himself to be a man of strong conservative habits, and very slow to recognize the great practical improvements which have taken place. But the day must come, and that quickly, when the exigencies of competition will lead him to adopt artificial advantages which have proved of service to the continental producer of sugar from beet-root. Then, perchance, the prediction of the Brazilian commission, quoted in the former article, will be verified.

The methods employed for the extraction of the raw sugar from the beet are practically the same as for raw cane sugar; but the impulses towards change and improvement, and the necessity for the rapid evolution of more economic manipulation of details, have led to the foregoing inventions.

One new process, however, has been invented which so strikes at the root of the old process that it merits a description by itself. Instead of crushing the beet-root to a pulp, and then extracting the sugar juice together with albuminoid and gummy matters, it aims at removing the sugar without these foreign substances, and so avoids the subsequent labor for their removal. The beet is cut into slices, and these are washed with water. It is claimed that the sugar diffuses out through the walls of the unbroken cells, whereas the albuminoids and the gummy matters of far greater molecular complexity cannot so escape. When the washing is carried out systematically, the process works exceedingly well. Again, the principle of this improvement, like those which underlie the others, is quite old. The walls of the unbroken cells are perforated with fine pores. The particles of sugar can pass through, but the bulky albuminoid aggregates cannot pass. It is like a sieve at work on a minute scale: sugar for the fine gravel, albuminoids for the stones, gummy matters for the lumps of clay, and the minute pores for the holes of the sieve. The originality consists in the application. The same plan has been used over and over again to detect arsenic in a viscous mixture of substances; the mixture is merely boiled with dilute hydrochloric acid, and then floated on a parchment membrane on a vessel of water, the arsenic passes through into the water, and the filth with which it was mixed remains behind. This diffusion-process, which thus owes its birth to the experiments of the Englishman Graham, is much used on the continent, and its applicability to the production of sugar from the sorgho grass is a source of confidence to those who are trying to develop this new American industry. The sugar trade at this moment watches with interest the practical experiments which are now being made, with, as far as can be judged at present, satisfactory results on its application to the extraction from the sugar-cane. Even in Japan an effort has been made to utilize it, and the government have aided the industry by a bounty, and have, it is said, a considerable share in a large manufactory which is now being floated; here, too, the Japanese evince their keenness in adopting Western inventions, and even in extending European ideas.

But the manufacture of sugar does not end with the production of raw sugar; in England it commenced with the raw sugar. The refining of sugar chiefly consists in the removal of the coloring matter which adheres to the small crystals of the raw sugar, and the casting of the purified crystals into moulds. The same processes are applied both to the raw material from the cane sugar, which is pleasant to the taste, and to that from the beet, which smells unpleasantly and is uneatable. The method is the same as a chemist would adopt, who, in the course of an investigation, prepared a substance which he wanted in a state of perfect purity. The sugar is dissolved, and the solution filtered to remove mechanical impurities. The solution by its tint shows the presence of coloring matter, which is removed by filtering through animal charcoal, when it will filter from the charcoal in a colorless condition. It is a curious experiment to shake a wine-glass of port wine with some finely divided animal charcoal; after filtering, the wine is obtained as colorless as water, but it completely preserves all its characteristic properties of taste unaltered. The colorless solution of sugar is then concentrated in a vacuum pan until of the right strength for rapid crystallization. To ascertain this point, the workman places a drop between his finger and thumb, and tests into what length of thread it can be drawn. If the right strength has been reached, some cold unboiled solution is added. Crystals at once appear. If the sugar is finally to be cast in loaves, the conditions are so adjusted as only to produce small crystals. The mixture of crystals and sirup is then heated to within thirty or forty degrees of the boiling point of water, and poured into the iron moulds of the familiar shape. At the apex of the mould there is an aperture which when unplugged allows the sirup to drain away. Finally, the remaining traces of sirup are removed by allowing a quantity of fine colorless sirup to percolate through the loaf. After the loaf has been subsequently dried and turned in a lathe, it is ready for the market.

Thus, then, the production of sugar is completed. The plants utilize the waste products of animal existence, and work their wonderful chemical transformations. Man gathers wealth from these storehouses of nature, and exercises his ingenuity in obtaining as much as possible. So the history of a lump of sugar contains the story of how plants work, and how mankind inherits their store by aid of labor both of mind and body.

HEALTH MATTERS.

Weight of the Body in Typhoid-Fever.

DR. L. H. COHIN has published a thesis in which he sets forth the daily variations in the weight of patients in typhoid-fever. This publication is the result of studies pursued in Cochin Hospital, where, by a skilful contrivance, successive series of patients were carefully weighed every day, and the weight recorded on their charts, from the beginning to the end of the fever.

