left in charge of the wireless telegraph station, has been surveyed and its natural history studied. Here, and on the mainland, rare seals, fish, and numerous birds were obtained, with a large collection of eggs, most of which were previously unknown. Sounding and dredging were carried on, with excellent results, in the sea between Australia and the Antarctic continent. The rocks of the mainland appear to be largely crystalline, probably Archæan, with some sedimentaries (among which the Beacon Sandstone apparently occurs), containing coal and carbonaceous shales. Capping them are great masses of columnar dolerite (Fig. 1).

The climate of all the region explored seems to be even worse than that in the Ross Sea district. Blizzards are almost incessant, even in summer: the average annual velocity of the wind

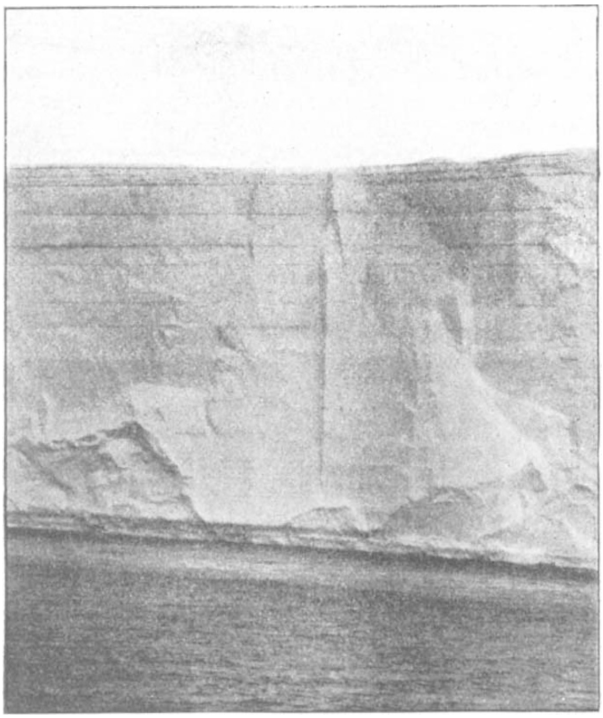

FIG. 1.—The face of the Shackleton Shelf. Each band represents an annual snowfall addition. From the *Geographical Journal*

being 50 miles an hour, and it often rises to above 100 miles. In winter the air is full of particles of ice, and the electricity generated is so great that hands, noses, and projecting parts of the clothes show pale gleams like St. Elmo's fire.

This portion of the Antarctic continent seems to be less mountainous than South Victoria Land, but its snowfields rise inland to heights of from 2000 feet to above 4000 feet; one of the exploring parties attaining in that direction an elevation of nearly 6000 feet. An ice barrier, like the well-known one in Ross Sea (named Shackleton's Shelf) defends most parts of the coast, and gives a still more conspicuous instance than that affords of projecting tongues of ice formed by the huge land glaciers, which force their way through the barrier, and protrude many miles, in one case quite sixty, out to sea. In other words the barrier exchanges the piedmont for the more normal glacier type. But in other respects the history of this floating ice corresponds with that of the Ross Sea Barrier. Its upper part, probably all visible at its extremity, is not land-ice, but stratified frozen snow, as shown in Fig. 2, formed by the accumulated annual snowfalls: the great part of the original land-ice having been melted off by the sea-water. Thus the rock *débris* incorporated in the lower part of that ice (and in these regions there cannot be much in the upper) must be distributed over the sea bottom—a fact of which the advocates of the terrestrial origin of all boulder clays will do well to take cognisance. Thus a fine piece of work—geographical, meteorological, botanical and zoological—has been accomplished, and Australia, as in the case of the Funafuti boring, has done a most notable service to science.

T. G. BONNEY.

DETERIORATIVE CHANGES IN WINE.[1]

SINCE the time when Pasteur, in his "Études sur le Vin," described a certain bitterness sometimes occurring in wine (*Maladie de l'amertume*) as being apparently due to a specific micro-organism, most of the forms of deterioration which wine undergoes have been recognised as due to biological action. Thus the *Kahmigwerden*, the *Essigstich*, and the *Milchsäurestich* of German writers, the *poux* and the *graisse* of French œnologists, are ascribed to the undesirable activity of various bacteria, moulds, and yeasts. Sourness, for example, is often due to acetic acid produced by the ferment *Mycoderma aceti* from the alcohol of the wine; whilst another mycoderm (*M. vini*) is believed to produce faulty wine by attacking the cream of tartar and albuminous extractive matters.

Some of the faults which may develop in wine, however, are attributable to causes not primarily biological. A certain kind of mustiness, for instance, is ascribed to the effect of a malodorous essential oil. The presence of iron salts, again, has been recognised as a necessary condition for the appearance of a particular kind of turbidity—the *casse ferrique*—which in certain circumstances may affect white wines. With this phenomenon oxidation processes are known to be associated, and the intervention of an oxidase, transferring oxygen from the air to substances in the wine not directly oxidisable under ordinary conditions, has been suggested to account for the results observed.

