relation to it as the sour-milk bacterium has to the curdling of milk.

### Objects of the Ripening of Cream.

There seem to be two chief objects in ripening cream. It is a matter of experience that the butter will separate more readily from ripened cream, and the churning therefore be easier; and it is believed by many that the butter made from ripened cream will keep longer than butter made from sweet cream. A simple explanation is suggested, if not warranted, by the facts at hand, and may be of interest to butter-makers. Dr. Babcock of the Wisconsin Agricultural Experiment Station has pointed out, that, shortly after milk is drawn from the cow, there appears in it a fine, inappreciable network of fibres, which produce in the milk a slight thickening somewhat like the clotting of blood, except that it is much less marked. This, which Babcock calls "fibrine," is of an albuminous nature, and will readily putrefy. When the cream rises to the surface of the milk, a considerable quantity of this so-called fibrine is entangled with it, and is skimmed off with the cream. The butter-globules are enclosed in this fibrine, and in churning they must be shaken out. Now, in the time that the cream is ripening, the numerous bacteria are at work upon this albuminous fibrine, feeding upon it and decomposing it. The breaking-down of the fibrine is also assisted by the acid that is formed by the bacteria, for it is a well-known fact that acid will greatly assist in the solution of materials similar to this fibrine. After the fibrine is thus partly dissolved by the action of the bacteria, the butter-globules will much more readily be shaken free from them, and churning be made easier.

The keeping-property of the butter is easily explained by the same considerations. There is no doubt that bacteria are the cause of rancidity in butter. Bacteria cannot live upon pure fat, but require for food a certain amount of albuminous matter. It follows that the more albuminous matter there is in the butter, the more readily will they grow, and the quicker will the butter become bad. If the cream is churned before the albuminous fibrine has become decomposed, the butter will usually contain more of the fibrine than will butter made from cream after the fibrine has decomposed. Butter made from ripened cream will naturally contain more bacteria than that made from sweet, since the ripened cream itself contains them; but this is a matter of less importance than the ability of the bacteria to grow and multiply in the butter, and, for reasons above stated, this they can more readily do in butter made from sweet cream.

From this it would seem that the value of ripening cream depends upon the albuminous fibrine that is present in the cream; and any process that diminishes this diminishes the necessity of ripening, at least so far as concerns the two objects above mentioned. Babcock has shown that the quicker the cream rises, the less will be the amount of the fibrine entangled with it; and that, when cream is separated by a centrifugal machine, a considerable part of the fibrine collects on the drum of the machine, and less in the cream. It would seem, therefore, that there would be less need of ripening centrifugal cream than that raised in the more common way.

A third object attained by ripening cream is to give a certain flavor to the butter which is not obtained in butter made from sweet cream. This is a matter of as much importance to butter-makers as either of the other two, for the value of butter usually depends more upon its taste than upon its keeping-properties. But the relation of the taste of butter to the ripening of the cream, and to the method of handling the butter, is a matter too vague and indefinite at present to warrant definite statements.

### Cleanliness in Dairying.

It must be remembered that many bacteria are so minute that thousands of them might occupy less space than the point of a needle; that they multiply so rapidly that millions may be produced in a short time from a single one; that organic (animal and vegetable) matters, including many forms of what are ordinarily called dirt, are media for them to grow in; that milk is especially adapted to their development, and the most minute quantities of it may serve for their dwelling-place, and furnish food for their rapid growth; and that they are sure to adhere to the surface or cling in the joints of vessels that have contained milk. Bearing all of these facts in mind, the necessity for thorough cleansing of all vessels used in handling milk is apparent. To wash such vessels so that no particles of dirt will remain on the surface or in the joints is extremely difficult. It has been frequently demonstrated that no amount of washing in cold or even warm water will remove all bacteria. It is necessary to use boiling water, and to leave it in the vessels for a considerable time, to destroy the active forms of bacteria that are sure to be present. Even though the active forms may be killed by boiling water in the course of a few minutes, their spores, which correspond to seeds, will resist boiling temperature for a long time. The danger of contamination from spores is not so great but that it may be neglected for all practical purposes, and, unless the vessels are contaminated with some dangerous bacteria, a thorough washing in boiling water is sufficient. But vessels in which milk is to be kept cannot be properly cleaned by pouring boiling water into one, allowing it to remain there for a few minutes, and then pouring it into another, and making one heating of the water suffice for the cleaning of several vessels. The last ones thus treated will not be much cleaner, so far as bacteria are concerned, than if they were washed with cold water. To clean vessels thoroughly, it is necessary to use a higher temperature than that of boiling water, which can be readily obtained by putting them for a few minutes in a hot oven or on a hot stove. If this is thoroughly done, there is no danger of contamination of milk from the milk-vessels.

