

tronized him, so that he was able to build a new model, which was inspected by the Emperor of Austria. It was the intention to utilize the invention practically in the Austrian navy; but the project had to be abandoned for the want of money experienced at that time by Austria. When, during the Crimean war, the English and French fleets invested Cronstadt, Bauer was invited by the Grand Duke Constantine to come at once to Russia and construct a ship which could be employed against besiegers. The ship was finished just when peace was concluded; but Bauer undertook 120 submarine trips with it. A large pecuniary compensation had been accorded to him; but as he did not comply with the demands of Russian officials, he was exposed to many intrigues, and had almost to fly from Russia under the protection of the Bavarian ambassador. He repeatedly resided in London, and settled finally at Munich, where he continued his studies undisturbed. His name came again prominently before the public when he effected the raising of the Ludwig, sunk in the Lake of Constance. He earned a lasting name and honors by this feat, but at the same time contracted a severe affliction of the gout, which grew worse with time. Paralyzed and deprived of speech, he spent his days in a chair, but his mind, notwithstanding bodily infirmities, was as fresh as ever. He subsisted on a pension granted him by King Louis, until death released him from his sufferings.—Engineering.

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THE ENGLISH PATENT BILL.

The new Patent Bill, which lately passed the House of Lords, was withdrawn in the House of Commons, and has failed therefore to become a law. A great mass of petitions were presented against it, but none in its favor. The general object of the proposed law was, as we have heretofore intimated, to curtail and ultimately to abolish the granting of patents in England. The intended change appears to have roused the strongest opposition among the scientific and working people of England, but was favored by the aristocracy.

The failure of the new bill leaves the present law in force, with all its excellent provisions for the granting and holding of patents by American citizens and other foreigners. Among the provisions are the following:

Any person may apply for, obtain, and hold an English patent for a period of fourteen years; the patent remains good during this period, if the fees are paid, whether the patentee works the invention or not; he is at liberty to do as he pleases in this respect; no one may use the invention without his consent.

Models are not required; but full drawings and specifications must be furnished by the applicant.

The government grants a patent to every applicant, whether the invention be new or old; no official preliminary examination as to novelty is made, but the applicant is expected to make his own examinations, all previous patents being printed and accessible.

If the applicant takes out a patent for an old invention, one that is already publicly known, or has been previously patented in England, such patent will be worthless, as it will not be sustained by the English courts. But if the invention is new in England, the patent will be liberally construed and sustained by the courts.

The British patent covers England, Scotland, Wales, Ireland, and the Channel Islands, or a population of about forty millions of the most intelligent people in the world.

The business connected with the obtaining of English patents is easily transacted, while the postal and commercial facilities now existing between the United States and Great Britain are such that an American patentee experiences little more trouble in introducing and profiting from his English patent than from his home patent.

Nearly all inventions that are worth patenting in this country are equally valuable in England.

Circulars containing further information concerning English patents, their cost, etc., can be had, free of charge, at the office of the SCIENTIFIC AMERICAN.

THE IRRIGATION WORKS OF INDIA.

Among the more remarkable engineering undertakings of the last quarter of a century, remarkable for their bold conception and sometimes for their blundering execution, must be numbered the irrigation works of India. And since the Indian government has announced the intention of devoting to the extension of such works, during the next fifteen years, the enormous sum of a hundred million dollars, it becomes a matter of no slight interest to know both what has been done and what is proposed to be done in this direction.

The conditions, climatic and otherwise, which make necessary the expenditure of millions to correct the unkindnesses of Nature, are happily but little known in this land of abundant and timely rains. It is to be hoped that they never will be experienced; though it must be confessed that, in some of the more fertile parts of the land, the drift of climatic change is as pointedly in that direction as it used to be in other parts of the world, once fertile and densely peopled, now deserted and desolate. Ages ago, when Northern Africa was swarming with thrifty people, when Asia Minor harbored unnumbered paradises, when Persia was the garden of the world, their people would have scorned the idea that their lands could ever become the prey of drought and famine. But such has been their fate. So in Northwestern and in North Central India, many seats of ancient power and civilization have become untilled and tenantless through the failure of genial showers; and large areas, as in the lower half of the Punjab and the adjoining territory of Scinde are scarcely habitable, except along the rivers, where irrigation is possible. To a less but still serious extent, the upper valley of the Ganges, a large portion of Central India, and the east coast of the Madras Presidency are made to suffer from a scanty and somewhat precarious rainfall, and are even liable to witness famine following hard upon drought, except where irrigation has made them partially independent of local rains.

It is about forty years since the British conquerors of India began to take a constructive interest in the reclaiming of the formerly fertile parts of the country by means of irrigation works, first by the restoration of ancient works which had fallen into decay.

From an early period the lowlands along the Indus and its five branches—which give name to the Punjab—were saved, from the desiccation which befel the plains away from the river, by means of wells and inundation canals leading off from the natural water courses. These works were shallow trenches, unskillfully planned and rudely executed, from five to seventy miles in length, and fed by the surplus water of the rivers when swollen by the melted snow of the Himalayas. At a relatively early period, many of these canals were restored, deepened, and improved under British management, to the great advantage of the surrounding country. For the further alleviation of the same region, a much more ambitious series of irrigation works has been undertaken, of which more will be said further on.

