

tion, cannot be modified by the contraction-works: for their effect on the distribution of velocities in the bend below, it is only necessary to point to the portion of the river below Baton Rouge. Here the conditions prescribed for a regularized river obtain in greater perfection than can possibly be realized on the river above. Yet in this ideal stream the distribution of velocities follows the cart-wheel analogy as closely as anywhere else.

To sum up, the effect of the contraction-works on a shoal, upon the conditions existing in the bend below, is simply nothing, — nothing as to the distribution of velocities, and nothing as to the amount of sediment carried.

In the face of this conclusion, the changes required by our hypothesis, before it agrees to stop the caving, are quite discouraging. It asks nothing less than the complete reversal of present conditions. It requires that the restraint of a fundamental hydraulic law be removed, so that the water may move at the same velocity at bottom and surface. It demands that the rapid currents along the caving banks be checked, and the sluggish ones on the other side quickened; that sediment shall be deposited in places whence it is now removed, and removed from those where it is now deposited. These revolutions of the river's regimen, as results of works at a distant point, and which have, as has been shown, no effect upon the conditions to be changed, are severally and equally impossible. The greatest actual velocity will be found, as now, in front of the caving bank. If the lesser velocity at the contraction-works be sufficient to produce scour there, the greater velocity at the point of caving must also scour and the caving continue. If the velocity along the caving bank correspond to saturation, so as to prevent caving, the lesser velocity on the shoal must allow deposits, and navigation will be injured.

The disparity in velocities is utilized by steamboats, the down boats being assisted by the rapid currents in the bends, while the up boats take advantage of the slack water on the other side. Uniform motion all the way across would retard the former preceptibly, and the latter fifty per cent. It is now difficult to get up stream enough pieces to accommodate the down-stream traffic. With uniform motion, it would be impossible. Navigation will suffer by the most cautious bestowal of such benefits.

A more general view leads to the same result as the local one. Suppose the channel to have been regularized from Cairo to Baton Rouge as completely as it now is below the latter point. In this conduit, the water supplied by its tributaries is to flow under the conditions that it shall always have the normal charge of sediment due to the velocity, and that it shall neither erode the channel nor make any deposits therein. No sediment being derived from action on the bed, the supply must come entirely from the tributaries.

The tributaries differ widely in their turbidity. The Missouri is the largest silt contributor, furnishing much more than all the others together. After it, but still classed as muddy, come the small streams on the east side above Memphis, the Arkansas and the Red. The Ohio, St. Francis, White, and Yazoo are comparatively clear. If our regularized channel be adapted in size to carry Ohio water without scour or fill, deposits must result when the Missouri predominates. If the channel be such that Missouri water can be carried without loss or gain of sediment, scour and caving must be expected when the supply is mainly from the Ohio. If a mean be taken, the scour and fill will alternately occur, which is simply a relapse into the present difficulties. No natural adjustment by mixture is possible, since the streams named have drainage areas lying in widely different latitudes, and it is rarely that their rises or floods are co-incident.

Suppose, again, that the corrected channel just below Cairo is filled to a certain level with just the right mixture of Ohio and Missouri water, having the normal charge of sediment due to its velocity, and carrying it without loss or gain. A slight rise comes out of the Ohio. Bringing an insufficient supply of sediment, it reduces the degree of saturation in the trunk stream. In order that scour and caving may not begin, this addition of water must be accompanied by a decrease of velocity and a rise of surface. If the rise, on the other hand, comes from the Missouri, the case is reversed, and, in order to prevent deposits and shoals, the velocity must be increased without a corresponding rise in surface. To realize either set of conditions requires an inverse ratio between

velocity and slope, which is a blow at the fundamental law of the universe, that of gravitation. These contradictory requirements are repeated all along the river's course. The Forked Deer, Obion, and Wolf Rivers must produce an effect on the main stream directly the reverse of the St. Francis; the Arkansas, of the White; and the Yazoo, of the Red. The velocity of the river must conform to the supply of sediment, or the hypothesis will be violated. The supply of sediment is fortuitous: hence chance must take the place of hydraulic laws in controlling the flow of the water.

