of $80,143,390, as compared with similar receipts amounting to $61,934,437 for the year preceding. Of chemicals, drugs, dyes, and medicines, about half our imports are free and half dutiable, the latter amounting last year to $5,764,698, and the former to $6,738,862, the free goods showing an increase of 50 and the dutiable of 25 per cent, as compared with the imports of the year preceding. But the most remarkable showing in the increased imports of free goods is found in the item of hides and skins, other than furs. These constitute a raw material, the bringing of which here from abroad to be manufactured involves the use of a large amount of capital and the employment of a great number of hands, whether the manufacture be only so far carried out as to produce leather, or whether, as with the greater proportion, it is carried forward into the making of boots and shoes. In 1878–9 we had a full average import, amounting to $15,959,017, but for 1879–80 our receipts were far greater than ever before in the history of the country, footing up $30,002,254. In the other articles free of duty which enter most largely into our manufactures, we find that the imports of India-rubber and gutta percha have increased from $6,063,088 to $9,606,239, rags for paper-makers from $2,402,457 to 5,474,737, raw silk from $8,371,025 to $13,024,699, and block, bar, or pig tin from $2,312,297 to $6,223,176. The large capital and increased employment of labor necessitated by this larger use of raw material requiring so much work to fit it for the requirements of the public will at once be evident.

When we come to the imports of dutiable goods, however, such as are generally brought here in competition with the productions of our own manufactures, we find in most branches an increase quite as great as that noticed in our imports of free raw materials, a fact which would tend to discredit our general industrial prosperity were it not that we have such cumulative evidence to the contrary, and can see that these increased imports, bought from the superabundant proceeds of two bountiful crops, are but supplementing demands upon our own manufacturers which the latter find themselves unable to fill. Thus, in cotton manufactures, although the mills at Fall River, Lowell, and other places, have been producing more goods than ever before, our imports for 1879–80 were $29,929,366, as against $19,928,310 for the year preceding. So, too, in manufactures of wool, although our imports have increased from $24,355,801 in 1878–9, to $33,911,093 in 1879–80, the home industries in this line have been remarkably prosperous. In iron and steel and their manufactures the business has not been so steadily prosperous as in some other branches, because of the intense speculative fever which dominated that market during a great portion of the year, but there was a great improvement in the many industries embraced in this line as compared with the condition of the trade for the year preceding. It is to be particularly noted also, in this connection, that while our increased imports of this class were enormous, by far the largest items were of pig and old and scrap iron, which, considering the work necessary to turn them into marketable products as finished goods, may properly be considered as raw material. In fact these two items alone constitute more than half our imports of iron and steel and its manufactures for the past year, figuring for $27,956,144, as against $2,054,885 in 1878–9, while all our other imports in this class, such as castings, steel and iron rails, machinery, cutlery, files, saws, and tools, foot up to but $26,757,844 in 1879–80, as against $7,392,363 in 1878–9.

When we turn to the other side of the account, however, and look at the items which make up our increased exports, it is not at all surprising to find that in the shipment of manufactured goods we have only just about held our own, and that our larger shipments are almost entirely in grain, cotton, and provisions. Of the latter we had an unprecedented abundance, and the marketing thereof furnished the people with the abundant means which has enabled them to purchase so freely of manufactures. On this account the ambition to build up a trade in our manufactured goods in foreign markets has been, this year, to a great extent, held in abeyance, in the presence of an active and generally more remunerative home trade. Of course this has been only a temporary condition, to be probably followed by more earnest efforts than have ever before been made to enlarge the sale of our manufactures abroad, for, aside from the fact that we can hardly expect a continuance of such magnificent harvests, the great enlargement of our manufacturing facilities during the past year will compel those interested in such lines to seek wider markets, if they would place their trade on a permanently prosperous footing. There never has been a time more propitious than the present for the putting forth of the most zealous efforts in this direction. Labor is comparatively cheap, but at the same time all the necessities of life are sold at such reasonable rates that the condition of the workman is much better than in former years, when we had a vitiated currency and wages were much higher; American manufacturers, too, have now won such a position in most of the markets of the world that they will not have to encounter the prejudices which were formerly a chief obstacle in developing foreign trade, but they will find customers everywhere not only willing but desirous to meet them on grounds which cannot fail to be mutually advantageous.

HORSE RAILWAYS IN EUROPE.—Ten years ago the horse railway, or "tramway," was scarcely known in Europe. Now there are fully 700 miles of "tramways" in Germany, Great Britain, France, and Belgium

BLIGHT OF PEAR TREES.