The use of sal-soda in washing milk-vessels is advantageous, because it acts chemically upon fatty matters (grease), and thus helps to remove them and other materials which adhere to the vessels with them. In like manner, the use of "live steam" to "dry" vessels after washing has the advantage of sterilizing them; i.e., killing the bacteria by the highly heated steam.

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## BOOK-REVIEWS.

*The Ice Age in North America and its Bearings upon the Antiquity of Man.* By G. F. WRIGHT. New York, Appleton. 8°. $5.

IT may perhaps be questioned whether the time has yet come for a popular presentation of the glacial theory in so detailed a form as is given in Professor Wright's book, for it is still a matter upon which much investigation must be expended; but, on talking with teachers and intelligent readers who have not access to the scattered literature of investigation, it is apparent enough that they greatly need a compendium of the results of glacial study as it now stands, as they have no sufficient comprehension of its remarkable conclusions. This book on the ice age in North America will therefore have a wide reading, and, if its readers note carefully the expressions of doubt as well as the expressions of fact, it must be serviceable to them. Professor Wright's style is entertaining, and he brings together a large and well-selected body of description from the works of pretty much all the glacialists in the country. The illustrations are excellent, and the citations are numerous; but, for the sake of historical precision, it would have been better to add the date of publication of the writings of others, and it might have been advisable for the author to place the "Report of the Ohio Geological Survey," and several other papers, before his own in the extended list of essays on our terminal moraines (p. 139), to which the studious reader is referred.

The book opens by discussing the nature of glaciers in general, and illustrates this by descriptions of our glaciers in the West, and by the author's account of his observations on the Muir glacier in Alaska in 1886. Glaciers in Greenland and other parts of the world are then allowed two chapters before taking up the indications of extinct glacial action, to which the rest of the volume is devoted. Some of the more important headings are, "The Glacial Boundary and Terminal Moraines," "Glacial Erosion, Transportation, and Deposition;" "Contrasts of Pre-glacial, Glacial, and Post-glacial Drainage;" "The Date of the Glacial Period and its Relation to the Antiquity of Man."

If one may judge by the small attention given to glacial topography in our ordinary text-books on physical geography, it may be

concluded that there is no general appreciation of its great significance. One may hardly find a history of the United States that does not give an introductory account of the early Indians; and yet it is safe to say that they are of less importance in forming an understanding of our historic progress than the work of the old glaciers is in gaining a conception of our geography. The moraines and drumlins, the kames and sand-plains, the lakes, falls, and gorges, the gravel-filled and terraced valleys that characterize the northern glaciated country, are, to be sure, relatively small topographic forms; but they are forms on which we live, and which we daily see around us. It is proper that they should be introduced to public notice; and Professor Wright's book will certainly aid in calling attention to them, particularly if his readers go further than his text, and follow up his footnotes, through which they will be led to the most important discussions on these subjects. Look, for example, at the illustration of a new river-course marked by a waterfall, or of an old river-course blockaded into a lake, both of these excellent views being copied from Chamberlin and Salisbury's invaluable essay on the driftless area of Wisconsin; or at the strongly marked morainic wall of the Kettle range in Wisconsin, taken from one of Chamberlin's reports; or at the extraordinary loops of the moraines in Minnesota and Dakota, taken from Upham's and Todd's figures; or at the drumlins reproduced from Hitchcock's report on New Hampshire; or at the map of the kames of Maine by Stone. All of these are not only valuable illustrations of highly significant topographic forms, they are also tempting suggestions towards study of the original sources on which Professor Wright has drawn freely in preparing his book. The same may be said of numerous quotations, often extended over a page or more, from the writings of those who have given us the best interpretations of glacial geology. There are extracts from Gilbert's and Pohlmann's papers on the recession of Niagara Falls; Winchell's account of the post-glacial recession of the Falls of St. Anthony; Upham's description of Lake Agassiz, now the great wheat-growing plain of Minnesota and Dakota; Claypole's suggestive although rather highly deductive account of the temporary lakes marginal to the retreating ice-sheet; Newberry's studies on pre-glacial drainage; and many more. The thoughtful reader of all this will perceive something of the long growth of the present belief in glacial geology, and of the efforts of the many workers who have so greatly contributed to its understanding. Professor Wright's own observations on the margin of the glaciated tract are of course also described.

