rium. There is little reason, therefore, for the incorporation, without explanation, of five or six pages from an English treatise referring to English conditions (p. 112 *et seq.*). Perhaps it is English predilection which fixed 68 degrees as the maximum temperature a Colorado room should attain (p. 118). Colorado has an enormous sanitary area, from Fort Collins and Greeley on the north to Trinidad on the south of its eastern slope, with the less-known Grand Junction and Durango on the western and southwestern borders. But the climatic centre about which the volume revolves is Colorado Springs (whose springs are at Manitou, six miles away). It is chiefly concerned with the town under the great mountain rampart whose type and best-known feature is the always visible Pike's Peak. As the plains stretch away to the east and south, the redeeming flood of sunshine, as at Denver (still more blessed with light), pours over it from the earliest morning. The dust-storms, its one drawback, usually ignored by short-sighted advocates, are frankly acknowledged here; but their influence is minimized by a statement of the five colder months, which shows graphically the exact condition of every day.

The author has done more than to explain the sanitary advantages of Colorado Springs. He has gone into the economics of the question, and gives in detail the cost of travel and of living there, and has done it accurately. But there is a curious omission. Colorado College, an excellent institution, under management of the highest character, affords admirable educational advantages, but Dr. Gardiner is absolutely silent in regard to it. Is it possible that he does not approve of Colorado College at The Springs, or of the University of Denver, or of the State University at Boulder? These, particularly the first and last, the Agricultural College at Fort Collins, and the School of Mines at Golden, are high-grade institutions within the best climatic conditions. They, as well as the numerous churches, are important factors in making it possible, as Dr. Gardiner urges, for damaged families to establish themselves in the Centennial State. A well-founded fear of the concentration of so many consumptives has been that new cases may arise. That happens. In the last twenty years there have been in all, from locally contracted consumption, ten deaths at Colorado Springs, and the yearly proportion at Denver is from one-third to one-half of one in each thousand inhabitants. Had no consumption been brought to Colorado, it is probable that these fatalities would never have occurred. But statistics show that, whether predisposed or not, the chance of dying there from the non-imported disease is only one in ten to that run by citizens of the East who remain at home. Still, it is probable that the risk will increase as the sources of infection multiply.

Dr. Gardiner's book is the latest and best on its subject, and is entirely commended to those whose "lungs are a little weak," whose "bronchial tubes are affected," who "have a tendency to cough in the morning," or labor under similar indications of commencing tuberculosis euphemistically expressed. There is no undue encouragement for the dying, whose characteristic optimism leads them to accept any straw as a life-preserver; but there is plenty of legitimate hope for fairly incipient cases; and, apart from its distance from older centres, Colorado is a physical paradise, when one becomes accustomed to it. A proof-reader's oversight retains Practice for Practical six times on two pages (55-6), and Yager for Jaeger twice (p. 62).

Dr. Alfred Hillier's 'Tuberculosis' is primarily intended for the medical profession. The author hopes that legislators and agriculturists also may be concerned, and accordingly he has produced a composite volume, not very attractive in appearance or in style, nor of particular interest to Americans. Its special value is the truthful, but not novel, estimate it places upon an unlimited supply of pure air as the essential element of successful treatment, and in the illustrations for its application.

