from which the proposition is regarded; that the assumption made, "that the preservation of the individual and the continuance of the species are the final causes of the organization of an animal," is quite on a par with the old-fashioned teleology which is nowadays justly reprobated; that, at any rate, the pleasure which the crayfish apparently takes in watching for and capturing his prey is something quite distinct from 'work done by an organism;' and that, "if pleasure of some kind be denied to the crayfish, contrary to all appearances, I do not know at what point in the scale of animal life pleasure is to be admitted as a factor. If to speak of mind as a factor in work done be an absurdity in the case of a crayfish, is it not an absurdity in the case of a dog, or even in the case of a man?" And he proceeds to vindicate the delight of existence as one of the ends for which animals exist.

This idea, and the vindication of the mind of brutes, have a prominent place in the next following essay, on 'Man's place in nature.'

'Law, physical and moral,' is the topic in the sixth essay, in which a passage from Hooker's 'Ecclesiastical polity' is set over against one from the Duke of Argyll's 'Reign of law.' We need not continue our analysis, which is already longer than was intended: indeed, there is less occasion to continue; for the remaining articles, being popular addresses reproduced, are less thorough, however sensible. Even the last essay, on 'Evolution and evolution,' and the appreciative funeral sermon for Charles Darwin preached in Westminster Abbey on the Sunday following his burial there, need not detain us.

The noteworthy thing, to which this volume adds its testimony, is this: that thoughtful churchmen are following the example of thoughtful men of science. They are accepting the scientific principle of evolution as a working-hypothesis, — trying it, as naturalists and physicists have done, in their several lines of research and thought, and with somewhat similar results. The new science is accepted with complacency, if not with welcome, by the discerning. The questionable philosophy, in which it has too often been dressed, is examined and exposed.

THE second book named above appears to have excited considerable attention in England. Like the volume we have just noticed, it is an excursion into the borderland of science and faith, but with a difference. The divine is the more scientific, the layman and naturalist (for such we take him to be), the more homiletical of the two. The one picks his way along the ground with firm but cautious and carefully chosen steps: the other soars into the air. The one discriminates between science and faith, and in his book guards rather than enters upon the field of morals: the other seeks to identify the two, and in a novel way. He has discovered that natural laws, meaning the principles of physics and biology, extend to the spiritual world, and help us to understand it. He does not mean that there are analogies between the two, which may be profitable for instruction, but identities; that 'in the spiritual world,' to use his own figure, 'the same wheels revolve, but without the iron.' And the laws to which he refers are the principle of continuity, of conformity to type, action of environment as causing variation, the adage *omne vivum ex vivo*, possibly even gravitation, if there be any thing for it to act upon; and, if there is nothing for these laws to act upon, "it is not the law that fails, but opportunity." We cannot look upon this as any great improvement upon Swedenborg's 'law of correspondences;' and, as the helpfulness of the book is entirely upon the religious side, we need not further notice a volume which attracted us by its title, but which we find to be morally edifying rather than scientifically satisfying.

BACTERIA, AND THE GERM-THEORY OF DISEASE.

On the relations of micro-organisms to disease. The Cartwright lectures, 1883. By WILLIAM T. BELFIELD, M.D. Chicago, *Keener*, 1883. 131 p., illustr. 24°.

Bacteria, and the germ-theory of disease. Eight lectures by Dr. H. GRADLE. Chicago, *Keener*, 1883. 4+219 p. 8°.

DR. BELFIELD'S little book is cheaply gotten up, and, beyond the possession of a few poor woodcuts, seems to be his original lectures, four in number, delivered before the Alumni association of the College of physicians and surgeons in New York in February, 1883. Even the phraseology of the lecture-room is apparently preserved throughout, and is sometimes decidedly more forcible than polite. Nevertheless, these four lectures, making in all about one hundred and thirty pages, give an admirable summary of the germ-theory of disease as it stood a year ago. Beginners or casual readers, perhaps, will not find the book diffuse enough; but pathologists and biologists will prize it for its lucidity, crispness, and keen discriminations.

After a careful perusal of these lectures, one finds himself impressed with the author's ability to go behind the returns, to draw the line between good and bad work, to catch or to predict the drift of things; and this is the peculiar merit of the book. Indignant at the attitude of some American physicians, Dr. Belfield treats their shallow objections with deserved contempt, sometimes even with harshness; but he preserves throughout the critical insight which might be expected of a follower of Tyndall and of Koch, and holds very fast indeed to that which is good.

