eruption may be said to have come to an end. There are already to be seen fumaroles with beautiful incrustations of sublimated substances, especially of ammonium chloride. On the whole, this eruption of Etna has been of brief duration, briefer than would be expected, seeing the very low position of the mouth from which the lava was emitted. An end so premature was principally due to the lack of fragmentary material. The mouths of the eruptive apparatus were not able to form those great cones which, like monuments, indicate to posterity the hundreds of eccentric eruptions of Etna.

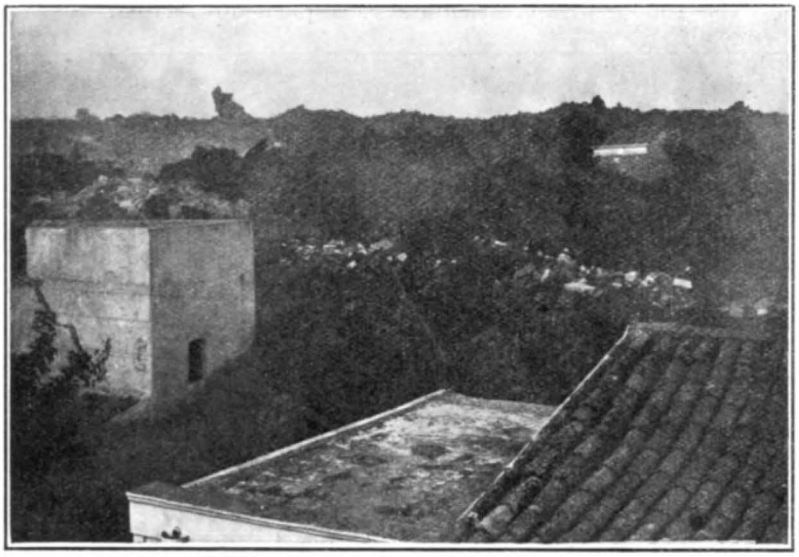

FIG. 4.—The last houses of Mascali burning.

Many threatened villages have been spared, but the district round Mascali remains buried for ever. After the tremendous eruption of 1669, which destroyed many villages and reached as far as Catania and the sea, passing rapidly over 18 km., this is the first instance of a district invaded by lava. At some future time, when the district now covered with lava once again enables plants to flourish and to provide men with means of living, the present eruption will be forgotten or will remain as an historical event, until another will come to revive its memory and pass through the same cycle of events.

A 'Growth Substance' and Phototropic Response in Plants.

THE remarkable development made in recent years in animal physiology in the study of the endocrinal secretions and their relation to growth has naturally encouraged the tendency to find growth-regulating substances in plants. Most such suggestions as yet are notable for their slender experimental basis, so that the more importance attaches to a recent dissertation by Dr. F. W. Went,[1] describing numerous experiments carried out in his father's laboratory at Utrecht, which are regarded by the author as establishing the existence of a growth substance (*Wuchsstoff*) in the organ of one plant, the coleoptile of the oat.

The coleoptile is a remarkable little structure—the first part of the shoot of the oat (or other grass) seedling to emerge from the grain into the air; it is a little hollow cylinder with a conical closed top which is burst through by the first leaf of the plant, when it is left as a collar around the base of the lamina. It has been the basis of innumerable studies in plant physiology, and it is no exaggeration to say that recently scores of papers have come each year from Continental laboratories dealing with this little structure. Indeed, one distinguished German botanist is reported as saying that there is at present a 'coleoptile fashion' in the German laboratories.

The reason for this intensive study is that the coleoptile is the classic object upon which was first demonstrated by Charles Darwin the reception of an external (light) stimulus at one point, the apex of the coleoptile, followed by a growth movement, curvature towards the light, near the base of the object. Thus the response of the plant to light apparently could not be the direct result of the action of light upon a complex growing tissue. Rather we had to deal with an external stimulus received in one region, from which influences then were transmitted which modified the mechanism of growth at work in another region of the plant. Thus the phototropic response of this little organ has profoundly influenced the development of botanical ideas as to growth and its response to light and gravity, etc.

The new outburst of experimental activity upon the coleoptile followed upon some interesting experiments by Boysen-Jensen, in which he showed that if the tip of the coleoptile were cut off and then replaced again upon the stump by the aid of a little gelatin, when the tip was afterwards illuminated laterally, the usual tropic curvature took place in the base of the organ. This immediately seemed to place the growth controlling machinery in the category of substances, in this case diffusible through gelatin, which were moving from the receptive tip towards the responsive base of the coleoptile. The one-sided illumination of the tip then modified either the formation or the subsequent distribution of these substances, or partially destroyed them, so that on their arrival in the basal region, unequal growth now took place.

