erode its base, surely miles of the very same mass of ice, with the same mud and stones, when broken off and driven by wind and current on a shelving shore, must grind and polish the floor on which it is driven.

It is difficult to follow the explanation offered of the pushing up of shells belonging to temperate climates by the great ice sheet, or the wrenching off of large masses of rock underneath the ice, except on the supposition that all this was done during the *first* advance of the ice over the sea bottom, and over a surface irregularly fretted by subærial action. When once the sea-bed had been swept, no more such life would be there till the ice receded; and, when the crags had once been planed down, there could be no more jagged rock for the ice to break off and carry along. Moreover, it does not seem to have been observed that the flints so universally distributed through the marine gravels, such as those of Moel Tryfaen, are rusty gravel flints, and that there is no long interval without them all round the southern and central portions of the British Isles.

The point, however, to which our author seems to attach greatest importance is the occurrence of interglacial periods. He describes successive sheets of boulder clay, each of which is the accumulation of a separate and distinct ice flow. He points out that the fauna and flora found in beds interstratified in these clays are suggestive of alternations of cold and damp conditions with those indicative of a warm and genial climate. In Scotland and Scandinavia the gradual disappearance of the latest ice-sheets was, he says, marked by a partial submergence, but a great submergence he does not believe in, and, after describing the grand series of moraines which stretches across the northern states of America into the British possessions, says that "no one who has traversed the regions I refer to is at all likely to agree with Sir W. Dawson's view that the American mounds, &c., are the shore accumulations of an ice-laden sea."

We regret the somewhat assured manner in which the views of those who differ from our author are dismissed. Sir William Dawson traversed the regions referred to by him (p. 190) and arrived at a different conclusion; and there are some who have not confined themselves so exclusively to the subjects on which our author has made himself a name, who yet do not deserve to be excluded from the list of geologists because they do not agree with him on every point. It would be well also if he would strike out from any future edition all references to "the trained observer" and "the experienced eye," as his readers cannot help recalling many instances where trained observers have differed in interpretation, and where, the position having been shifted, even the experienced eye has seen things differently at different times.

Though our author could not in these essays discuss fully the various points which must be fixed before any theory can be considered as fairly established, he has indicated the lines of reasoning on which he would rely.

His position seems to be that there are known to recur such astronomical combinations as by a general lowering of the snow line would be sufficient to account for glacial conditions with such distribution of land and water as for instance prevail at present; that with unfavourable geographical arrangement no glaciation is possible; that the

greater part of the results observed were produced by land ice, icebergs playing quite a subordinate part, and marine currents of any considerable volume and velocity being quite exceptional; that within each period of possible glaciation there were alternations of conditions of greater or less intensity corresponding to established astronomical cycles, and that the evidence of these were to be seen in certain beds intercalated in the drift. He admits, but explains away, the absence of evidence of the regular recurrence of such effects throughout the previous geological ages.

The geographical theory which he principally combats may be briefly summed up thus: There have been through all time terrestrial movements of wider or narrower extent which have carried portions of the earth's surface to depths below the lowest known abyss, and raised portions through distances greater than the highest mountain peak; the depression and elevation of extensive areas or ridges must, with sufficient precipitation, deflect ocean currents and produce such snowfields as would feed the largest glaciers or ice-sheets required in explanation of the drifts, boulders, and accompanying phenomena; there is evidence of movements on a grand scale since the period of great cold and similar movements have been going on up to a quite recent date, and these, if extended over a longer time, would produce all the effects required.

In the course of these addresses our author is frequently led to speculate upon the causes and some of the effects of earth-movements, and we find (*e.g.* pp. 129, 267, 342) such a good case made out every now and then for the geographical theory that we cannot help feeling that the difference between the two schools is not irreconcilable but this is a vast question which cannot be settled till many possibilities have been considered.

The various theories referred to have been built up on such a number of observations and hypothetical explanations that it is impossible to discuss them in one volume of essays, still less in a short review of that volume.

All the more, however, because the subject involves so many matters of controversy, do we welcome the publication of the latest views of one who is so skilled an observer as our author, and so competent to watch the progress of research in regions beyond that which he has especially studied.

WATER BACTERIA.

Diagnostik der Bakterien des Wassers. Von Dr. Alexander Lustig. Zweite sehr vermehrte Auflage. 128 pp. (Jena: Gustav Fischer, 1893.)

THIS is, we believe, the first attempt made to gather together in a compact form the various descriptions of bacteria which from time to time have been isolated from water by different observers. In those cases where the water investigator is concerned only with the number of microbes present in any given water, the task of mere enumeration is such that, however anxious to do so, it is almost impossible to take an intelligent interest in the nature of the microbes present, beyond a superficial glance at their more striking characteristics. But even this is sufficient to indicate what numbers of different

kinds of microbes are present in water, whilst on a closer examination the list of varieties is very much more extended. Having regard to their superficial differences, then, Lustig, following the example set by Eisenberg in his "Bakteriologische Diagnostik," has mapped out two classes of microbes—those which liquefy and those which do not liquefy the gelatine—which are again divided up into micrococci and bacilli respectively. The tabulated account appended to each micro-organism includes its microscopic appearance, behaviour in gelatine-plate and tube-cultures, on agar-agar and potatoes, relationship to pathogenic properties, temperature, together with other special tests which have from time to time been employed, as well as the authority for its discovery in water.