There never has been a day in the known history of the river when caving was not in progress. The amount of sediment requisite to produce normal saturation and prevent caving must therefore be greater than the river has ever before carried. The demand is, that the river be made muddier, and kept so. How as to supply? Of the present contributions, a considerable part is to be cut off by the cessation of caving and scour, which are promised as results of the improvement. The tributaries remain; but of these, the only one worth considering, the Missouri, is already under improvement. The result of that improvement, if successful, will be a fixation of its bed, and a large reduction of its output of sediment. The maintenance of even the present supply of sediment in the trunk stream involves the degradation of the tributary. If the Mississippi is to be improved on such principles, the regulation of the Missouri must be stopped at once.

We see, that, while the demand for sediment is increased, the supply is largely reduced. A scheme of improvement, the vital feature of which is the production and maintenance of increased muddiness, promises as its results changes which must largely reduce the muddiness. Surely this is necromancy on a large scale.

The saturation hypothesis, whether true or false, and following it the anti-revetment theory and plan of improvement based thereon, must be entirely rejected so far as the Mississippi River is concerned; because the conditions under which it is claimed to act cannot be produced or maintained; because uniformity of velocity in any cross-section, or from one section to another, is impossible, either in natural or regulated channel; because the volume of water which controls the velocity, and the supply of sediment, the two factors which determine the saturation, are now practically independent, and in a regulated channel become absolutely so, thus making the combination of the two to produce normal saturation a matter of chance and not of law; finally and principally, because the hypothesis contradicts and defeats itself in that it requires an increased supply of sediment to produce results which, if realized, must make this supply a constantly decreasing quantity.

If the caving of banks is to be stopped, it must be done by means outside of the contraction-works, since the latter cannot produce the slightest diminution of caving. That they will greatly increase it, may be strongly argued both from theory and experience; but such is beyond the present purpose.

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MENTAL SCIENCE.

A Second Laura Bridgman.

THE recently issued report of the Perkins Institution for the Blind, where Laura Bridgman has spent fifty years of her life, adds another most interesting and promising record to the accounts of persons afflicted with this double infirmity. The number of persons deprived of both sight and hearing is larger than is commonly supposed, and gives no sanction to the common belief that the loss of one sense insures an unusually strong development of the others. From a psychological point of view, the value of such cases depends, first and chiefly, on the age at which the senses were lost, those cases being the most suggestive and valuable in which the loss is earliest; secondly, upon the degree of blindness and deafness, as well as the rapidity with which these senses lose their function, the most instructive inferences being deducible from cases in which the loss is total; and, thirdly, from the completeness and accuracy of the record of the person's capabilities and achievements at the various periods of life, and especially during early childhood. In all these respects the case of Laura Bridgman is a most phenomenal one. Her life-history is to the psychologist most fruitful of hints and suggestions, throwing clear light upon questions otherwise

difficult of approach. It is an experiment of nature, and as rightfully gets the eager eyes of the psychological student turned towards it, as the transit of Venus attracts the gaze of every astronomer's telescope. The majority of cases of deafness combined with blindness, however, do not belong to this category. In many instances enough remains of hearing or sight, or both, to allow these to enter as a factor in the mental development of the individual, and to that extent to vitiate the exclusive inference as to the rôles that these senses play in the psychic life. Often, too, though sight and hearing are practically totally lost, the loss occurred at a period of life when the mind has begun to profit by the experience which these senses collect, and can for many years feed upon the material thus brought together. This independence of the intellectual centres from their food-supply of sensations after a certain age—the fifth to the seventh year for sight—has been proved by actual observation. The report above referred to mentions that there are between thirty and thirty-five blind deaf-mutes in Sweden, where a benevolent lady has organized a school for such defections, and not less than forty such in this country. Eight of these are mentioned by name; but in only two of these cases is the age mentioned at which the loss of the senses occurred,—the one at eleven years, the other at seven, but with enough sight remaining to distinguish color,—and in both these, as well as in a third case, hearing was not lost until the power of speech had been permanently acquired. But of all these cases, hardly excepting that of Laura Bridgman, that of Helen Keller deserves the most minute and careful study. A *résumé* of the facts concerning her condition, collected by Mr. Anagnos, the director of the Perkins Institute, cannot fail to be of interest.

Helen is the daughter of cultured and well-to-do parents, and was born in Alabama on June 27, 1880. When about nineteen months old, she was attacked violently with congestion of the stomach; and to the effects of this disease are referred her total loss of sight and hearing. Previously she is said to have been of perfect health, and unusually bright and active. She had learned to walk, and was fast learning to talk. The loss of her senses thus took place about seven months earlier than in the case of Laura Bridgman, though Helen seems to have been as much if not more developed at nineteen months than was the latter at twenty-six months. In both cases a slow recovery was made, and a painful inflammation of the eyes set in. It is recorded of Helen that she "soon ceased to talk, because she had ceased to hear any sound."