Dr. Horace Brown has studied at considerable length a variety of *casse* to which the white wines of the Cape are particularly liable. Although the wines may have been bottled perfectly bright, they have a tendency to become

[1] "An account of some investigations on the White Wines of South Africa: an Œnological Study. By Horace T. Brown. *Journ. Inst. of Brewing*, vol. xx, No. 5.

cloudy and to throw out a light deposit. This tendency is accompanied as a rule by more or less darkening of colour, and by modifications in the flavour and odour which are very characteristic. Even before any *casse* or "break" (cloudiness) is observable in them, wines undergoing this change acquire an "earthy" odour or *terroir;* and simultaneously a distinctive bitter flavour of a greater or less intensity is developed. These faults—cloudiness, earthy odour, bitterness, and modification of colour—may exist in different degrees, but are apparently all related to a common cause; and Dr. Brown's experiments indicate that this cause is not to be sought in the action of micro-organisms. The malady is conditioned by purely chemical changes. Moreover, it only occurs when the wine is in contact with air, or with free oxygen derived from some such source as hydrogen peroxide.

Naturally one of the first things to ascertain in studying the malady was the true character of the suspended matter forming the turbidity. Under the microscope it was found to consist of amorphous aggregates of minute, roughly-spherical particles, which were readily stained by Coupier's blue, dissolved easily by caustic alkali, and also, though with some difficulty, by dilute acid. Except in this last point the deposit resembles the amorphous matter which separates from beer in certain circumstances, and which has been shown by Dr. Brown himself to consist mainly of a combination of tannic acid with albuminoids. The actual amount of the deposit necessary to give a distinct turbidity to wine is relatively very small: in one instance the weight of the substance when dried was only 6·4 milligrammes per litre of wine. The organic portion of the deposit contained nitrogen equivalent to 55·9 per cent. of albuminoids. When incinerated, the dry substance of the deposit yielded 12·9 per cent. of inorganic material, four-fifths of which was ferric oxide. In fact, a striking feature about all the deposits in this kind of *casse* is the comparatively large proportion of iron which they contain.

It was found, further, that an essential factor in the production of *casse* was the presence of a little iron in the *ferrous* state. This apparently acts as a carrier of atmospheric oxygen to certain oxidisable substances in the wine, much in the same way as traces of ferrous salts behave in the well-known "Fenton" reaction.

Systematic experiments showed not only that air and ferrous salts are necessary, but that certain oxidisable substances in the wine are also required. Of these the most notable is tannic acid; and the author concludes that the material forming the turbidity or deposit is in fact "a colloidal combination of iron with products derived from the limited oxidation of tannins and certain wine-albuminoids." This does not, of course, tell us all that it is desirable to know about the deposit and the conditions of its formation. The question of the nature and amount of the nitrogenous substances in the wine, and the part they play in the production of the changes, has still to be investigated. As the author remarks, wine-making has its own particular "nitrogen question," and it is at present virgin ground.

Good evidence was obtained to show that the oxidising agent concerned is not a vegetable oxidase. Freshly expressed grape juice contains no oxidase, though it may dissolve some from the grape skins if left in contact with them. In any case there appears to be no connection between the occurrence of oxidase and the *casse ferrique.* The immediate cause of this deterioration is the alternate reduction and oxidation of iron, with consequent transference of oxygen to the changeable tannins and other constituents of the wine.

Now if this is true, it points the way to preventive and remedial measures. One such measure, obviously, is to avoid so far as possible the must or wine taking up iron at any stage of the making or storing. If, however, an excess of iron cannot be helped, it would be expected that the addition of a reducing agent to maintain the iron permanently in the ferrous condition would prevent the occurrence of the malady. This was found to be so, the action of sulphites in this respect being very pronounced. Again, since tannic acid is one of the essentials, its removal should be beneficial; and in fact the addition of casein to the wine has a favourable influence which is attributed to an adsorptive separation of tannin by the casein. As regards the other essential condition—the presence of air—the author recommends that aeration of the wine should be guarded against during the maturing and bottling operations, and that the bottles should be completely filled. In this connection it is noted as unfortunate that the visitor to the Cape generally makes the acquaintance of South African wines for the first time on the ship going out. The bottles are frequently not completely filled, and this, with the alternations of temperature and the swing of the ship, helps to produce the malady in question, especially in the more delicate white wines.

The faults mentioned are so common in the white wines of South Africa that the author at one time regarded them as due to some fundamental causes, such as soil and climate, which were beyond control. But the occurrence of perfectly "clean" wines, the production of such wines under his own auspices, and the results of the investigation which has been outlined, have altered this view. Not Providence, but the producer, is responsible—or at least, the producer and the merchant must share the responsibility.

The scientific study of this question made by Dr. Brown, necessarily incomplete though it is, has given definite knowledge where hitherto information has been vague or absent, whilst the practical application of this knowledge indicates the direction in which remedial measures are to be sought. It is to be hoped that the author will be able to extend the research to the "nitrogen question" already mentioned, and with equally definite results.

C. SIMMONDS.