BY T. J. BURRILL, PROFESSOR OF BOTANY AND HORTICULTURE, ILLINOIS INDUSTRIAL UNIVERSITY, URBANA, ILL.

The writer has been very fully convinced by many observations and varied investigations, that this dreaded disease of the pear tree is caused by a minute organism belonging to a group of the lowest fungi, best known as *Bacteria*. These organisms require high powers of the microscope to detect their presence, hence the failure by microscopists to find anything to which the disease could be attributed. Much larger parasites, animal and vegetable, have been sought for, but sought for to no purpose, except to thoroughly establish the fact that insects and the ordinary parasitic fungi on plants were *not* the cause of the disease. Bacteria have not been known as active agents in the destruction of living plants, and microscopical investigations have not usually been of the peculiar kind to reveal them. But these organisms do occur, and may always be found in the bark of pear trees actually undergoing the change which we call blight. They multiply with rapidity and become excessively numerous, thousands in a minute drop placed under our microscope. They move to and fro with a slow, undulating, twisting, tumbling motion. They gradually elongate, becoming two or three times as long as wide, and then divide transversely into two equal parts, the joints clinging together for some time, but eventually separating entirely. The fluid which contains them may become dry and the life processes of the minute things apparently stopped for an indefinite length of time, when, by the addition of water, they recommence their movements and otherwise exhibit the phenomena of life.

Upon careful examination of the tissues of infected trees, we find that the stored starch grains gradually disappear. The protoplasm may not be destroyed, and the walls of the cells are left in most cases without the slightest trace of perforation or other injury. The disease is pre-eminently one of the bark. The wood, except in the case of very young shoots, is not affected. The water from the roots, passing as it does through the wood, may, and often does, ascend for months to living leaves above, while the bark is dead entirely around the stem or branch for several inches or even feet. The upper portion of course ultimately dies, unless as may happen when the cambium is not destroyed, a new bark is formed underneath the dead one. The leaves are invaded by the destroyer, but the sudden destruction often witnessed is especially due to the girdling effects upon the limb or trunk.

The progress of the disease in the tissues of the plant is always slow. The bacteria are not carried by the circulation in the fluids of the tree, but gradually work their way by their own powers of movement through the imperforated walls of the cells. These walls must present an almost unsurmountable barrier to their progress from cell to cell. Indeed, the puzzle really is how they get through at all. In old wood the cell walls become pierced with minute pores, but no such thing exists in the cells containing the stored materials upon which the bacteria live. The walls of such cells, though permeable by water, have no openings which the highest powers of the microscope reveal, either before or after the change produced by blight. The thick cells of the liber (*bast*) or inner fibrous layer are really proof against the invasion by the bacteria. Not unfrequently a continuous layer of these cells separates the diseased parts from those perfectly healthy. It may be that the progress of the malady is thus checked in some plants, while in others, with less bast, its course is uninterrupted.

In the fermentation which occurs of the starch, and presumably of other carbonaceous materials, carbonic acid, butyric acid, and hydrogen are formed. This is very different from the results of putrefaction or ordinary decay, and especially indicates the agency of bacteria, for the butyric fermentation is only known as a consequence of their action.

Having now indicated the changes which take place in the still living but infected cells, and having found an organism capable of producing these changes, it remains to show that this organism really does *cause* the phenomena observed. The proof is direct and it is believed conclusive. It consists in artificially introducing the bacteria into the healthy bark of living trees and noting the results. If in a great number of cases the disease follows such inoculation, plainly spreading from the minute puncture required, and if we are reasonably certain no other active agent is thus introduced, can the conclusion be avoided that the bacteria which we see multiplying and spreading from cell to cell, do certainly cause the observed changes, and thus the disease? This has been done in the most careful manner, and, in case of the pear tree, has been followed by disease in sixty-three per cent of the inoculations!

In a few of the operations small pieces of diseased bark were inserted as in budding, but in most cases the inoculations were performed by dipping a needle or sharp pointed knife into the fluid (distilled water) containing many bacteria taken from diseased trees, and thrusting the wetted instrument into healthy bark. As a counter check a *clean* needle or knife was frequently inserted in a similar manner in the bark.

In a row of fifty-five pear trees, three years old, certain evidence of blight followed in sixty-three per cent of the inoculations with bacteria, in no case from the puncture with a clean instrument, and in one case only spontaneously, *i. e.*, without conscious introduction by myself. Many applications of bacteria to the uninjured surface of the bark and the leaves were without result.

