard against outbreaks of disease and to devise satisfactory means of control when such outbreaks occur.

[1] Substance of paper read before the Manchester Literary and Philosophical Society by Dr. Wilfrid Robinson on December 8.

Causes of Volcanic Activity.

ON the occasion of the centenary of the Franklin Institute in 1924, Dr. A. L. Day delivered an address on volcanic activity, which appears in the journal of the Institute for August 1925. It is well known that the crater of Mauna Loa is 10,000 feet higher than the lava lake of Kilauea. Since more lava emerges from the higher vent than the lower, and eruptions rarely occur simultaneously, it is clear that the two vents cannot be connected with a continuous liquid interior. The changes of level of the lava of Kilauea would show periodic tidal effects if there were a molten cauldron underneath, but they fail to do so. Moreover, the lava lake was recently drained to a depth of 1500 feet, and a solid relatively cold bottom was exposed. A number of channels leading in from below were detected on the side walls.

Another firmly established conclusion is that the varying temperatures and fluidity of the lava are due to irregular uprisings of gases. These have evidently come from isolated chambers in which crystallisation is approaching completion, but at different stages from place to place. The gases pass up through various channels into the central basin, where they meet and react, and so produce the heat necessary to maintain the superficial vulcanism. The gases actually collected from the lava include hydrogen, chlorine, and sulphur, which, in association with others, make an unstable mixture that could not have come from any single source, since it is in a state of active exothermic reaction.

Modern volcanoes thus appear to be controlled by the liberation of gases from a crystallising mass below, and are very different phenomena from the fissure eruptions that gave rise to the great basalt plateaux of the Deccan and the Brito-Arctic region. The conclusion is amply confirmed by the study of the recent explosions of Lassen Peak, which were essentially due to the release of steam from a closed chamber of crystallising magma beneath the crater. Practically no chemically active gases were discharged, and consequently the temperature remained much lower than at Kilauea, and no lava was emitted.

No other North American volcano, and few in the whole world, have been investigated so thoroughly as Lassen Peak, and the magnificent memoir by Dr. A. L. Day and Dr. E. T. Allen (Carnegie Inst. of Washington, Pub. No. 360, 1925) dealing exhaustively with its activity in 1914–17 will take a high place in the literature of vulcanism. Lassen Peak began its life as a volcanic centre in early Neocene times, and has continued with diminishing violence down to the present day. It is now an old and dying volcano, for the explosive eruptions which began in 1914 followed a period of apparent extinction which had lasted at least two centuries. Only once during its four years of activity were red-hot ejecta witnessed, and it seems to be completely established that high temperatures, such as are attained at Kilauea or Vesuvius, played no part in the eruptions. The first explosions broke through the snow-filled crater basin, and open cracks developed, down which the melted snow disappeared. A year later a lid or plug of dacitic andesite was forced up the vent to the level of the old crater-rim, and just failed to rise sufficiently to expose the underlying volcanic hearth. A plane of weakness was formed, however, on the north-east side of the cone, and through this two devastating horizontal blasts forced a passage. The adjacent valleys were stripped of all vegetation for four miles, but no fires were started save momentarily where a few dead leaves were ignited. Trees were merely scorched. Solid ejectamenta embedded themselves in the snow without melting any appreciable quantity. The great floods that followed a day or two later were most probably caused by the condensation of superheated steam from the volcanic cloud.

The outburst seems to have been assisted by an earthquake that weakened the structure of the volcano, and also by the flowing of water from melted snow down the first-formed cracks. But though this water must have participated in the tremendous steam-explosions that followed, it can scarcely have been an essential contributory cause, for the violence of the eruptions increased long after the snow had gone, and quantitatively it was inadequate to account for the enormous volumes of steam that escaped during the 300 or more explosions that afterwards occurred. Another source for the steam must therefore be postulated. The authors suggest that the gases responsible for the explosions were for the most part in solution in the crystallising magma beneath the crater, water being by far the most abundant ingredient of these volatile constituents.