As her strength returned, she gave ample evidence of the soundness of her mental faculties. She learned to distinguish the different members of her family and her friends by feeling their features, and took an especial interest in the affairs of the household. The little hands were constantly busy in feeling objects and detecting the movements of those about her. She began to imitate these motions, and thus learned to express her wants and meaning by signs, to a remarkable degree. Just before completing her seventh year, a skilful teacher from the Perkins Institute—Miss Sullivan—was engaged for her. At this age Helen is described as a "bright, active, well-grown girl," "quick and graceful in her movements, having fortunately not acquired any of those nervous habits so common among the blind. She has a merry laugh, and is fond of romping with other children. Indeed, she is never sad, but has the gayety which belongs to her age and temperament. When alone she is restless, and always flits from place to place as if searching for some thing or some body." Her sense of touch is developed to an unusual degree, and enables her to recognize her associates upon the slightest contact. Her sense of smell is very acute, enabling her to separate her own clothes from those of others; and her sense of taste is equally sound. In this respect she has an advantage over Laura Bridgman, in whom both these senses were reduced almost to extinction. She speedily learned to be neat and orderly about her person, and correct in her deportment. The first lesson is an interesting epoch. A doll had been sent Helen from Boston; and when she had made a satisfactory exploration of it, and was sitting quietly holding it, Miss Sullivan took Helen's hand and passed it over the doll; she then made the letters d-o-l-l in the finger-alphabet while Helen held her hand. "I began to make the letters a second time. She immediately dropped the doll, and followed the motions of my fingers with one hand, while she

repeated the letters with the other. She next tried to spell the word without assistance, though rather awkwardly. She did not give the double l, and so I spelled the word once more, laying stress on the repeated letter. She then spelled 'doll' correctly. This process was repeated with other words, and Helen soon learned six words,—'doll,' 'hat,' 'mug,' 'pin,' 'cup,' 'ball.' When given one of these objects, she would spell its name, but it was more than a week before she understood that all things were thus identified." In a surprisingly short time Helen completely mastered the notion that objects had names, and that the finger-alphabet opened up to her a rich avenue of knowledge. Every thing had to be named, and she seemed to remember difficult combinations of letters, such as 'heliotrope' and 'chrysanthemum,' quite as readily and securely as shorter words. In less than two months she learned three hundred words, and in about four months she had acquired six hundred and twenty-five words,—a truly remarkable achievement. She still used her gesture-signs; but, as her knowledge of words increased, the former fell into disuse. Next verbs were taught her, beginning with such as Helen herself could act, as 'sit,' 'stand,' 'shut,' 'open,' etc. Prepositions were similarly mastered. Helen was placed *in* the wardrobe, and the sentence spelled out to her. 'Box is *on* table,' 'Mildred is *in* crib,' are sentences which she constructed after little more than a month's instruction. Adjectives were skilfully introduced by an object-lesson upon a large, soft worsted ball and a bullet. Helen felt the difference in size at once. "Taking the bullet, she made her habitual sign for 'small'; that is, by pinching a little bit of the skin of one hand. Then she took the other ball, and made her sign for 'large' by spreading both hands over it. I substituted the adjectives 'large' and 'small' for these signs. Then her attention was called to the hardness of the one ball, and the softness of the other; and so she learned 'soft' and 'hard.' A few minutes afterwards she felt of her little sister's head, and said to her mother, 'Mildred's head is small and hard.'" Even so arbitrary elements of language as the auxiliary 'will' and the conjunction 'and' were learned before two months of instruction had passed, and on May 1 she formed the sentence, "Give Helen key, and Helen will open door."