Among the questions on which the conclusions favored by the author are most likely to find dissent with some investigators are the date and duration of the glacial period, and the ice-dam at Cincinnati, by which the Ohio was blocked into a great lake. The objections to the latter theory are not so much on account of its inherent improbability as because the effects and products of such a lake have not been as yet clearly enough seen to require a moderate sceptic to admit its existence. It is natural enough for Professor Wright to feel a paternal fondness for this idea, which he originated some years ago, and look with favor on facts that point towards it; but, before it can command general acceptance, it must be examined in the light of a broader view of the evolution of rivers and of the various changes to which they are subject. It does not seem as if this broader view has been attained, for it is said that the Ohio has been at work on its present valley from the first elevation of the continent to glacial time, that is, through all mesozoic and nearly all cenozoic time; while it must be apparent to the student of river history that the present valley of the Ohio is of by no means so great an age. The water-worn pebbles on high land in West Virginia have relatives in similar deposits in Tennessee, outside of the hypothetical Ohio lake. The terraces of western Pennsylvania are not described in such a way as to make it clear that they are of lacustrine and not of fluviatile origin. The case had best stand open yet for a time till further facts are developed.

The date of the glacial period commonly alluded to, as determined by such post-glacial river-gorges as the Niagara, is rather the date of a somewhat late phase in the disappearance of the ice. How long a time elapsed from the maximum advance of the ice to the beginning of work on the gorge is not now determinate. The unknown factors in this problem are very numerous, and they will require much labor in their definition. Prominent among these is the time-interval between the various terminal moraines and drift margins; and in this question, Wright differs from the conclusions of Chamberlin, McGee, and Gilbert, as to the division of the glacial period into two distinctly separate epochs, and regards the whole period as essentially single and continuous. Extracts are given from the writings of the above-named investigators; but the reader will do well to consult the original essays, as the discussion is rather intricate. Here, as in the case of the ice-blocked Ohio, it appears to me that Professor Wright does not sufficiently consider other arguments than those of strictly glacial geology. The evidence of topographic development, as adduced by Chamberlin and McGee, particularly needs further examination.

On these larger questions, it is to be hoped that an open mind can be maintained for some years to come. It is only by regarding them as settled that the student may be unwisely guided. The treatment of the smaller subjects, such as those of which many examples have been named above, will prove instructive to many readers. W. M. D.

*An Elementary Treatise on Mechanics. Part I. Statics.* By ISAAC WARREN. London and New York, Longmans, Green, & Co. 16°. $1.

THIS is a compact and well-arranged little volume, intended for the use of schools and students in universities. It is the first part of a work on mechanics, the second part of which will treat of dynamics, under which term the author includes kinematics and kinetics. The work follows to a great extent the same lines as those of the same author's elementary treatise on plane trigonometry, and is especially rich in exercises, — a feature which ought to recommend it to teachers. As additional exercises, a series of ten examination-papers proposed in Trinity College, Dublin, are annexed to the volume, and a note on the order of lever to which the oar belongs. This latter, though a clever thing in itself, and well adapted to develop certain faculties of the youthful mind, might well be omitted in a text-book.

*Steam Engine Design.* By JAY M. WHITHAM. New York, Wiley. 8°. $6.

MECHANICAL engineers, students of engineering, and draughtsmen will find this a book well adapted to their requirements, and it will not be without value to any person interested in mechanical engineering as a profession. Its author was at one time assistant engineer in the United States Navy, and is now professor of engineering in the Arkansas Industrial University. The work treats of the application of the principles of mechanics to the design of the parts of a steam-engine of any type or for any duty, and also of auxiliary attachments and constructive details. The best and most approved engineering practice, evidently, has been drawn upon freely for the examples with which the book abounds; and the illustrations, of which there are a profusion, are, with one or two exceptions, excellent specimens of the engraver's art.

The more general elements pertaining to steam-engine practice, such as types of engines, clearance, piston speed, friction, fuel, weight of parts, and radiation of heat, are discussed in a brief introduction, after which pistons, slide-valves, and valve and reversing gears receive a chapter each. A separate chapter is devoted to the steam-chest, stuffing-box, link, eccentric, etc. A description of the principles of the compound and triple-expansion engines is condensed into one chapter, though the growing importance of this branch of the subject would seem to warrant a more extended and detailed treatment of it. After a brief chapter on indicator-diagrams of a compound engine, a chapter each is given to crank-effort diagrams, the relation of friction to the turning-power of the engine, the piston-rod and its cross-head and guides, the connecting-rod, and the crank-pin. Then comes a long and full chapter on crank-arms, crank, line and propeller shafts, bearings, and couplings; one on condensers and pumps; and one on the engine-frame, pillow-blocks, reversing-engines, walking-beams, etc. The screw-propeller and paddle-wheels, both radial and feathering, are treated of in the final chapter; and a short appendix is devoted to the strength of materials and a saturated-steam table.