

which are hard to accept and must surely have been founded on hearsay evidence, and perhaps too readily believed. We are told that when the blaeberrys have ripened, the woodcocks betake themselves to the hillsides and consume great quantities of the fruit! With regard to the statement that "deer, calves, and lambs" are taken by eagles, we wonder whether this may be a slip for "deer-calves and lambs," which sounds much more likely to be true. The book might have been smaller with advantage had it been confined to the relation of the author's most valuable observations. But a considerable amount of space is occupied with descriptions of the plumage of the birds treated of, and accounts of their distribution within and outside the British islands. Both these subjects seem to us to be beyond the province of the book. The descriptions seem to be unnecessary, and in some cases inadequate, while of the accounts of distribution it must be said that they are open to criticism. For instance, we are told that "there is no bird which has so

there are now only two pairs of them breeding in Britain. The extermination seems to have been effected mainly by sheep farmers and shepherds, their hatred of the bird sometimes prompting them to acts of unnecessary and cold-blooded cruelty.

There are some things in the book which might well be altered in a second edition. The author thinks that in our language there is no distinctive name for the peculiar evening flight of the woodcock, and treats "Röding" as only a Scandinavian one. But "road" is surely English, and the well-known tracks through covers pursued by woodcocks have long been called 'cock-roads. It is scarcely correct to say that prior to the nineteenth century no case of the woodcock nesting in Britain was recorded. Willughby (1678) mentions that they bred sometimes in England. White (1789) records nests, and Pennant (1776), Walcot (1789), and Lewin (1797) all record woodcocks breeding with us.

There is in the opinion of west-country ornithologists no ground for believing that the dotterel ever bred on the Mendip Hills. And the observation that this bird "is the only representative of the widely distributed and extensive group [of waders] to restrict her clutch always to three hostages to fortune" shows a want of knowledge of these birds. For, not to mention some others, the normal clutch laid by the Kentish plover consists of three eggs only.

There are between thirty and forty illustrations, the most pleasing of which show the wild scenery affected by the birds treated of. Others show the nests or young of birds, and we



FIG. 2.—Dotterel going to the nest. From "Hill Birds of Scotland."

notice occasionally the want of consideration for the feelings and interests of both sitting and young birds, which is sometimes regrettable, on the part of enthusiastic bird-photographers.

The publishers allow us to reproduce a beautiful picture of the haunts of those oyster-catchers which go far inland and high up to breed—the hills in the background with a fresh coat of snow, and the bulky collection of dead heather stems brought together by this erratic bird when (as it does sometimes) it constructs a nest in the true sense of the term; also a photograph of a dotterel going to her nest.

wide a range as the golden eagle—in fact, it is met with almost throughout the world." One of the pleasantest chapters in the book is that on the snow bunting. A curious incident is related showing the undoubted love of coolness which drives this arctic bird to the high Scotch mountains. One very hot day a bird which usually frequented a scree was found on a dwindling snowfield seeking relief from the heat. At times he would seek to cool himself by running over the snow with his head half-buried beneath the surface, and throwing up a furrow as from a diminutive snow-plough. The oyster-catcher (a name which we read at first with surprise among hill-birds) appears to be only a winter visitor to the eastern seaboard of Scotland—or such parts of it as the author is familiar with—and to retire to the hills to breed. Early in March oyster-catchers leave the river estuaries and make their way in pairs up the rivers—the Don and Spey, for instance. Near the source of the Spey the bird reaches, and is numerous on, a flat 1500 ft. above sea-level. We regret to read that the white-tailed eagle has decreased enormously during the last thirty years, and that

SCIENTIFIC METHOD IN BREWING PRACTICE.

IN his address to the Institute of Brewing, of which an abstract was published in NATURE of July 6, Dr. Horace Brown has given a very fascinating account of the gradual introduction of scientific method into the brewery, and his reminiscences, which extend over rather more than half a century, enable us to appreciate very

thoroughly the progress that has been made in this respect.

So familiar has the idea of the existence of bacteria become to the mind that some effort is required to realise the state of things fifty years ago, when brewing was carried on in total ignorance of the very existence of these ubiquitous organisms. At that comparatively recent date even the facts that yeast was a living organism and that fermentation was correlated with its growth and activity had only just been finally and definitely proved by Pasteur and were by no means universally accepted.