From this the step to reading the raised type of the blind was an easy one. "Incredible as it may seem, she learned all the letters, both capital and small, in one day. Next I turned to the first page of the 'Primer,' and made her touch the word 'cat,' spelling it on my fingers at the same time. Instantly she caught the idea, and asked me to find 'dog,' and many other words. Indeed, she was much displeased because I could not find her name in the book." She soon added writing to her accomplishments, and carefully formed the letters upon the grooved boards used by the blind. On the 12th of July she wrote her first letter, beginning thus: "Helen will write mother letter papa did give helen medicine mildred will sit in swing mildred will kiss helen teacher did give helen peach," etc. This well justifies the statement that she acquired more in four months than did Laura Bridgman in two years. Letter-writing is quite a passion with her, and, as she is also able to write by the Braille system, she has the pleasure of being able to read what she has written. Her progress in arithmetic is equally remarkable, going through such exercises as "fifteen threes make forty-five," etc. As examples of her powers of inference, the following will do service: she asked her teacher, "What is Helen made of?" and was answered, "Flesh and blood and bone." When asked what her dog was made of, she answered, after a moment's pause, "Flesh and bone and blood." When asked the same question about her doll, she was puzzled, but at last answered slowly, "Straw." That some of her inferences are not equally happy, the following illustrates: "on being told that she was white, and that one of the servants was black, she concluded that all who occupied a similar menial position were of the same hue; and whenever I asked her the color of a servant, she would say, 'Black.' When asked the color of some one whose occupation she did not know, she seemed bewildered, and finally said, 'Blue.'" Her memory is remarkably retentive, and her powers of imitation unusually developed. One of her favorite occupations is to dress herself up,—a performance which she accomplishes not always with success according to our ideas. Her progress continues, and each letter is a marked improvement upon its predecessors. A letter to Mr. Anagnos contains

the following sentences: "My doll nancy is sleeping. She is sick. mildred is well uncle frank has gone hunting deer. we will have venison for breakfast when he comes home. I did ride in wheelbarrow and teacher did push it," and so on. Enough has been said to indicate the remarkable powers of this unfortunate child, and to give basis for the belief, that if her training is continued in a wise direction, and with a proper appreciation of the value of detailed and accurate investigation, the world will be able to read in the life of Helen Keller a most momentous psychological lesson.

EXPLORATION AND TRAVEL.

Tibet and Nepaul.

A SUPPLEMENT to the 'Indian Survey Report for 1885-86' has just been issued. It contains the description of a native surveyor, M—H, through eastern Nepaul and southern Tibet, of which the *London Times* gives the following extract:—

"The explorer crossed the Nepaul boundary near Dagmarathana, in Bhagalpur, and, after making customary presents, obtained a passport authorizing his further progress, which lay northward over the Mahabharat range, one of the spurs of the great Himalayan Mountains. At various points along the route his passport was examined, his goods searched, and a tax exacted from him, and in some cases he had, in addition, to propitiate the local authorities with presents. On July 24, 1885, the explorer passed a great temple, called Halsia Mahadeo, situated on a mountain-spur, and deputed his travelling-companion to visit and examine the temple, which is held in veneration in the neighborhood, and has been endowed with a large free grant of land. At Asaliakhark, a fort held by four hundred Nepaulese soldiers under a captain, whose duty it is to examine all passes brought by travellers from the south, and, after full inquiry, to grant fresh ones to those proceeding farther north, the explorer was subjected to much interrogation, as his pass was only available for Nepaul. As it was known that he intended penetrating northwards into Tibet, he was closely searched, interrogated, and directed to return by the way he came, the soldiers being ordered to keep him under surveillance for such time as he remained there. After being detained for six days, the explorer was able, by making suitable presents, to obtain permission to proceed, having persuaded the official that he and his party were inhabitants of Jumla, and that they were anxious to return thither by Dingri, Jonkhajong, and Kagbeni, as being the most expeditious route. Their further march lay pretty close to the Dudhkosi River, and at Jubang Tibetan inhabitants were met for the first time. Khumbujong, a little west of Mount Everest, is the residence of the governor of the Khumbu district. The official is a Tibetan, and has held the post for the last thirty years: he receives no pay from the Nepaul Government, but is allowed fifteen per cent of the net revenue of the district, and pays an annual official visit to Khatmandu. For a time the governor absolutely refused the party permission to proceed northwards by a route which he alleged had never till then been traversed by any Hindostanee or Goorkha. The explorer had therefore to make a lengthened stay at this place, during which he endeavored to ingratiate himself with the inhabitants by treating their sick. One of the commonest diseases in the locality was goitre, and, as he succeeded in curing the governor's daughter-in-law of this, he was naturally taken into favor, and secured the sympathies of her husband, Sunnam Durje. This last-named individual was about starting on a trading expedition to the north, and by the exercise of sufficient tact was prevailed upon to take the explorer's party in his train. The man eventually gained his father's tacit consent to the arrangement, and, after a six-weeks' enforced inactivity, the explorer again started on his way. On Sept. 23, near Pangji, the famous deity Takdeo ('horse-god'), a black rock, in shape like a huge horse, was passed. Out of deference to Takdeo, which is considered very sacred by the Tibetans, no ponies are allowed on the route over the pass. The Pangula Pass over the Himalayas, he says, is decidedly the highest and most formidable ever crossed by him: he estimates the height at over twenty thousand feet, but, owing to an unfortunate accident to his boiling-point thermometer, he was unable to estimate it more accurately. The ridge forms the boundary between Tibet and Nepaul. At Keprak, the first frontier village, the Tibetan official refused the