It is now well known that a silicate magma can hold a considerable quantity of water in solution under appropriate conditions. G. W. Morey has pointed out (*Journ. Washington Acad. Sci.*, vol. 12, p. 219, 1922) that as crystallisation proceeds with falling temperature, the pressure of the volatile constituents increases at a rapid rate. This deduction from laboratory experience and thermodynamical reasoning goes far towards elucidating, not perhaps the entire problem of vulcanism as Dr. Day claims, but certainly most of the superficial phenomena of present-day volcanoes. The discharge of water during crystallisation must develop immense pressures when it takes place in a closed cauldron. The pressure may find relief in a single tremendous explosion, as in the case of Bandai San; or intermittently, as at Mt. Pelée or Lassen Peak, according to the rate of release of the water, and the roof conditions permitting or resisting its active escape. That the water-content of magmas before crystallisation is greater than that of crystallised rock is proved by the high percentage of water which is retained by obsidians and pitchstones.

The concluding sentences of Dr. Day's address summarise a long and consistently sustained argument: "Through all of these studies our conclusion seems to stand fast wherever it is applied, namely, that the outstanding factor in determining the character of modern vulcanism is the gas content of the crystallising magma. If this be mainly of steam released in a closed chamber, as at Lassen Peak, then only steam explosions are to be expected as the surface manifestation of the crystallisation of the magma below; if to the steam are added such chemically active gases as chlorine, sulphur, hydrogen and the hydrocarbons, then chemical reaction between these will be a sufficient cause of higher temperatures, and lava flows of the character well known at Vesuvius, Stromboli or Kilauea." ARTHUR HOLMES.

Diseases of the Hop.

A NUMBER of interesting communications have recently appeared dealing with diseases of the hop. In particular a paper by E. S. Salmon and W. M. Ware (*Annals of Applied Biology*, 1925, 12, 121) discusses in detail a downy mildew which was first found in Europe in 1920 at the experimental hop gardens of Wye College. Since that year the intensity of the disease has been increasing rapidly, and it may become a serious factor in hop production in the future.

Previous to 1920 the disease was observed in Japan in 1905 (*Pseudoperonospora Humuli* (Miyabe and Takah.) Wils.) and in the United States in 1909, and there appears to be little doubt that the three diseases are identical. In 1923 the opinion was expressed that the fungus causing the disease had been imported into Great Britain from one of the countries mentioned, but subsequent work has led to the conclusion that it is indigenous. The downy mildew which is common to the nettle, *Peronospora Urticæ* (Lib.) de Bary, has been found to differ only as regards the size of the oospore from that occurring on the hop, and cross-inoculation experiments have led to the suggestion that the fungus may be transferred from one to the other. This is supported by the fact that infected nettles have often been found in close proximity to infected hops. Assuming then that the fungus from the nettle has found a new host, it would seem that the chance of infection becomes greater in a wet than in a dry season. This might account for the great increase in infection during the particularly wet season of 1924. On the other hand, a process of evolution may be taking place in which the hop is being infected by new forms of the downy mildew of the nettle, and in this case the prospect is rather more serious. Consequently the results of investigations during the 1925 season will be awaited with great interest.

It may also be mentioned that a similar disease has recently been noted for the first time in Germany, and as the nettle mildew is known to occur in the hop-growing districts of that country, some light may be shed on the problem from this quarter.

The disease is characterised by the appearance on the hop leaf of reddish-brown angular spots. Under the microscope these can be seen to consist of hair-like growths, which differ from ordinary hop mildew in that they are branched instead of unbranched. The branches bear conidia which drop off and spread the disease by germination in the presence of water. The hop cones may also be attacked, in which case the whole cone may turn brown and wither.

These symptoms must not be confused with those arising as a result of the "browning of cones" disease which in recent years has attacked hops on the Continent. This disease is also characterised by