The recognition of these facts has placed in the hands of the brewer the means of instituting a rigorous system of control, which must be regarded as one of the most important applications of scientific method to the art of brewing. It is now recognised that infection by "disease" organisms is the cause of many of the troubles which beset the brewer, and, further, that these infecting organisms may either be bacteria or "wild" yeasts.

As in medicine, so in brewing, prevention is better than cure, and the brewer's first line of defence is the avoidance of infection from external agencies, such as dust, unsterilised casks, bottles, etc. This application of the elementary principles of bacteriology, simple as it may appear, has worked nothing less than a revolution in brewing practice, for we read that in 1865 the breweries in Burton were habitually shut down during the summer months owing to difficulties which we now know were due to infection. Another weapon in the hands of the scientific brewer is the system of "forcing"—incubating a sample of the beer for several days—whereby early information is obtained as to the stability of the beer and the presence or absence of dangerous infection. Even if infection has occurred and the dreaded *Saccharobacillus pastorianus*, which sours the beer by producing lactic acid from sugar, has increased to a dangerous extent, the yeast can be freed from it by subculture in the solution containing 0.1 per cent. of tartaric acid, which was originally proposed by Pasteur for this purpose. This purified yeast can then be used with perfect safety for pitching purposes. The statement made by Hansen that this treatment encouraged the growth of wild yeasts to a dangerous extent has not been realised in British practice.

The hops used in the production of beer provide a natural protection against bacteria, but not against "wild" yeasts, and it is to the undesired intrusion of these widely spread organisms that many faults of flavour and clarification are due. These wild yeasts grow chiefly on fruits, passing the winter and spring, as shown by Hansen, in the soil, and are therefore very abundant in dust during the late summer and autumn. They pass into the wort or beer in precisely the same manner as bacteria, but there find a friendly instead of an antagonistic medium, and they withstand the acid treatment which is fatal to bacteria. In the presence of a healthy culture yeast the wild yeasts only develop very slowly, but in their absence—

as, for example, when the beer becomes infected after racking—they may increase rapidly and cause serious trouble. The explanation of this inhibitive action of the culture yeast on the growth of the wild yeast is due to Dr. Horace Brown, who found that the growth of all yeasts is conditioned by the amount of oxygen which is taken up by the cells before fermentation commences. This is shared between the large amount of culture yeast and the small infection, and, since the quantity of yeast present only increases some five-fold during a large-scale fermentation, no great increase in the infecting organism is possible. If, however, infection occurs after racking, when only a small proportion of primary yeast is left, and if, at the same time, air, as is usually the case, obtains access to the beer, all the conditions for a well-developed yeast trouble are at hand. To be forewarned is to be forearmed, and, the conditions which conduce to contamination having been ascertained, the brewer is in a position to avoid these as completely as possible.

A further refinement, chiefly valuable when applied in addition to the most scrupulous "bacteriological" cleanliness throughout the brewery, is the use of air which has been freed from organisms by filtration. The wort, after having been boiled, is cooled and aerated. During these processes, before the addition of the yeast, there is a manifest danger of infection by air organisms, which is largely avoided by the use at this stage of filtered air. As already pointed out, however, the main source of danger in actual practice is the infection of the beer after the primary fermentation has been completed.

One of the chief triumphs claimed for the application of scientific method to brewing is the production and use of pure yeast cultures, by which, it is maintained, greater constancy of result is obtainable. Following the principles laid down by Hansen, such cultures are derived from a single cell which is isolated under the microscope, and serves as the origin of the whole of the yeast employed. This system is largely used abroad, but has not been adopted to any great extent in this country, partly owing, no doubt, to the national inertia, but partly to the different conditions prevailing in the top-yeast breweries. This system undoubtedly keeps the pitching yeast free from contamination, but is, of course, in itself no protection against the subsequent infection by wild yeasts or bacteria, which, as we have seen, is the most frequent cause of trouble. It is, moreover, doubtful, as pointed out by Dr. Brown, whether a single-cell culture can be expected invariably to reproduce all the qualities of a stock yeast, which represent the statistical average of the properties of an immense number of cells, all differing slightly from each other.