party permission to go on, saying any such concession would cost him his life; but with the influence of their friend, Sunnam Durje, and by the exercise of a little diplomacy, a guide was eventually obtained to Dingri, across the great grassy plain called the Dingri Maidan.

"The town of Dingri, which has an elevation of 13,860 feet, consists of about two hundred and fifty houses, and the inhabitants are chiefly Tibetans, though there are five houses belonging to Goorkhas, and three or four to Chinamen, who have established themselves at this place for trading purposes. The houses are all stone-built, a tenacious whitish clay being used in place of mortar, and with flat roofs. The country round is well cultivated, but barley and peas are the only produce. The inhabitants all appear well-to-do. On the hill which rises immediately from the north of the town to a height of about three hundred feet, stands the stone-built fort occupied by the Daibung and forty Chinese officers, who are in command of about five hundred Tibetan soldiers. The Daibung is relieved once in three years, and during his tenure of office is allowed to trade within the limits of his province. There are said to be only three Daibungs, in all, under the Lhasa Government: of these, one resides in Lhasa, another in the Nam-Cho district, and the third at Dingri. The authority of the last mentioned extends from Shakia to the westernmost limits of Tibet, and he exercises both military and civil jurisdiction, short of capital punishment, within his territory. The trade in which the Daibung engages, so far as tea and salt are concerned, cannot be characterized as free. Each house in his jurisdiction is compelled to take one brick yearly from the Daibung at a high rate, and he realizes a large annual revenue from it. In addition to these two articles, he deals in blankets on the same footing as private traders. No gold is to be seen at Dingri: it is much sought after, and many inquiries were made of the explorer as to whether he had any gold, pearls, or coral to dispose of.

"The soldiers occupying the Dingri fort are armed with a sword, matchlock, and bow and arrows. The sword is the usual short, straight weapon, in wooden scabbard, met with all over Tibet; the matchlocks are sent from Lhasa; and the bows are made of bamboo which is brought from Nepaul. The soldiers manufacture their own powder on the spot. Lead is imported from Nepaul and Darjeeling; but, as bullet-moulds are unknown, they pour out the molten lead into a long, hollow scoop in the ground, and then clip it into convenient-sized pieces, which are hammered to suit the bores of the guns. The soldiers receive a small yearly pay (about £2 to £2 10s.), and are allowed to engage in agriculture, trade, etc. They are drilled by their Chinese officers every week or so, sometimes on foot, at other times mounted on ponies, which they maintain for themselves, and there are periodic inspections by the Daibung. At these inspections the soldiers always appear mounted, in uniform, and have to go through target-practice. For the latter a disk of leather, one foot in diameter, painted white, is suspended to a rope stretched across two poles. Each soldier in turn then rides full gallop across the field at about fifteen feet from the target, and fires as he goes past. Should he hit the mark, the officer in attendance with the Daibung scores a point. When all the soldiers have gone past in one direction, they return, firing in the same way as they go past the target, to their original position. They next go through the same course, using their bows and arrows instead of matchlocks. The Daibung then examines the notes of each officer, and for every point scored presents him with a khatag or kerchief. The explorer was not much impressed with the marksmanship he saw.

"As Dingri is situated on the high road from Lhasa westwards, it is the constant resort of traders, for whose convenience a serai capable of accommodating two hundred men has been built. The bulk of the goods is carried on mules, chiefly because they travel so much faster than either yaks or asses.

"Throughout the country from Bhagalpur to Dingri the chief articles carried northwards are tobacco-leaf, cotton-cloth, broad-cloth, iron, brass, and copper vessels, corals, and rupees, which are used for making jewelry; and for these the men of Khumbu go annually in parties to India, some even as far as Calcutta, taking with them musk-pods, yak-tails, antelope-horns, blankets, and stuffed munal and argus pheasants. From Dingri are exported into Nepaul