Since Boysen-Jensen's papers an army of in-

[1] "Wuchsstoff und Wachstum," by F. W. Went. *Rec. des Trav. bot. Neerland.*, **25**, 1-116; 1928.

vestigators have entered this field and interpretations are almost as numerous as the workers; it is only intended here, however, to refer to the recent interesting monograph by Dr. Went, which, starting from the phototropic problem, has ended by contributing rather to the more general problem — the nature of the mechanism involved in normal growth.

Dr. Went has developed a most beautiful and careful technique for which reference must be made to the original paper, which is very clearly written and is full of interest. The crucial experiment, repeated in many forms, consists in placing a number of coleoptile tips (grown in darkness and manipulated in red light, to which they are insensitive) upon a thin slice of jelly (gelatin, agar or silica gel). When afterwards a little piece of this jelly is placed asymmetrically upon the cut end of another coleoptile, from which the tip has just been removed, the result is a negative curvature (*i.e.* away from the side receiving the jelly) which is interpreted as due to the growth substances diffusing from the jelly into the base of the coleoptile.

After 170 minutes or so (at 25° C.) this original negative curvature was followed by a positive curvature which soon cancelled the first curvature and is regarded as due to the regeneration of a new 'physiological' tip, which apparently forms first on the side of the cut stump not under the jelly, and from which a new supply of growth substances must be released into the base of the coleoptile. This 'physiological' tip is a very obscure phenomenon. The stump simply heals by slow suberisation and drying at the cut surface; there is no regeneration of active growing cells as when a wound phellogen forms beneath the cut surface.

Dr. Went shows by remarkable experiments that the amount of curvature produced is proportional to the number of tips that are put upon the jelly originally and to the length of time they are left upon it; in fact, that the curvature is determined by the absolute amount of this growth substance thus placed upon the stump of the reacting coleoptile.

Dr. Went is then led to consider how this substance, diffusing from the coleoptile tip, determines its growth. In the first place, the coleoptile exhibits a strictly limited type of growth. No new cells are formed throughout its extension in length, except perhaps in its two vascular bundles, and all increase in length is due to increase in cell size as the result of taking in water. Dr. Went's *Wuchsstoff* must act, then, by modifying this process of extension in cell size, and he suggests that it modifies the extensibility of the wall. Such an effect is a very subsidiary type of growth modification, and it is doubtful if it is desirable to call the substance producing it 'growth substance.'

Curiously enough also, the cells at the tip of the coleoptile, presumably the first to come under the influence of this substance, which Dr. Went shows is only produced at the tip and by no other part of the coleoptile, are the least extended in length in the coleoptile. He is thus led to suggest that there is a second necessary factor governing cell extension, namely, the supply of what he describes as the materials required for wall extension. These are supposed to come from the base of the coleoptile and to be limiting the extension of these apical cells. Presumably, such wall-extending materials would be carbohydrate in nature, and as the cells of the tip, as of the rest of the coleoptile, are originally packed with starch, it is a little difficult to accept this interpretation of the failure of the apical cells to extend in length. There are obviously other alternatives. For successful cell extension the extensible stage in wall development must coincide with the development of high osmotic pressures within the cell. Starch disappearance always begins at the apex of the coleoptile, and possibly the walls in this region are too thick and inextensible to stretch at the time that the rest of the cells of this organ are taking in water and extending.

Dr. Went discusses the mode of transport of the *Wuchsstoff* down the coleoptile. He confirms an earlier observation of Brauner that protoplasmic streaming occurs in the cells, and from his observations of this process concludes that this is responsible for a downward rate of movement which is 200 times too fast to be explained by diffusion. He has some very interesting experiments in which he watches the transfer of the substance from a piece of jelly at the top cut end, down the coleoptile and into a piece of jelly at the lower end. He concludes that some of the substance is missing, 'used up' in the length of coleoptile, though it is not clear why this missing substance should not be looked upon as in transit. He is unable in a similar experiment to get his growth substance carried in this manner *up* the coleoptile from a jelly containing it placed at the lower end. This is surprising, as presumably the streaming machinery should be equally effective in carrying substances in either direction, and, indeed, Dr. Went assumes that it is responsible for carrying the wall-extending materials up to the apical region of the coleoptile from the reserves in the grain.

Dolk's experiments had previously suggested that without the growth substance from the apex of the coleoptile, no extension in length of this organ is possible. Dr. Went is inclined to agree with this, and, indeed, not only in the coleoptile, but also in earlier experiments by Tammes upon shoot defoliation, the effect of such leaf removal upon cell extension in the internode was remarkable. The cells towards the base of the coleoptile are not so long as those farther up this structure. Dr. Went cut out the middle region of the coleoptile and placed the jelly with the growth-promoting substance on the cut stump. He thus obtained a slight elongation (six per cent in three hours) in cells of the stump which previously had ceased to grow, whilst without such jelly no increase in length occurred.