From quite a different side the investigations of the past half-century on the action of diastase on starch, both in the barley grain and in the mash-tun—investigations in which Dr. Brown himself has taken a leading part—have also largely contributed to the scientific control of the brewery. The mechanism of the processes of malting and

mashing has been to some extent revealed, and it is now possible, when necessary, intelligently to adapt the procedure to the special requirements of any particular case.

Throughout the address Dr. Brown pursues the thesis that modern surgery and preventive medicine are the children of the fermentation industries, the great development of these in recent years being primarily due to the ideas gained by Pasteur from his study of wine and beer. The argument is ably supported by an historical account of Pasteur's researches and of the gradual development of those conceptions which, partly owing to his own work and partly to that of others, led to our present views. The science of bacteriology is, however, not alone in having benefited so largely from researches on fermentation. Many other branches of science have indirectly been furthered by the study of phenomena first observed in the investigation of brewing problems. So widely, indeed, has the inspiration derived from the scientific study of brewing been diffused that the author, with pardonable enthusiasm, sums the situation in the aphorism, "Omnis Scientia ex Cerevisiâ."

THE BRITISH ASSOCIATION AT NEWCASTLE.

THE holiday which was suddenly granted throughout the north-eastern district had a greater adverse effect than was anticipated on the attendance at the Newcastle-on-Tyne meeting of the British Association. Many who in normal times would most certainly have enrolled were far away from Newcastle enjoying a well-earned rest from their labours in connection with the manufacture of the munitions of war.

The actual total attendance was 826, so that the meeting was even a smaller one than was expected. But the only person connected with the Association who has shown any sign of disappointment is the general treasurer. He, naturally, is primarily concerned with financial matters of the Association, and a small meeting means a correspondingly small and inadequate amount available as grants towards the expenses of research committees. The rest, from the President to the members who joined recently, speak in terms of appreciation and satisfaction of both the arrangements made for them by the local committee and the work done by the sections. Locally it is generally admitted that the results obtained justified the Council of the British Association in holding a meeting this year, and the members are of the opinion that, taking into account the circumstances in which the nation stands at present, the meeting was very successful. One fact which is both interesting and significant is that, while the total number of members present was far below that of normal years, the attendance at the meetings of the Sections in Newcastle was quite up to the average. In other words, nearly everyone who attended the Newcastle meeting was a real worker and

interested in the chief object for which the British Association was founded, viz., the advancement of science.

One of the outstanding features of the meeting, from the local point of view especially, was the election of the Hon. Sir Charles A. Parsons to the Presidency of the Association for the meeting next year. His name is a household word on the north-east coast, and any honour done him is genuinely appreciated by the residents, more especially the engineers and shipbuilders. Nor can we help mentioning an incident that happened on the last day of the meeting. It was small in itself, but it was kindly and gracious, and it helped to sow the seed from which will spring a still heartier welcome to the British Association than it has previously received in Newcastle, if that were possible. Owing to the scarcity of adult labour a troop of Boy Scouts was employed to act as messengers between the reception room and the Section rooms. These lads did their work admirably; they carried out their instructions to the letter, and earned the praise of the local committee as well as of the general officers. On the closing morning of the meeting those who happened to be in the vicinity of the reception room fairly early were glad to hear Prof. H. H. Turner thank the boys for their services and explain the objects and work of the British Association in a manner that helped them not only to go away feeling that they had rendered good service, but also with an ambition to become members in time to come.

The proceedings of all the sections were well up to the usual standard, both as regards interest and value. Among the subjects of important discussions were the investigation of the chemical and geological characters of different varieties of coal, with a view to their most effective utilisation as fuel, and to the extraction of by-products; science in education and industry; the effects of the war upon credit, currency, and finance; national aspects of fuel economy; the development of fisheries; political frontiers; and afforestation. Some of the main points brought out in these discussions will be described in later issues.

The General Committee adopted a recommendation of the Council that research committees should have power to report through organising committees of Sections to the Council at any time when the Association is not in annual session. Hitherto research committees have had to await the annual meeting before presenting their reports, even when their conclusions call for early action. Under the new rules this will no longer be necessary if the organising committee to which a research committee presents its report considers it desirable to report direct to the Council. Another alteration of the rules of the Association makes it possible for the Council to include upon research committees persons who are not members of the Association, but "whose assistance may be regarded as of special importance to the research undertaken."