without sufficient evidence, said to be caused by the palms, — comparatively high vegetable types, perfectly innocent of the crime of which they were accused. Late investigations point to a bacterium of elongated form as the cause, but the proofs are still insufficient. To learn to recognize the enemy is certainly the most necessary thing to be done, but it is only half the task: we must then learn to resist it. The more or less effective means of combat which have been employed up to the present time have aimed, 1°, to prevent the dissemination of dangerous microbes; 2°, to make the organism unsuitable for the propagation of the intruders; 3°, to retard, as far as possible, the growth of those which have entered, in order to give the organs opportunity to throw them off. The first of these measures engrosses the attention of the hygienists: hospitals, quarantines, and disinfectants are among the means employed. I will not enter upon a subject which touches so many disputed questions, but will confine myself to noticing certain facts and to rectifying certain very wide-spread errors. Regarding infection, the nose is a poor guide; for the experiments of Mr. Miquel show very distinctly that substances in a state of putrefaction, so long as they are moist, do not emit living germs. The water of the Paris sewers holds eighty million microbes per litre; and yet the air of the sewers contains only eight hundred or nine hundred germs per cubic metre, about one-tenth the number found in a hospital. By inoculating a rabbit, it was shown that these germs are perfectly harmless. The moist earth does not give out living organisms to the atmosphere. On the contrary, the dust of our rooms, which we do not at all mistrust, shows about two millions of these living germs per gram. The bacteria of intermittent fevers, which vegetate in the soil of the Roman Campagna, begin to spread in the air and to become dangerous only when the soil, dried by a scorching sun, is raised by the wind in the form of dust. It would be easy to multiply examples, and to prove, that, in point of hygiene, we must be guided by sense rather than by smell. We have as yet but begun this kind of study; for how does this total number of germs which the air or water holds interest us? We would prefer to know the number of dangerous germs. The proportions would doubtless be very different from those which concise analysis affords.

Until we are better informed, we shall do well to push cleanliness to an extreme, and especially to put little trust in disinfection. The number of subtances which are less injurious to man than to micro-parasites is very small. The best disinfectant is perfectly useless if too weak a dose be used. For each of these substances there is one proportion which will destroy the germs, and another which will arrest their vegetation but not destroy them. This last dose is the one with which we are generally obliged to content ourselves. The experiments of Mr. Koch and Mr. Miquel show that the narcotic effect begins to be effective on microbes only when the substance in which they are vegetating contains, among a thousand parts, 95 parts of alcohol, or 70 of borax, or 10 of salicylate of soda, or 3.2 of phenic acid, or 5 of quinine, or 0.6 of bromine, or 0.07 of bichloride of mercury, or 0.05 of oxygenated water. Certain of the substances indicated are useful in these doses; while others, as bromine, are impracticable. But especially let us not forget that the result is not a radical disinfection: it is merely a momentary weakening. Is it still needful to insist on the uselessness of too mild doses? We are constantly seeing phenic acid used at less than one in a thousand parts with the sole effect of creating a mistaken sense of security. Let me mention another almost unknown antiseptic: essence of terebinthine, according to Mr. Koch, arrests the vegetation of microbes in a dose of $\frac{1}{75000}$, a quantity easily endured by man.

All these hygienic precautions are bristling with difficulties. How convenient it would be to let the microbes live and to protect our bodies from their influence! Unfortunately we know but one way to effect this: it is based on a remark, made long ago, that certain diseases can be retaken only after many years, and that this freedom may be obtained by contracting the disease in a very mild form. This is the principle of vaccination, and also of inoculation, employed by Mr. Pasteur on certain animals. The matter inoculated contains the microbe of the disease from which we wish to protect the subject, but modified by a special cultivation: it is a virus weakened according to the methods of Mr. Toussaint and Mr. Pasteur. We touch here upon a question, at present much contested, in regard to the regularity of specific forms of these very low vegetable types. Mr. Zopf and the school of Munich believe that the most harmless species can, under certain circumstances, be changed into dangerous ones, and *vice versa*. The school of Berlin thinks that artificial modifications are only transient and momentary, and that the species may be considered invariable. However this may be, it is certain, that, if the inoculations of Mr. Pasteur have no great practical importance in their present form, they at least have a considerable theoretical value. We may hope that the time will come when it will be possible to vaccinate for all diseases which can seldom be taken a second time. Who knows if it will not end by discovering the nature of the influence which the parasitic invasion exerts on the tissues of our bodies, and in obtaining the same result in a more direct way without inoculation? When we consider the progress of science in the last half of the present century, we venture no longer to answer, 'Impossible.'

THE WATER-PORES OF THE LAMELLI-BRANCH FOOT.

