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cent. by systematic selection. The history of the improvement of sugar beet from 1838, when the first records of sugar content of the beets were taken, to the present day might be divided into three stages. In the first period, from 1838 to 1868, the improvers of beet confined their attention almost entirely to physical characters such as form. During that period it was observed that the smallest roots were generally richest in sugar. But as the small roots gave a low yield per acre, the growers made a compromise and selected medium-sized shapely roots. From 1838 to 1868 the average sugar content of the beets was raised from 8.8 to 10.1 per cent. During the second period, 1868-1888, Vilmorin discovered that the fact that, although the sugar content of the beet was an hereditary character, it was necessary to repeat the selection of seed-bearing plants at frequent intervals in order to maintain the improvement. To ascertain the richness in sugar of the roots, he floated them in baths of salt and in sugar solutions of known specific gravity, and adjusted the concentration of the bath so that the great majority of the roots would float. He selected for breeding processes only the densest beets. That method was replaced by a process of analysis of sections of the root and determination of the sugar content by the use of the polarimeter. From 1868 to 1888 the sugar content of the beet was raised from 10.1 to 13.7 per cent.

The final stage of improvement was begun when the breeder took into account the ancestral heredity of the mother plants, pedigree, or genealogical selection being adopted. Hundreds of thousands of roots of beet were analysed. A core was bored diagonally through the beet in such a way that the various zones of high or low sugar content would be represented. Removing the core of beet does not interfere with the growth of the beet. The beets were numbered and the sugar content determined. The individual beet might be high in sugar because of its environment, and might not be a high producing strain.

It was not merely the beet of high sugar content that was desired, but the one whose progeny would be high in sugar. By comparing the sugar content of the progeny of each beet with that of the original beet the breeder was in a position to determine which of the original beets transmitted high sugar content to the progeny. That method of selection, i.e., estimating the worth of each individual strain of beet by its power to produce high-grade progeny, aided and controlled by chemical analysis had enabled the average sugar content of the beets to be increased during the last 25 years from 13.7 to 19.0 per cent. As individual beets often contained up to 25 per cent. of sugar, there was every reason to believe that the improvement had not yet reached its limit.

To be continued.

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EXTENDING THE UNIVERSITY.

Yesterday Professor R. W. Chapman described the advantages which will be obtained from the new building which is being erected for the University in front of the Darling Building. It will accommodate the departments of engineering and physics. Professor Chapman said there had never been anything here comparable in the way of equipment for the engineering school with that found in either Sydney, Melbourne, or Brisbane. The laboratories here were small and not well equipped, although in spite of that the men had held their own. The new engineering laboratories would contain provision for a large testing laboratory, in which tests would be carried out, not only for teaching purposes, but also for Government departments and for the general public, on steel, concrete, cement, and other structural materials. There was an increasing demand for tests of that kind, for hardly any structural work of any importance went on now unless the materials were tested at the University. There would also be a special hydraulic laboratory, mainly for instructional purposes, for experiments on the flow of water and the efficiency of pumps and hydraulic motors. There was no such equipment in this State at present. The new electrical laboratory would compare favorably with those in the other States, and there would be ample provision for teaching rooms and an engineering museum. The difficulty now would be to provide money for the equipment. Provision would also be made for the increasing growth and development of physics, which was perhaps the most fundamental subject. Nearly all the students took physics, and on account of the smallness of the laboratories classes had to be triplicated and even quadruplicated. The larger laboratories would enable the practical teaching to be done much more effectively. There would also be a very fine lecture-room, capable of holding about 300 persons, which would be available for extension lectures and also for the considerable number of classes that the University now has of 100 and over. Provision was also made for research laboratories, and the question of research must be kept in the foreground if the University was to be a living force in the community. The removal of the two departments would also provide much needed space for the Faculty of Arts. The building is being erected by a Government grant under the supervision of the Architect-in-Chief's Department. It is in an advanced stage, and is expected to be in use next year.

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CATHEDRAL ADDRESSES.

During August, under the auspices of the Adelaide Diocesan Social Union, special addresses will be given in St. Peter's Cathedral on Sunday evenings. On August 2 the Bishop will speak on "Christianity and marriage." The subjects for the other evenings of the month are "Christianity and maternity" (Rev. W. H. Irwin); "Christianity and racial problems" (Major V. M. Newland, formerly of Kenya, Central Africa) and the Rev. C. W. T. Rogers); "Christianity and leisure" (Mr. F. W. Eardley and the Rev. L. Denledge Sykes), and "Christianity and Commerce" (Mr. A. Grenfell Price and the Rev. N. Crawford).

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SCIENCE AND AGRICULTURE.

Work of Louis Pasteur.

Its Value Unlimited.

No. 3.

The work of Louis Pasteur affords a very striking illustration of the application of the exact methods of chemical and physical research to the phenomena of disease, and the demonstration of a controllable cause for diseases in plants, animals, and human beings, said Dr. A. E. V. Richardson, in his lecture on science and agriculture. His first piece of research gave him the key to his future work. He set himself the task of determining why two compounds, the two tartaric acids deposited from wine lees, though similar in chemical composition, were absolutely different in their properties. The French chemist, Biot, had observed that one of the forms of tartaric acid rotated a ray of polarised light to the right, while the other form possed no rotary power. Pasteur supplied the explanation. He was able to prove the inactivity of one acid depended on the fact that it was composed of two isomeric constituents—one the ordinary dextro-rotary acid, and the other, a new acid which possessed an equally powerful left-handed action. He then sought to prepare the inactive form by artificial means, and after great labour he succeeded. While doing this, he was led to begin his classical work on fermentation through the observation that when the inactive acid was placed in contact with a mould (Penicillium glaucum), the right-handed variety was destroyed, while the left-handed variety remained unchanged.