The observations of Dr. Cohin, as given in the *Boston Medical and Surgical Journal*, show that the loss of weight varies considerably for each individual. With some it was two hundred grams a day: this was the minimum. With others it was five hundred grams: this was the maximum. The mean of nine observations gives four hundred grams of loss per day; but on taking mild cases, free from complication, the mean fell to three hundred and twenty grams, which represents the daily loss in typhoid-fever of average intensity. The mean of the daily gain, when convalescence was established, was two hundred and eighty grams. The maximum of loss of weight corresponded to the end of the second week, or the beginning of the third. In reviewing the researches on the causes of the loss of weight in typhoid patients, the writer establishes the fact that the febricitant lives at the expense of his own substance.

The conclusions of these studies are as follows: (1) Typhoid-fever presents two distinct periods, one of loss and one of gain; certain accidental causes may modify them, but cannot affect their general character. (2) The daily loss is due to febrile combustion chiefly, and but little to abstinence. (3) The daily loss varies with individuals. (4) The losses in nitrogen and in weight are almost parallel with the march of the temperature, without always following it exactly. (5) The study of the weight-chart may aid in prognosis, a continual rise in the weight being a sign of convalescence. (6) The complications of the disease augment the loss of weight. (7) The study of the loss of weight enables the physician to determine with precision the action of nutritive substances in fevers. (8) The loss of weight in a typhoid patient takes place each day in a uniform manner.

HEALTH IN THE FRENCH ARMY. — According to the official report of the French minister of war, the mortality among the French troops has fallen from twelve to eight per thousand during the last year. From 1875 to 1887 there have occurred 141,648 cases of typhoid-fever, and 21,116 deaths. The percentage of this disease has materially decreased of late, owing to the attention that is being paid to pure water-supply in the barracks. The value of vaccination is proved by the fact that the number of small-pox cases has fallen from 1,042 to 242, and these were mostly among recruits.

NEW METHOD OF PRECIPITATING SEWAGE.—The problem of the disposal of the sewage of large towns has long defied the efforts of sanitary engineers to cope with it in a satisfactory manner. A new method of sterilizing and precipitating sewage has just been brought out, which, it is claimed, accomplishes all that can be required of it at as little cost as any such system can be worked. The method has been put in practice experimentally at

the Wimbledon Sewage Works, England. The principle underlying this plan of dealing with sewage is the employment of "amine" salts in combination with milk of lime. At Wimbledon, herring brine is used, and on mixing with the lime a very soluble gaseous re-agent is evolved, to which the inventor has given the name of "amerinol." This re-agent possesses a peculiar briny odor, and when introduced into sewage is said rapidly to extirpate all micro-organisms capable of causing putrefaction or disease. The effect is almost instantaneous. By the action of the lime, violent flocculation is caused, and subsidence takes place in about half an hour, the putrid smell of the sewage being replaced by the peculiar briny odor. According to Dr. Klein, the destruction of micro-organisms is absolute. The total cost per annum of treating London sewage by this method is put at $625,000. Should the residue prove to possess any value for agricultural purposes, its sale would tend still further to reduce the expense.

VACCINATION IN JAPAN. — Vaccination, according to *Medical News*, has been obligatory for some years in Japan, and every infant is required by the police to be vaccinated. The value of the procedure is, however, well recognized by the people themselves, and the government hospitals in every town are always thronged with applicants on the weekly "vaccination day." In 1886 there were 1,531 vaccinations to each 10,000 inhabitants.

BOOK-REVIEWS.

Benjamin Franklin. By JOHN T. MORSE, Jun. Boston, Houghton, Mifflin, & Co. 12°. $1.25.

THIS is the latest issue in the American Statesmen Series, and is well worthy of its place. It treats Franklin exclusively as a statesman, his scientific discoveries being only incidentally alluded to, and his business life very slightly sketched. His early years, too, are passed quickly over, the author thinking that Franklin himself has recounted his early life so admirably that no one else can successfully deal with it. Accordingly, with the third chapter we find our hero despatched on his first mission to England, and all the rest of the book is devoted exclusively to his public services. Mr. Morse shows perfect mastery of his subject, and his style is clear, refined, and dignified; and these qualities make the book interesting throughout. His account of Franklin's labors in England is sufficiently full, and shows why in the main they failed. The dispute between the people of Pennsylvania and the proprietaries of the province was one that could not be settled, and in fact was not settled, until the people had the entire government in their hands. But Franklin's efforts on behalf of Pennsylvania first, and afterwards of all the Colonies, form a very interesting chapter of American history, which is well set forth in this book. The most important of Franklin's public services, however, were rendered in the capacity of minister to France, and it is this part of his work that Mr. Morse has most elaborately treated. Franklin's labors were by no means confined to securing the alliance of France, but included also the difficult task of borrowing, or begging, money in France and everywhere else where it could be got, together with a great variety of services besides. He had for a time two colleagues, but neither was of much use, while one was a mischief-maker of the first order, so that the whole burden virtually fell upon Franklin; and Mr. Morse probably does not exaggerate when he affirms that Franklin's services to the national cause were only less arduous and important than those of Washington.