To biologists it is of great interest to observe that pathologists are passing beyond the 'germ' theory, and are looking towards the unexplored country of unorganized ferments, ptomaines, etc., for the sources of disease, precisely as they themselves have gone thither to search for the causes of fermentation, of cellular digestion, and for many of the more intricate phenomena of physiology. The future of cellular biology seems to lie in these obscure ferments and ptomaines, affording a golden opportunity for the physiological chemist.

Dr. Belfield states his subject summarily as follows (p. 31): —

"Bacteria then, which, by virtue of their ubiquity, are in constant and frequently recurring contact with the animal body, are, like other minute bodies, organized and unorganized, frequently introduced into the body through solutions of continuity of the integuments, or through intact skin and mucous membranes, particularly by way of the lungs.

"The burning question in pathology to-day is, in what degree are the various species of bacteria, present in human tissues during certain morbid conditions, to be regarded as the cause of the morbid processes with which they are respectively associated?"

If we look for his answer, we find farther on that investigations carried on with rigid exactitude justify us in accepting provisionally the causal relation in some degree, but not so far as to exclude other like causes.

Illness may be caused by the not living products of putrefactions, as well as by the living organisms which abound in and probably produce putrefactions. But in the latter case the disease may be farther extended to fresh, healthy individuals by infection: in the former it cannot be. This points, in the one case, to a self-perpetuating cause; in the other, to one of limited powers. Moreover, good evidence exists that the boiled products of putrefaction which may produce illness owe their septic action to substances of obscure composition (ptomaines?) manufactured by the bacteria of putrefaction. This line of thought leads to the important conclusion (p. 42), —

"Hence we are logically driven, by all this work, to the belief that septicaemia implies the introduction into the animal either of living bacteria, or of a substance which has acquired noxious properties through previous vital activity of these organisms.

"More recent experiments have demonstrated, however, that the etiology of . . . septicaemia is by no means restricted to putrid infection. [For it was noticed by Schmidt that] the introduction or production in the blood of fibrin-ferment in considerable quantity produces effects identical with those of putrid infection — septicaemia."

It has since been asserted that pepsin and trypsin produce similar effects. If so, we may find eventually a cause behind the bacteria, — a fibrin-ferment-liberating cause (p. 44): —

"It would appear, athough not for all cases demonstrated, that the . . . features common to the various forms of septicaemia are attributable to the rapid liberation of fibrin-ferment in the blood; and that any agent — organized or unorganized, putrid or fresh — capable of effecting such liberation may induce the disease."

So with the cause of suppuration. Belfield looks even beyond the germ-theory, beyond the bacteria involved, and with the eye of a biologist perceives that (p. 51)

"Suppuration must be regarded, then, as indicating the presence of an element foreign to the living animal cells; which may be induced directly [as by the introduction of a powerful irritant, e.g., Croton-oil], or indirectly as an incident in the life of various fungi [e.g., bacteria]. . . . Practically, we may regard acute suppuration as proof of the access of external irritant matter, organized or unorganized."

Antiseptic surgery is then easily defined. It is not a hissing spray, nor (p. 60)

"Simply a question as to the relative anti-bacterial properties of this, that, and the other so-called antiseptic agents. It is an attempt to prevent the entrance into, as well as the formation within, a wound of all substances, organized and unorganized, which can interfere with cell-nutrition."

Enough has been said to show the spirit of these lectures. They take a broad but thoughtful and critical view of the various questions involved, treating the scoffers who speak without knowledge as they richly deserve, and taking a rather conservative view of the work done in the direction of protective vaccination; displaying everywhere the thorough training of a German laboratory, and closing with a moral which all scientific men and all believers in rational medicine will do well to read, mark, and inwardly digest (p. 114): —