Inoculations in a similar way with virus from the diseased pear in apple and quince produced disease identical in every respect with that in the pear. Of those in the apple, thirty per cent only were successful, while one hundred per cent of the inoculations in quince clearly communicated the disease. In the apple the percentage successful was much reduced by the failure of all the inoculations in the bark of portions more than one year old. This may have been due to temporary causes, not to uniform conditions.

Here, then, is given the change in the tissues, a living thing known to produce such changes discovered, and its active agency confirmed by trial. Is it not more than probable that the bacteria really cause the disease?

The experiments above referred to (inoculations) were made during July and August, 1880, and papers based upon these and previous investigations were read by the author before the recent meeting of the American Society of Microscopists, at Detroit, and of the American Association for the Advancement of Science, at Boston. Examinations have since confirmed an expressed opinion that the disease of the peach tree, known as the "yellows," is also due to bacteria. The peach tree parasite, if such it may be called, is less in transverse diameter, being only 1 mm. (0·0000343 inch) thick, and has shorter articulations. The length of what seems to be the typical form is 3·5 mm. (0·0001202 inch). The physiological effects seem to be very nearly the same. The stored starch is destroyed and the cells left otherwise intact.

DESTRUCTION OF OYSTERS BY PETROLEUM.

The setting up of a large petroleum refinery on the shore of San Francisco Bay has been followed by the destruction of the shell fish along a wide reach of shore and the driving away of the shoals of food fish which formerly gave occupation and profit to many fishermen. The question has been before the California Academy of Sciences, and the evidence produced seems to be conclusive that the waste and refuse of the oil works floated upon the water and washed upon the shores are the sole cause of the heavy losses to the fishermen and markets of San Francisco.

A corresponding conflict of interest prevails in this region. The oil works at Hunter's Point have had the effect of spoiling a wide area of shore and river—East River, Hell Gate, and beyond—which once produced large quantities of fish, oysters, and clams. The oystermen and fishermen of Newark Bay and the adjacent waters complain that since the oil works have been established at Constable Hook the refuse oil from them has almost entirely driven the fish from those waters and has seriously injured the oyster crop. Just now they are complaining bitterly against the proposed extension of pipe lines in the waters of Newark Bay and the Hackensack River. The oyster trade of the bay is immense, it being one of the best of our northern fields for oyster seedlings. The fear is that the leakage from the pipes will injuriously affect if not entirely destroy this important industry. The fear is not without just foundation; but the petroleum industry is of such overwhelming magnitude and importance, and is operated by such heavy combinations of capital, that it is doubtful whether, even by an appeal to the State Legislature, the New Jersey fishermen will be able to arrest the evil which threatens them.

The Trans-Sahara Railway.

On his return to Marseilles recently, the chief of the Trans-Sahara Railway expedition, Colonel Flatters, reported the practicability of a route about 200 kilometers south of El Golea, in 24° north latitude. The expedition found a reasonable amount of water, never having been three days without it, and in the course of the exploration a lake was discovered full of fish and surrounded by vegetation. The general character of the soil was a hard sandstone, though for 80 kilometers there was an arid belt of very hard limestone. The whole country is much infested with snakes and lizards, and among the wild animals were antelopes in great numbers. The tamarisk tree grows luxuriantly in the Sahara, acquiring a development of three and a half yards in circumference. The price of salt is enormous, 100 kilos of this necessary article being valued at four slaves. As each slave is estimated at 900 francs, the cost of 2¼ pounds of salt is about 28*s*. Colonel Flatters met with great friendliness on the part of the Tovaregs, and he entertains no doubt as to the feasibility of the project.

Tin in Maine.

Referring to our recent article on tin mining in Maine a correspondent in that State writes that the promise of the mine at Winslow continues to be most encouraging, indeed far better than that offered by the best Cornwall mine at an equal depth from the surface. He adds that "with every day's work the seams are widening and rapidly converging towards what must at no great depth prove a champion vein of large dimensions."

Our correspondent is of the opinion, however, that the western portions of the State give indications of more valuable deposits of tin. In this region are extensive belts of gneissoid ledges interspersed with fluorspar, and in several places in Cumberland county fine specimens of cassiterite have been taken from what appear to be well defined seams. Some of these seams were laid open in rock cuttings for railways some years ago, but those who did the blasting knew nothing of mineral ores, and the geologists were looking for other things.