The most generally valuable recent essay upon this subject is Dr. Knopf's 'Tuberculosis, and How to Combat It,' for which was awarded, as against eighty competing papers, the prize of 4,000 marks offered by an international congress sitting in Berlin in 1899 for a popular composition upon 'Die Tuberkulose als Volkskrankheit und deren Bekämpfung.' Tuberculosis in some form, the most common being consumption, causes one death in every six or seven among the white races; it is clearly infectious; and it is distinctly curable in most cases during the early stages, and as certainly fatal when neglected—the exceptions to both extremes practically balancing each other. Every patient is a prolific seminary for its cultivation and distribution, so that the public welfare requires preventive measures to go hand in hand with those for cure. In general terms, it is not the disease but the tendency to it which is inherited. The efficient cause is the tubercle bacillus, and the remote causes are those which reduce the natural resistance of the body. Were every such bacillus annihilated, there would be no more consumption. Were every human being consumption-proof, the bacillus would be negligible. The aim of society should be to destroy the one and to maintain the other. Both objects are entirely feasible, and Dr. Knopf is perfectly justified in saying that all that is required to combat tuberculosis successfully is the combined action of a wise Government, well-trained physicians, and an intelligent people. Those factors would surely yield that result. Under existing conditions, the combination may seem utopian, but if the goal is never reached, it may at least be striven for and approximated. The practical suppression over wide limits of many serious diseases, as has actually been effected, encourages the attempt to attack tuberculosis systematically. One good working agency would be the dissemination of such a pamphlet as this, prepared as it is for popular instruction and not for personal aggrandizement.

Essays in Illustration of the Action of Astral Gravitation in Natural Phenomena. By William Leighton Jordan, F.R.G.S., etc. Longmans, Green & Co. 1900. 8vo, pp. 192, with two folding tables and a plate.

Mr. Jordan's book is charmingly printed on excellent paper, and is written in good taste. He admits that "from a theoretical point of view, the argument is unassailable" that a body will not alter its velocity unless acted upon by an extraneous force; but he declares that the opinion which prevailed before Galileo is "equally reasonable as pure theory," and is in better accord with physical phenomena. He is mistaken, however, as to what the old opinion was. It really was that a body left to itself would instantly come to rest, so that what made a slung stone move on; after it left the hand, was the motion of the air; and what kept the air in motion was the motion of the stone. Now, as a matter of "pure theory," this was not all that could be desired. Mr. Jordan, on the other hand, thinks that a body left to itself would gradually lose velocity till it came to rest. Furthermore, "it is, I say, matter of fact, and not abstract argument, that must be appealed to for a decision." Being in that state of opinion, one might expect that he would make experiments to ascertain according to what law the velocity is diminished, and, that law having been made out, to determine how long it takes a body to come to a state of absolute rest. Since the solar system seems to be moving through space many times faster than the fastest locomotive, a body at absolute rest would fly off at a relatively tremendous rate; so that, if there be such a tendency "from a practical point of view," one would think there ought to be some way of utilizing it. But Mr. Jordan in one place confesses that he has not mathematics enough to solve a certain problem which, in fact, merely involves a simple application of the calculus; and he seems not to have a sufficiently mathematical mind to perceive that his theory calls for the formulation of a law and for the measurement of a constant. This does not, however, in the least prevent his discussing problems in dynamics of considerable difficulty.

If a common physicist is asked why he accepts the first law of motion, he will reply that the pendulum of an ordinary astronomical clock, detached from the escapement, will, in air, swing for several hours; that, under such a partial vacuum as an ordinary air-pump will furnish without much labor, it will swing many times longer; and that observation shows that the departure from the usual theory is too small to be detected in that way. No experiments have ever been made in high vacua; but the earth continues to rotate without any retardation or acceleration that any clocks hitherto made can discover, and thus the retardation or acceleration, if there be any, of the motion of an isolated body, must be so small that it is best assumed to be zero, until we meet with some facts which point to a different value. If, now, we turn to Mr. Jordan, and demand his explanation of the earth's rotation, he inquires of us whether we do not accept the proposition that every particle of matter exerts a gravitation upon every other inversely proportional to the square of the distance; and on our granting this, he adds, "Very well; it is the gravitation of the fixed stars—astral gravitation—which keeps the earth rotating." Were we rashly to produce a dynamical demonstration, which would be easy enough, that astral gravitation cannot produce any such effect, he would not pretend to understand it, but would inquire of us whether it did not assume the truth of the first law of motion, in which case it would beg the question; and we should be obliged to admit the entire justice of this. Mr. Jordan has us at an advantage by making no preten-

