

present from its mouth to the Falls of St. Anthony, about two thousand two hundred miles. Above these falls it is again navigable. The Arkansas and Red rivers emptying into it are each navigable for more than one thousand miles. The Missouri, its principal western tributary, is navigable to a point nearly four thousand miles by water from the Gulf of Mexico. Its large eastern tributaries, the Ohio, Tennessee, and Cumberland rivers give two thousand miles or so additional scope for steamers; while the total number of branches, large and small, towards its mouth, which are to a greater or less extent navigable, has been estimated at not less than fifteen hundred.

The lower plain through which the Mississippi flows, extending from the mouth of the Ohio to the Gulf, is about five hundred miles in length and of varying breadth, say from thirty to one hundred and fifty miles, including the great delta at its mouth. The delta is in all its parts nearly on a level with the water in the river when at its lowest point, and in consequence a system of dykes has been found requisite to prevent inundation. In the low water of summer the current towards the mouth of the river is extremely sluggish, an average fall of about eight inches per mile being all that is estimated for the lower plain through which it flows. It could hardly be otherwise under these circumstances that the course of the river over this plain should be very crooked, and its channels should be very changeable. Add to this the fact that the entire system embraces many tracts of sandy country and timber land and it will be easily understood how bars are constantly forming and shifting and "snags" are constantly drifting down the current to obstruct navigation.

How to relieve navigation from these embarrassments and at the same time to protect the low lands from the dangers of inundation, constitutes an intricate problem and one which will probably never be solved except by repeated experiment. The clearing up and removal of timber along the banks of the principle stream and its affluents, will gradually lessen the trouble arising from "snags," but the sediment poured into the river by the Missouri and other rivers and the periodical freshets remain. Some of the convolutions in the course of this river are so great that a distance of twenty-five to thirty miles by water only makes an air-line headway of a mile or two.

Some cuttings have been attempted to straighten the channel in such cases as the above but we believe the result has generally been that the succeeding freshets have wholly or partially filled up the channels thus formed, and the obstinate waters have either selected an entirely new bed or have returned to the old one. True these works were very imperfect in their nature and could hardly be expected to be durable; but there are doubtless difficulties to be surmounted in making permanent improvements in the Mississippi channel arising from the general instability of its banks, that are hardly appreciated by engineers who have not given special attention to the subject.

A plan has been recently laid before the Louisville Board of Trade, recommended by the New Orleans Academy of Sciences, which it is claimed meets the exigencies of the case; embracing, first, the proper direction to be given to walls or jetties for controlling the action of flowing water; and, second, a material for the construction of these walls or jetties, which can be conveniently handled, and which water cannot move or undermine. The first part of this plan depending upon the principle of reflection for the direction of currents, it is claimed can be readily applied by the exercise of proper judgment in constructing the jetties at the necessary angles to the currents intended to be controlled. In regard to the second part of the plan it was represented to the board that Manico's caissons is the best material for the construction of these jetties. These caissons are the invention of Lieut. Manico, of the Royal Marines of Great Britain, the engineer in charge of the construction of the breakwaters and other sea works of England, and are now used exclusively for such works on its coasts. Their construction and the method of placing them in position were described to the board as follows: "They are usually constructed of a latticed frame of wood or iron filled with loose stones of any kind; and for the convenience of being carried in barges, and handled with the crane, they are only one yard square. They are made sufficiently strong to bear the weight of from 1,200 to 2,000 pounds of stone, and to be craned or dumped down to form walls or obstructions upon the lines marked by the engineers for breakwaters, jetties, the foundations of lighthouses and forts, or any subaqueous works in seas or rivers. They are used exclusively in England for such purposes, and they are especially useful in all water currents, and indispensably necessary in bottoms of sand and mud, like those of our harbors and great rivers where piling and plank ing will not answer. Their great excellence consists not only in the convenience of their form for transportation, and handling for engineering purposes, and their cheapness, but in their stability to resist the undermining power of water. Their latticed form gives them the property of the snow shoe formed by the savage of plaited splits, and which prevents his foot from slipping or sinking in the snow; or like the knotted and webbed foot of the duck, which the Creator has formed for standing or walking on the mud and sand. They will not sink upon a sand bar and no power can drive them into it.

"The work done by the aid of these caissons is very simply and quickly performed. The lines for the jetties to protect a caving bank, or remove a bar, or shift or deepen a channel are 'staked off' by the engineer, and the barges of caissons are unloaded upon these lines and the work is done. The water completes the structure, and by its deposits makes a solid wall of the whole. No matter how they are thrown in a current, they can never be removed by the water. Every interstice between the loose stones is filled with sand and clay, Chemical action takes place in the compacted mass, and the

whole becomes a conglomerate which will endure to the end of time."