With regard to the character of his hero, our author expresses himself with some enthusiasm. "Intellectually," he maintains, "there are few men who are Franklin's peers in all the ages and nations. . . . He illustrates humanity in an astonishing multiplicity of ways at an infinite number of points. He, more than any other, seems to show us how many-sided our human nature is." This may be somewhat exaggerated, but it is substantially true; for few men in history have been great at once in such widely separated departments as politics, science, and literature. With regard to his moral character, Mr. Morse, while not extenuating his faults, prefers to dwell on his excellences, which were undeniably of a high order. "As a patriot, none surpassed him," and "the chief motive of his life was to promote the welfare of mankind." "It is not worth while to deify him, or to speak with extravagant reverence, as if he had neither faults nor limitations. Yet it seems ungracious to recall those concerning one who did for his fellow-men so much as Franklin did. Moral, intellectual, and material boons he conferred in such abundance that few such benefactors of the race can be named, though one should survey all the ages." This is high praise, but it is in the main well deserved; and now, when disinterested patriotism is rare among us, Franklin's example ought to be kept before our eyes, and we hope that this book will be widely read.

Darwinism: An Exposition of the Theory of Natural Selection, with Some of its Applications. By ALFRED RUSSEL WALLACE, LL.D. London and New York, Macmillan. 12°. $1.75.

DARWIN, in the greatness of his unselfish candor, receded somewhat from the claims of his theory of natural selection, yielding to certain adverse criticisms; and now Dr. Wallace, who had independently originated the same theory, shows anew his own magnanimity in coming to the rescue in a volume entitled "Darwinism." The book is opportune, and worthy of its distinguished author, who is a recognized authority. Addressing all intelligent readers, it surveys the whole subject, confining this for the most part, however, to Darwinism pure and simple, which, as given in the title of Darwin's first enunciation, is the "origin of species;" namely, from pre-existing species by natural selection. Dr. Wallace has the advantage of reviewing the subject "after nearly thirty years of discussion, with an abundance of new facts and the advocacy of many new and old theories," especially from the pens of noted investigators and leading evolutionists.

This limitation to evolution of species, in twelve of the fifteen chapters, avoids many perplexing questions, and gives simplicity and unity to the argument. The author regards the main proposition, in its application to existing or comparatively recent species, as all that can be proven, every thing beyond that lying in the region of probable conjecture. The difficulties, popular or scientific, relate chiefly to the origin of the larger divisions of the organic kingdom, the first development of complex organs, and the like. All this is too remote and too imperfectly recorded to be entirely solved; yet he believes that the generic and ordinal differences among plants and animals are of the same nature as those found in many groups of species, only greater in amount. As we rise to classes and sub-kingdoms, the difficulty is much increased, and we may reasonably doubt whether a radically distinct plan of structure is due to the action of the same laws that have developed species.

In the second chapter, on the struggle for existence, old and new facts are presented, ending with an ethical vindication of nature. In the third the variability of species is illustrated by statistical diagrams and otherwise, showing that it superabounds and offers always and everywhere material that is plentiful for natural selection, rather than slight and rare, thus obviating one of the common objections to transmutation of species. After discussing in further chapters the subjects of artificial and natural selection, and after meeting certain objections (the utility of all specific characters being especially asserted, with some qualification, and the swamping effects of intercrossing denied), the author treats of infertility of crosses, and sterility of hybrids, and opposes the "physiological selection" of Romanes. Going a step further than Darwin, he regards infertility as beneficial under certain circumstances, and increased by selection. Four chapters are given to color, exhibiting the author's well-known views as to its origin and its uses, re-enforced by Alfred Tylor's observations on structural decoration. Darwin's theory of sexual selection of the ornamental is rejected, there being, for example, no evidence, except to the contrary, "that slight variations in the color or plumes, in the way of increased intensity or complexity, are what determines the choice."

The concluding chapters consider geographical distribution; the geological evidences of evolution; certain fundamental problems of variation and heredity, with criticism of the recent speculations of Spencer, Cope, Karl Semper, and Geddes, referring particularly to the improved Lamarckian doctrine, lately revived, that acquired characters are inherited; and, finally, Darwinism applied to man.