IN 1817 Cuvier showed that in Aplysia there was a closed vascular system, and claimed the same for all Mollusca. His view was followed till 1845, when Valenciennes and others described in many lamellibranchs pores which passed through the foot to introduce water into the lacunar tissue, where the blood circulates. This view found general acceptance, and was taught by Siebold, Huxley, Gegenbaur, Semper, etc. Recently discussion of the subject has been re-opened by the appearance of numerous papers. Mr. Justus Carrière in several papers maintains that no *pori aquiferi* exist in the lamellibranch foot. Hermann Griesbach, last spring, in a careful paper (*Zeitschr. wiss. zool.*, 38), reviewed the whole subject, studying by sections and injections, and concluded that the molluscan vascular system was not closed, that the blood wandered in the lacunar tissues of the body-cavity, that large lacunar spaces communicated directly with the exterior through aquiferous pores in the foot, and that these pores were for the reception of water to be carried out through the Bojanus organ. He figures sections of Anodonta where the surface-epithelium of the foot bends up into the opening of the pores (there are three in Anodonta), and fades out as the pore opens into the lacunar body-cavity. During last October two quite independent papers appeared simultaneously upon the other side. Dr. Cattie, in *Zool. anzeiger*, vi., No. 151, p. 562, claims to have cut a complete series of about twenty-five hundred consecutive transverse sections through the foot of Anodonta. In no one of these was there any break in the epithelium. He has studied twenty-three species, and in no one finds the least trace of aquiferous pore. Dr. Th. Barrois, in a private imprint from Lille, dated Oct. 30, 1883, arrives at the same results. He discusses the work of Carrière and himself, and finds that they have studied most of the forms where the presence of aquiferous pores has been claimed, and in every case find pores absent, or in such position that it seems they are either connected with the functional byssogenous organ, or, where such is absent, in the aduct, with the remnant of the same. Barrois sums up his views thus: no pores exist for the introduction of water into the circulation; the only pores of the foot are those connected with the byssus organ, which never communicates with the interior of the foot. The blood may have water introduced into it, but this must be effected by osmosis, or in some manner not now to be discussed. H. L. OSBORN.

THE BORDERLAND OF SCIENCE AND FAITH.

Walks in the regions of science and faith: a series of essays. By HARVEY GOODWIN, D.D., Lord Bishop of Carlisle. London, *Murray*, 1883. 310 p. 8°.

Natural law in the spiritual world. By HENRY DRUMMOND, F.R.S.E., F.G.S. New York, *James Pott.* (Apparently sheets of the English edition.) 414 p. 12°.

THE 'science' of these regions is of course physical science; the 'faith' is the theistic and more specifically the Christian faith. These 'walks' are taken along the borders of the two. Normally, the course of this journal of science lies quite away from this borderland, which, indeed, has not always been an agreeable road for a scientific man to travel. Of late, however, a better understanding has made it pleasanter than it was for the peaceably disposed naturalist. And the Bishop of Carlisle, a trained mathematician as well as a divine, whose thoughtful essays are essentially irenical, is an instructive companion in an excursion "through that land which belongs exclusively neither to science nor to faith, but appertains more or less to both." A book "which opens with an essay on the connection between mechanics and geometry, which closes with a funeral sermon preached in Westminster Abbey," and the larger part of which had already appeared in widely read periodicals, — some of the articles being in fact, though not in name, of the nature of critical reviews, — hardly need be, and could not well be, reviewed in our journal; yet we are free to give a brief account of it, enough to indicate its lines of thought.

The first essay, on the connection between mechanics and geometry, is a modified reprint of a paper which was published almost forty years ago. The point made is, that these two sciences are essentially identical, being developments in different subject-matters of the selfsame ideas. The moral is, "that all demonstrations tend to merge in intuition, and that human knowledge, as it becomes more clear and more thorough, converges toward that absolute intuition which is the attribute of the Divine Mind." This idea is further worked out in the second essay (entitled 'The unity of nature, a speculation,' which appeared in the *Nineteenth century* in 1879), in which it is argued, that as the schoolboy begins by painfully proving the simpler theorems in geometry, and ends by perceiving that they are really self-evident, and that as all the propositions of Euclid appeared intuitively true to Sir Isaac Newton, "it is quite conceivable, by merely extending in imagination the powers of which we have actual experience, that all geometrical truth in any department might exhibit itself without intermediate steps of demonstration to a mind of sufficient acuteness, when the appropriate definitions had been given. . . . To a mind like that of Newton, I should imagine that the principles of mechanics would present themselves almost in the same self-evident light as those of geometry." And "that possibly, as the truths of geometry help us to realize those of mechanics, we may use the truths of mechanics to help us to realize some of the truths of the more subtle sciences, say, even that of biology." And the speculation, fortified and illustrated by mathematical analogies, goes on