The earliest work of the sort undertaken by the English was planned and executed by Sir Arthur Cotton, of the Madras Engineers. In the southeastern quarter of Madras, the rainfall, though double that of the Punjab and Scinde, has long been slight and precarious. Various means were adopted by the native rulers to store up water against the time of need, chiefly by means of reservoirs locally known as tanks. Many of these tanks have fallen into ruin, still as many as 43,000 remain, with 30,000 miles of embankment and 300,000 separate masonry works. The same presidency contains also the most ancient specimens of a more ambitious class of irrigation works, consisting of extensive systems of canals, fed from reservoirs formed by the damming of large rivers. The first great work of Sir Arthur Cotton was the restoration of one of these systems, by means of which fertility had once been given to the lower valley of the Cauvery river.

In consequence of the gradual erosion of the bed of one division of the Cauvery, the stream which fed the irrigation canals had been almost deprived of its water, and the total ruin of the country, which depended on the canals, was seriously threatened. By means of an immense dam or annicut, the water was set back into the old channel, the canals were

supplied once more, and the irrigation of Tanjore was restored. Thousands of acres of previous waste were brought under tillage, and the productiveness of the whole territory was much increased. The value of the land was doubled, the annual profits of the cultivators were increased by nearly \$500,000, and the government land revenue was increased \$350,000 a year, all by an improvement which cost only \$400,000.

So successful and beneficial was this work that Colonel Cotton was enabled to undertake a similar but more extensive operation for the improvement of the lower valley of the Godavery. This was the construction of a dam across the river, two and a half miles long, one hundred and thirty feet broad at the base, and twelve feet high. The dam was faced with heavy masonry, filled in with earth, and protected by an apron of massy stones extending seventy or eighty feet down the stream. A vast system of canals, adapted both to irrigation and commerce, is fed from above the dam. Altogether there are between 800 and 900 miles of artificial channel from which water is supplied to ground otherwise barren, and 50,000 boats and rafts are employed in conveying the produce to market. When the works are finished, 1,000,000 acres will have been brought under cultivation. So far the works have cost somewhat more than \$3,000,000; but this sum has been repaid more than twice over by the increased public revenue. Similar though not so remunerative works have been executed for the irrigation of the delta of the Kistna.

While these works were in progress, the engineers of Bengal were employed in reopening and extending the Western Jumna Canal, giving life and verdure to 350,000 acres. In 1848 was begun the Ganges Canal, with a main channel 348 miles long, primary branches of 306 miles, and minor distributaries aggregating more than 3,000 miles. The area over which it diffuses irrigation is 320 miles long by about 50 miles wide. Its cost was \$7,000,000.

In the naturally rich and formerly populous region of the Punjab, as already noted, a renewal of life and fertility is being effected by the Barea Doab. This canal leaves the Ravee—one of the five rivers—where it issues from the Himalayas, and, passing the famous city of Umritser, strikes across the desert, and will eventually rejoin the Ravee after a course of 140 miles. On its way, it throws off branches right and left, the length of which gives the whole work (exclusive of minor distributaries) a length of 357 miles. The area expected to be irrigated is 650,000 acres.

In the adjoining province of Scinde are also large tracts of once productive and well peopled country, now a desert, whose productiveness might be restored by the improvement of the old and the construction of new irrigation canals. It is therefore proposed to re-water the country—the valley of the Lower Indus—by means of four systems of canals: an ambitious scheme, which will probably be carried out sooner or later, converting hundreds of miles of waste land into fertile fields.

Many other irrigation schemes are in various stages of development in India, some of great magnitude. Among these may be mentioned the operations recently begun for turning eastward a portion of the waters of the Sutlej, to restore to its ancient condition an immense area, once richly productive, but on which the desert has lately been fast encroaching. Still more important are the works which have been going on for several years in Orissa, to compel the rivers Brahminuy and Mahanuddy to fertilize the deltas which their inundations have heretofore periodically devastated—works on which \$6,000,000 have already been expended.

Though not always wisely planned or economically executed, the irrigation works of India have been, even in a commercial sense, paying investments. Some of them have been extremely remunerative, yielding to the government exchequer, in water rates, increased rent of land, and other revenues, a liberal percentage on the capital invested in them. For example, the Cauvery canals are reputed to pay 23 1/2 per cent on their cost, the Godavery works 45 per cent, the Kistna 16 per cent, the Western Jumna 30 per cent. In ordinary years the Ganges Canal, which was unnecessarily costly, pays barely 3 per cent; but in the rainless autumn of 1860, it was the means of saving grain crops enough to keep alive more than a million people, who must otherwise, if left to themselves, have perished from hunger; thus saving to the State not only that number of lives, but the necessity of a proportionate remission of rents and a vast expenditure for the relief of insolvent tenants. The Barea Doab, in the construction of which some stupendous blunders were made, pays 5 per cent. The unfinished Orissa works have not yet begun to be remunerative. Still, as a possible preventive of the horrors of a famine such as scourged the district in 1866, the vast sum thus far expended cannot be said to be an unprofitable investment.

IS EDUCATION FOR CULTURE OR FOR USE?

The interests of education and of educational institutions will occupy a large share of attention during these summer months. And while the universal commendation, by friends and interested parties, of good, bad, and indifferent alike, which conveys the false impression that there is not an inefficient school or instructor in the land, is a topic worthy of serious consideration, we pass it to notice the question as to the real object of education.

Many of our best educators sneer at the idea of making education commercial—at looking to the practical in its pursuit; and in our highest educational circles, these things are considered beneath the dignity of a real student. This idea has been so eloquently and beautifully expressed by President Capen, of Tufts College, in his recent inaugural address, that we quote it as a sort of text for the remarks we wish