sion to being a mathematician; for it is plain that if the first law of motion were to be modified, that would involve the complete demolition of natural philosophy down to the ground, so that it would have to be rebuilt in some radically new way. Now if Mr. Jordan were a mathematician, we could ask him how he proposed to do that rebuilding. But, as it is, he would simply tell us that it was our business, not his, to find that out. Poincaré, the Lorraine mathematician, says that since the unknown exceeds the known, there are more unknown quantities in physics than equations to be satisfied; so that we can assign to any one of the former—as, for instance, the rate of variation of the velocity of a body that is left to itself—any value we choose. If this were intended to show that we must in natural philosophy use some different method of reasoning from mathematical deduction, it would do very well.

If Mr. Jordan had known what eminent thinkers are virtually with him in ascribing the earth's continued rotation to the influence of the fixed stars, he probably would have been better pleased than they would be by the alliance. The facts deserve to be set forth. Although the first law of motion was discovered by Galileo, yet the accurate conception of it seems to have been reserved for Newton. The law is, that if the motion of a body is quite independent of other bodies, the velocity remains unchanged in amount and direction. But this is mere verbiage unless the motion of a body can, or at least could, without violation of any general principle of nature, really be independent of other bodies. The law assumes, then, that motion belongs to a body though no other exists, and continues to have the same definite amount and direction; a notion that drove Newton to assert that Space is a real entity. But German metaphysicians refuse to admit that Space is a real entity, no matter what the facts of observation may be. Some of them maintain that there is a certain body, called the Alpha, wherever it may be, and that the motion of a body left to itself simply continues to be the same relatively to that Alpha. They forget that no abstract definition of a straight path is possible; so that, in order to define how the ordinary body moves, it would be necessary to make the Alpha pervade all space, when the difference between it and Newton's entitative space would be reduced to its name being "Alpha," instead of "Real Space." But Ernest Mach, who is distinguished among Germans as an extra clear head, substitutes for the Alpha the aggregate of all the masses in the universe; and since the mass of bodies near us is perfectly insignificant in comparison with the fixed stars, his view amounts substantially to saying that the first law of motion is, that a body left to itself continues to move in the same way relatively to the fixed stars.

Now, it is an easy corollary from the first law of motion, that if a swinging pendulum is free to change its plane of rotation, it will, nevertheless, continue to swing in the same plane; and if its point of support is displaced (with infinite gentleness), it will continue to swing in a parallel plane. Hence, when Foucault hung up a pendulum, and found that, left to swing freely, its plane of rotation turned relatively to terrestrial objects at a certain rate (which would at the pole give one return every twelve hours, or a complete revolution in twenty-four hours), the Newtonians exclaimed that this proved the absolute motion of rotation of the earth. But no, says Mach, absolute rotation is simple nonsense (that is to say, his metaphysical system has no room for it), and what you call absolute motion, in your first law of motion, is really motion relatively to the fixed stars, so that the Foucault phenomenon is due to the relation of the earth to the fixed stars. Now that, we maintain, is the same thing as to say, with Mr. Jordan, that it is the fixed stars that keep the earth in rotation. If it be true that the relation of a body to the most distant objects is so much more important than its relations to near ones, one might be inclined to question whether, on the whole, spatial relations were as significant as we have been accustomed to think them. It ought, at any rate, to encourage the telepathists.

We will not recommend anybody to purchase this book; but if any young student of dynamics has a copy, he can find an excuse for giving it house-room in the pretty problems, all well known but conveniently collected in the fifth essay, where the author professes to explain them by astral gravitation.

BOOKS OF THE WEEK.

Annual Cyclopædia, 1900. Third Series, Vol. V. D. Appleton & Co.
Burnet, Ioannes. Platonis Opera, Tomus II. H. Frowde. 6s.
Cappon, James. Britain's Title in South Africa. Macmillan. $2.
Earle, John. The Alfred Jewel. H. Frowde. 12s. 6d.