The disease of wine and beer had from time immemorial baffled all attempts at cure. Pasteur showed that in all cases of fermentation, e.g., where alcohol is produced from malt or grape juice, where vinegar is produced from wine, and where milk turns sour—in all these cases the cause was due to the presence of micro organisms. Exclude every trace of these organisms, and no change takes place. The materials keep unchanged for years. But why does beer, milk, or wine become sour on exposure to air? Pasteur showed that when organisms from the air are excluded, no change takes place. In the interior of the grape no germs exist. But crush the grape and expose it to ordinary atmospheric agencies, and fermentative and putrefactive changes run their course. The application of these facts to surgical operations in the able hands of Lister revolutionised surgical practice. Pasteur's discoveries in fermentation inaugurated a new era in wine-making and dairying industries. Empiricism, hitherto the only guide, was replaced by exact scientific knowledge, and the connection of the phenomena of disease with a controllable cause was thus established. After a study of the diseases of wines which had a most important practical bearing, an opportunity came which not only changed the course of his career, but had a great influence on the development of medical science. His friend Dumas urged him in 1865 to investigate an epidemic and fatal disease in silkworms in southern France—a disease which had almost ruined the French silk industry. He succeeded in determining the cause of the disease and in suggesting methods of preventing its recurrence. His work resuscitated the silkworm industry of France. It was the first of his victories in the application of the experimental methods of the trained chemist to the problems of biology. At the close of this investigation he stated:—"There is no greater charm for the investigator than to make new discoveries, but his pleasure is heightened when he sees that they have a direct application to practical life. Pasteur was impressed with the analogies between fermentation and the infectious diseases. Two centuries earlier, the English physicist, Robert Boyle, had said that he who could probe to the bottom of the nature of ferments and fermentation would probably be more capable than any one of explaining certain morbid phenomena. These words had often recurred to the mind of Pasteur, who felt certain that his study of diseases of wine had given him the key to the nature of infective diseases.

Anthrax.

An extraordinary opportunity now offered for the study of a widespread epidemic known as anthrax, which in many parts of France had killed 25 to 30 per cent. of cattle and sheep. Devaine in 1863 had suggested that the rod-shaped bacteria present in the blood of animals which had died from the disease was the cause of anthrax. Koch in 1876 showed how to isolate the organism and grow it in pure culture outside the body. Pasteur confirmed these results, and made an even more important discovery—namely, that by growing successive and continued artificial cultures under different conditions, the virus or poison of the organism became weakened or attenuated, and that if this weakened virus or poison is injected into the animal, only a slight attack of the disease occurs and the animal is rendered immune from further attacks. The virus becomes a vaccine. This discovery produced a tremendous sensation in the agricultural and medical worlds. The Melun Agricultural Society urged Pasteur to conduct public experiments on anthrax to demonstrate the efficacy of his cure, and offered to conduct such trials. They placed 50 sheep at Pasteur's disposal for a test. Twenty-five were to be vaccinated by two inoculations at 12 days' interval with attenuated anthrax virus. Some days later those 25, and also 25 others would be inoculated with a culture of anthrax microbes. "The 25 unvaccinated sheep will all perish," said Pasteur, "and the 25 vaccinated ones will survive." It was an occasion famous in the history of medicine and veterinary science when in June, 1881, at a farmyard at Melun, hundreds of scientists gathered from all parts of Europe to witness the result of the inoculation. The 25 vaccinated sheep remained well, while every one of the unvaccinated sheep inoculated from the same material had died.

These experiments caused a tremendous sensation, and the whole of France burst out in an explosion of enthusiasm. The French Government awarded him the Grand Cross of the Legion of Honour for his discovery.

Many millions of sheep and cattle have since been treated for anthrax all over the world, and the rate of mortality has been reduced to less than 1 per cent. As to the money value of these discoveries, Huxley has estimated that it was sufficient to pay for the whole cost of the war indemnity paid by France to Germany in 1870. The Pasteur Institute was founded as a national memorial to the illustrious man whose name it bears. That restless, tireless genius had saved France millions in treasure, and hundreds of thousands of lives. The silk industry, the wine industry, the dairy, stockraising industry, medicine, and surgery had felt the impress of his mighty hand. Scorning the rich rewards which might have been his had he chosen to put his discoveries under the seal of letters patent, Pasteur deserved well of his country. The people understood and honoured him as few men of science have ever been honoured while they were alive. When one of the great newspapers opened a subscription for a splendid memorial for an institution wherein Pasteur had his disciples might carry on their work under the most favourable conditions, the response was instantaneous. There was hardly a humble home in France which was not in some way indebted to Pasteur, and there was hardly a home in France from which a subscription did not come. The wonderful Pasteur Institute was the result. Research workers come there now from every part of the world, and while the work of the institute is now highly technical, it may perhaps be said that nowhere has so close an approach been made to the solution of the most intimate problems of hygiene, health, and of life.

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