In opposition to the claims of this plan may be placed the statement of General Roberts, of the U. S. A., made at the last meeting of the Connecticut Academy of Sciences, in which he attempted to show that the system of confining the flood-waters of the Mississippi river in one narrow channel by dyking, is obstructing the creative laws of delta bottoms and basins, and working the most serious evil by emptying into the Gulf of Mexico the delta-forming material that would, if the waters were left free, spread themselves over the low marshes and swamps, and in time raise them up to higher levels, by the cumulative process of delta deposit, and create cotton lands.

His plan is to introduce a system of waste weirs that should create artificial rivers and carry all the flood waters into the swamps, morasses, bayous, etc., of the Mississippi basin. He also proposes a system of engineering for the waters of the lakes, using them as reservoirs for the regulation of minimum low water navigation.

Without pretending to decide finally upon the relative merits of these schemes, we repeat that experiment alone will determine the value of either. To attempt to carry out either of them without previous trial of their individual workings would be extreme folly. It would be well, we think, for the Government to employ some engineers of established reputation to devote their time and efforts to experimental solution of this problem, and to feel the way as it were to a practical method. We do not believe the man lives who can devise in his study a system that will fulfill all the conditions of the problem, but we do not by any means on that account hold that a solution is impossible. If ever obtained, however, it will be by practical attempts upon the fickle banks themselves and not upon drawing paper.

WHAT IS FUSEL OIL?

The New York dailies, since the report of analytical chemists of the Board of Excise has been made, are asking the question, What is fusel oil? Some have also made a feeble attempt to answer the question which is thus propounded. The query has arisen from the fact that the report above alluded to states that out of thirty-two samples of Bourbon and brandy obtained from the liquor dealers of this city all but four contained fusel oil. One daily gives vent to its feelings in the following:

"Is it after all such a frightful thing? Duglison describes it as an acrid, volatile oil, formed in the manufacture of potato brandy, and which is not easily separable from it; and another authority says it accompanies ordinary alcohol in its production from potatoes and grain. Duglison also says that its chemical constitution is analogous to that of alcohol, and that, in small doses, it is highly stimulating—acting like narcotics in general; while, in large doses, it destroys the mucous membrane of the stomach. The same authority also designates it as 'potato oil,' 'grain oil,' 'corn spirit oil,' 'amylic alcohol,' and 'hydrated oxide of amylic.' Some medical men have considered that in the use of whisky by consumptives, fusel oil was the effective element—having the tendency to retard the processes of decay in the tissues of the lungs. But there is no question of the ruinous effects of the fusel oil liquor sold in New York."

In regard to the effects of fusel oil upon the human system we can do no better than to quote the "United States Dispensary," which says: "Amylic alcohol (fusel oil), as shown by experiments on inferior animals, is an active irritant poison." If that is not sufficiently definite to satisfy anxious and thirsty inquirers we shall not attempt to make it more so. Of course it may be taken like other poisons diluted with water and common alcohol, as it is found in the compounds doled out by honest and conscientious rumsellers without danger of immediate death or anything more serious than "redness of eyes," temporary madness of brain, and now and then a touch of *delirium tremens*, until the coats of the stomach and the nervous system succumb to continued and prolonged attacks, and another wreck is cast upon the shores of life. But it is, nevertheless, a poison, an active irritant poison, upon good authority. How it gets into the liquor is of little consequence. The report says it is there, and we say let it alone and it won't poison you.

THE NEW FRENCH GASLIGHT.

Messrs. Ball, Black & Co. have illuminated the show windows of their splendid store in Broadway with the Bourbouze light. Its peculiar brilliance and beauty nightly attract a crowd of admiring spectators. So brilliant and pure is this light that the ordinary gaslights look like spots of sickly and ghastly yellow when placed between the eye and the pure white illumination of the Bourbouze burners. The light is as steady as the sun. The closest examination cannot detect the least tremor. We tried it with a sheet of white paper corrugated, and inclined so that portions should be thrown into shadow, thus magnifying any motion that might be imperceptible to the unaided eye, but could not detect any motion whatever. Equal parts of oxygen and common street gas are driven simultaneously upon a pencil of magnesia; this is all there is of mechanism of this wonderful light, which literally throws all other lights at all adapted to general use into the shade. In point of cost, when lights of equal intensities are used, the new light is so much cheaper that we should fear to be suspected of exaggeration should we make a statement of it. We are told that Messrs. Ball & Black's establishment is the first that has adopted the Bourbouze light on this continent. A full description of it will be found on pages 185, and 200 Vol. XVIII of the SCIENTIFIC AMERICAN.

We were recently shown a chain of brass, with hook and solid links, said to have been cast in a sand mold.

REMINISCENCES OF TRAVEL IN SPAIN.