"And when we consider the problems already half solved, the questions to whose solution the way appears open through the same methods already successfully applied to anthrax and tuberculosis, we may hope for results to which present knowledge shall seem

a mere introduction. But these results can be secured only by earnest, skilful, continuous experimental investigation, which is practically impossible without pecuniary support. In France and Germany such support is liberally supplied by the government; in the United States, where human life is certainly as valuable as there; where live-stock interests are already greater than in these countries combined, and must multiply many fold in the immediate future; where a single infectious disease of cattle has caused the loss of $20,000,000 in one year, and a single disease of hogs the destruction of $30,000,000 in the same time; where infectious diseases are so prevalent among live stock that the fear of infection has closed European markets against American meat and cattle — the government of this great commonwealth, which advances enormous sums for local river and harbor improvements; which sends expensive commissions over the world to observe the transit of Venus or of the moon, or to find an open polar sea; and engages in other undertakings of purely scientific interest, has not yet made one judicious, systematic, liberally supported inquiry into the possibility of acquiring protection against pleuro-pneumonia, hog-cholera, and other devourers of the national wealth. A glance at the imperial German health bureau and its work during the last four years, and a mental comparison of the pecuniary resources of Germany with those of the United States, inspire the hope that we shall not always lag so far behind in matters which appeal to the tenderest spot of the American anatomy — the pocket."

Dr. Gradle's book is made up of eight lectures delivered in Chicago, and is published on a more ambitious scale than are those of Dr. Belfield. For the beginner, or for one who is neither a pathologist, biologist, nor physiologist, this book is the more suitable. Its style is diffuse — not always, however, with a gain in perspicuity; and its index, its references to authorities, and its evident intention to give to all sides a fair showing, are features to be specially commended.

In these lectures we have, in fact, rather the report of the evidence than the judge's charge to the jury. We miss that critical and even judicial flavor which is so pleasant a feature of Dr. Belfield's book; and on that account we must consider the latter more suitable for the connoisseur; the former (Dr. Gradle's), for the beginner or the casual reader.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Yellowstone national park. — During the season of 1883 Mr. Arnold Hague began work in the Yellowstone national park, preliminary to a series of careful and systematic observations which are to be prosecuted in this field through a number of years. The geysers are to be made the subject of minute study; and the volcanic rocks, so abundant at numerous points in the park, will be examined in detail, not only as regards their geologic relations, but also in regard to their structure and composition. The field investigations in the park during the past season were confined mainly to the preliminary examinations necessary to determine what geologic and physical problems have to be solved, and to ascertain what thermal changes had taken place since the observations of 1878 recorded by Dr. Peale. Mr. Hague's party was constituted as follows: Mr. Arnold Hague, geologist in charge; Messrs. Joseph P. Iddings, W. H. Weed, George M. Wright, and C. D. Davis, assistant geologists; Dr. William Hallock, physicist; Mr. W. H. Jackson, photographer, with an assistant; Mr. Roland Holt, volunteer assistant; and cook, packers, etc.

Geologic work. — Mr. Hague took the field the latter part of July, outfitting at Bozeman, Montana. Work was begun in the park at Mammoth hot-springs early in August. From this point, slow marches were made to the upper geyser basin of Fire Hole River, to allow of a geologic reconnaissance of the route followed. At the latter locality a permanent camp was established until the last of August. In the mean time a hurried trip was taken to the Shoshone geyser basin and the Heart-lake basin, for the purpose of comparing them with the geyser basins of the Fire Hole River, and to note what changes have occurred during the past five years. While on this trip, Mount Sheridan was ascended. Mr. Hague thinks that this mountain, from which a fine view of the surrounding country was obtained, is a volcanic crater, which has been so greatly modified by glacial action that its true origin has been obscured.

Camp was moved from the geyser basin to the Great Falls of the Yellowstone, Sept. 1, and kept there until the 19th. While at this point, the structure of the Mount Washburn was examined, and a trip made to the head waters of the Gardiner and Gibbon Rivers. The region of the Grand Cañon was also investigated, and the bottom reached at four different places. The Grand Cañon is an admirable place to study the decomposition of rhyolitic flows, the weathering of which has produced the brilliant coloring for which the cañon is so justly celebrated. A trip was also made from this camp to Steamboat Point, on Yellowstone Lake, from which point the ascent of Mount Chittenden was made. Mr. Hague considers this mountain one of the best points of observation within the limits of the park, and, after a trail has been built to it, thinks it will become one of the objective points of tourists who visit the lake. It surpasses Mount Washburn; as it gives a closer and more detailed view of the lake, and presents a magnificent panorama of the high mountain range on the east side of the park. The prospect is perhaps not so ex-