From experiments upon the rate of diffusion, Dr. Went is able to make a rough estimate of the molecular weight of the *Wuchsstoff*. On the assumption that it is non-ionised, he thus arrives at the figure 376. Until now, the substance has defied

chemical characterisation; it is present in such minute quantities in the jelly and probably contaminated by other substances diffusing from the injured cells. It has been impossible to produce similar activity by the use of any pure substance in its place.

A new chapter thus seems to be opened in the study of the correlating influences controlling the process of cell extension in the tissues of the plant. It is safe to predict that the subject will not be left long in this interesting state, but that further work will elucidate the connexion of the apex of the coleoptile with the extension of its base, and at the same time determine the significance of this mysterious *Wuchsstoff* that diffuses from the cut tip when placed on agar. J. H. P.

The Wright Brothers' and Langley's Aeroplanes.

IN the new wing of the Science Museum, South Kensington, in perhaps the most prominent position, will be found the original Wright aeroplane with a long descriptive notice. This states that it was the first power-driven man-carrying aeroplane to make a free, controlled, and sustained flight. The machine, which was built by Wilbur and Orville Wright, was flown by them on Dec. 17, 1903, at Kittyhawk, North Carolina, and its production was the result of their prolonged experimentation and research, which had been stimulated by the gliding experiments of Otto Lilienthal.

Since the first flights were made the aeroplane has been preserved in the Wright laboratory, but certain parts which had been damaged during their last flight, one extending over 59 seconds and covering a distance of 852 feet, have been replaced, and the machine restored to its original condition.

The fact that this machine, essentially American in ownership and manufacture, should be in the possession of a British museum is rather significant, and is the key to a publication which has just been issued by the Smithsonian Institution, dealing with their relations with the Wright Brothers. The publication, which was issued over the name of C. G. Abbot, Secretary of the Institution, is an attempt to clarify an unfortunate controversy, to correct misunderstandings, and to do justice alike to three great pioneers of human flight—Wilbur and Orville Wright, and Samuel Pierpoint Langley, who, as they themselves said, gave them "a helping hand at a critical time." The details of the controversy, which in parts is rather painful, need not concern us at present, but the difficulty was associated with the exhibition in the United States National Museum in 1918 of a reconstructed variation of a machine which Langley endeavoured to fly in 1903. The label attached to it originally described it as "The original full-sized Langley Flying Machine"; this was later amplified to include a claim that it was the first man-carrying aeroplane in the history of the world capable of sustained free flight; that it was tested over the Potomac River by Langley in 1903, and successfully flown in June 1914.

As a result of the controversy and further investigation into the actual flights carried through by this machine, the label was altered to indicate that in the opinion of "many competent to judge," the machine was the first "heavier than air craft" in the history of the world capable of free flight under its own power, since it had become clear that in the original test no proper flight had emerged. Smarting under a sense of injustice, Mr. Orville Wright presented their machine for exhibition for five years to the South Kensington Museum.

Committees connected with the Smithsonian Institution have investigated the historical accuracy of the statements which have appeared on the labels, and now in this pamphlet the invitation of the Smithsonian Institution to Mr. Wright is renewed, to deposit for perpetual preservation in the United States National Museum the Kittyhawk plane with which he and his brother, it is agreed, were the first in history to make successful sustained human flight in a power-propelled heavier-than-air machine.

As a further display of goodwill, the Institution is willing to let Langley's aeroplane rest on its merits, and has directed that the label on the Langley Aerodrome shall be so modified as to tell nothing but facts, without additions of opinion as to the accomplishments of Langley. The label now reads: "Langley Aerodrome. The original Samuel Pierpoint Langley Flying Machine of 1903. Restored."

No doubt it was because the Wright brothers have always been appreciated in Great Britain for their wonderful pioneer work in this new field of human endeavour that the machine was deposited in one of our Museums. Whether or no it should now be returned to the United States is clearly a matter for Mr. Orville Wright himself to decide. We, at any rate, in Great Britain shall be extremely sorry if it is to leave our shores; but in any case it is to be hoped that the Science Museum authorities will take steps to procure the production of as close a replica as possible.

Obituary.

PROF. T. C. CHAMBERLIN.

A MASTER of research has passed in Thomas Crowder Chamberlin, emeritus professor of geology in the University of Chicago, whose death occurred on Nov. 15, shortly after celebrating his eighty-fifth birthday on Sept. 25. His place is with the greatest thinkers of the past. He leaves few if any equals among his contemporaries. His far-flung research into the processes of the universe is a challenge to younger students to spread wings of imagination toward the unknown, but only with thorough understanding of the course to be flown and constant checking of the navigation.

Chamberlin, the glacialist, geophysicist, and cos-