NO. V.

An anonymous correspondent, who signs himself "A Spaniard" complains of some of our strictures upon Spanish manners. We can only say that whatever we have written upon this subject is not only true, but our statements are borne out by other travelers and writers who have visited Spain. The habits and customs of a people are free to be observed and commented upon by all travelers, and in the preparation of our reminiscences of Spanish travel we have had neither motive nor purpose to do the slightest injustice to the people of that afflicted country; and if some of our statements have seemed singular even to a native Spaniard, we can only account for it by the fact of his long residence in this country, where life, untrammelled by usages of hoary antiquity, appears more new, fresh, and vigorous.

There is one other phase of Spanish character which we propose to present, and in thus closing our sketches of European travel, it is with the hope that Spain, which has so grand a history, with so much undeveloped wealth, may, even though it be through revolution, once more arise to greatness and substantial prosperity.

THE GREAT NATIONAL SPORTS—A BULL FIGHT.

The national sports of a people are true indexes of their character and civilization, and it is therefore difficult to believe that Spain is the only Christianized nation in the world which tolerates the cruel and inhuman practices of bull fights and cock fights.

It is commonly said that you must not quit Spain without seeing a bull fight, the great national sport. We had read about this heroic spectacle, and being naturally averse to cruelty in every form, we entered upon the business with considerable trepidation. But after all there is nothing like seeing of what stuff the people are made in order to properly appreciate their character. We wanted to see the whole thing or nothing, and to make the affair as respectable as possible in our own eyes, we joined a party of Americans and proceeded to visit the Plaza de Toros (Place of Bulls) the evening previous to the fight, for the purpose of inspecting the pens where the animals were kept. These pens, within the inclosure, are about fifteen feet square, and are provided with galleries, where the tormentors practice the humane sport of spearing the bulls, in order to get them into a towering rage before they are let through the dark narrow passage way communicating with the arena. Within the building there is also a hospital, provided with apparatus and medicines, in case any of the tormentors should chance to be injured, and in order to impart to the spectacle a serio-dramatic interest and solemnity, there is also an altar, where they kneel and kiss the crucifix before engaging in their work; the effect being heightened by the presence of a priest* to administer the consolations of religion in the event of any of them being mortally wounded. A most touching and beautiful adjunct to be sure.

The next morning, being the occasion of a popular religious festival, the whole city was astir, and in the afternoon the crowd began to wend its way towards the Plaza de Toros. The building resembles an ancient coliseum, built of stone, and furnished with several tiers of stone seats, above which are inclosed boxes for the higher classes. There is also an inclosed box emblazoned with the royal arms, and appropriated to the use of the royal family. We should judge that 15,000 spectators might be accommodated with seats. The arena is surrounded by a heavy plank barrier, about six feet high, to protect the spectators, and over which the tormentors leap when hotly pursued by the infuriated beast.

The performance was announced to begin at three o'clock in the afternoon, and an armed guard of handsomely mounted men were stationed about the Plaza to preserve order. The crowd inside, consisting of men, women, and children, must have numbered ten thousand, and aside from slight manifestations of impatience, behaved very orderly. The band performed an overture and the performers entered. There were several men in costume called *picadors*, mounted upon miserable old horses, of the same class used to draw fish wagons about our streets. The *picadors* have their legs incased to ward off the thrusts of the bull; and following them was a team of three mules in fancy harness, dragging a whiffletree and chains, accompanied by *banderillos*, who flaunt the red cloaks, also several men leading bloodhounds. We were satisfied at this point that we were not going to like the thing at all, but the ring being speedily cleared, a blast of the trumpet signaled that the beast was coming; and sure enough, in he plunged—a noble animal he was, too. After rushing wildly around, as if anxious to escape, he plunged headlong at one of the mounted *picadors*, who could offer no resistance, and in a moment he was thrown from his poor old horse, and the animal was soon beyond the need of a veterinary surgeon. After three horses had been killed, and the signal given, the red cloak flaunters had the bull to themselves. He pursued them with considerable fury for a while, but soon began to show signs of fatigue. In the meantime, by a most adroit movement, barbed arrows were thrown into his neck, two being lodged at the same moment, followed by others, until six or eight of these ugly weapons were firmly planted; the effect of which was to arouse the animal to a final desperate struggle. The next professional tormentor who enters the arena to share the honors of the occasion is the *matador*, dressed like a horseman in the circus, and whose duty it is to kill the bull—which is most skillfully done by thrusting a rapier into his neck, back of the horns, which, if well done, causes almost instant death. After this manner four bulls were tormented to death, and eleven horses were killed; each of the dead animals being dragged outside by the mules upon a keen jump.

* This information was given to me by a trustworthy local guide, who had no motive to misrepresent the facts.