In addition to the above classification, those bacteria which are known to be pathogenic to man and animals respectively are separately grouped, whilst those bacilli resembling the typhoid bacillus are brought together for purposes of comparison. The latter should prove a useful assistance in the separate diagnosis of the typhoid bacillus, for as it is by no means specially characteristic either in its macroscopic or microscopic appearances, there are many forms which may readily be mistaken for it on an ordinary water-plate.

We do not quite understand why Lustig has not rendered the cholera spirillum a similar service. There exist many spirilla in water which bear the most striking resemblance to Koch's comma spirillum, but which subsequent searching tests have proved to be distinct. Koch himself only a few weeks ago stated that no less than a dozen different vibrios had been isolated in his laboratory alone, from various waters which he examined last autumn during the cholera epidemic, none of which were the cholera spirillum, whilst other investigators have identified and described spirilla bearing the closest resemblance to the original comma spirillum.

Amongst the organisms pathogenic to man found in water we miss the tetanus bacillus. This organism was detected by Miquel in the rivers Seine and Marne, and G. Roux states that he found it in large numbers in the sediment of the filter beds belonging to the water-works supplying Lyon with river Rhône water, whilst Lortet alleges that he discovered it in mud obtained from the bottom of the Dead Sea. In a future edition the anthrax bacillus must also be included, since it has recently been detected in the sediment at the bottom of a well, to the water of which an outbreak of anthrax amongst a flock of sheep was traced.

In the preface to the German edition Baumgarten writes: "Grössere Reihen von 'Wasserbakterien' sind schon früher von anderen Forschern (Frankland, Maschek, Adametz, W. Zimmermann, Tils) auf Grund eigener Beobachtungen und Untersuchungen beschrieben worden. Diese sowie alle sonstigen, verstreut in der Literatur . . . ist Lustig's Verdienst vereinigt zu haben." It is obvious that in a guide of this kind the list should be as complete as possible, and it is, therefore, surprising to find many important and quite unaccountable omissions. For example, none of the interesting phosphorescent bacilli obtained from sea-water by Forster, Fischer, and Katz are described, neither is any mention made of the organisms isolated by Russell from sea-water.

Amongst other organisms conspicuous by their absence may be mentioned the *bacillus thermophilus* originally found in large numbers in river Seine water by Miquel, the anærobic bacillus, *B. amylozyme* obtained by Perdrix from the same water, the *bacille rouge de Kiel* so carefully studied by Laurent, the "peach-coloured bacterium" of Lankester, whilst Roscoe and Lunt's sewage organisms, and Tataroff's large collection of bacteria isolated from the Dorpat water are entirely overlooked.

The descriptions appended are often provokingly incomplete, and this greatly militates against the value of the book in assisting in the identification of a particular organism, whilst in some cases the details are not always correct.

The book was originally written in Italian, so possibly during the translation into German errors and misprints may have crept in which were not present in the original, but it is none the less troublesome to find wrong references occasionally given, whilst the description of the same organism twice over, which occurs more than once, ought surely to have been guarded against. As an example of this we may mention a bacillus found by Claessen (mis-spelt Claesten) in unfiltered river Spree water, and described on p. 62 as the *Indigoblauer bacillus*, whilst on p. 70 we find it figuring again as *bacillus, Berolinensis indicus*!

In order to bring the descriptions up to a level with those in Eisenberg's "Bakteriologische Diagnostik," even (and as the volume before us deals solely with water-microbes, they might not unreasonably be expected to be fuller) careful revision will be required, and the evident signs of haste which at present characterise its pages conscientiously removed.

Such an array of different water microbes, to each of which is given a "local habitation and a name," might well make the reader say with the "Ancient Mariner," "Water, water, everywhere, Nor any drop to drink;" but it is reassuring to find that out of the 181 varieties found in water, only six are stated by Lustig to be pathogenic to man.

P. FRANKLAND.

POPULAR METEOROLOGY.

Katechismus der Meteorologie. Dritte Auflage, gänzlich umgearbeitet. Von Prof. Dr. W. J. Van Bebbber. (Leipzig: J. J. Weber, 1893.)

THE object of the author of this little book is to present as briefly and intelligently as possible the fundamental principles of meteorology, in a manner which will enable the public to form for themselves an independent judgment on the meteorological conditions prevalent at the moment, and to make the knowledge so obtained available for the purposes of daily life. The author, who is well and favourably known as a popular writer on meteorology by his *Lehrbuch*, thinks that this eminently practical object can be best effected by placing his information in a catechetical form; a method of conveying instruction which appears to find great favour in Germany. This particular work is already in its third edition, and is the sixtieth of a series which in its entirety probably comprises more than twice that number of works devoted to the culture of science, art, and indus-