very large industry. It is not proposed to discuss the two sides of the question—the maintenance of the industry or the preservation of the purity of such a fine river as the Spey, or other rivers similarly situated—but rather to consider what can be done to meet both sides. Now it may be held as true that there is no operation to which the burnt ale or spent lees of a distillery can practically be subjected to, that will render the effluent innocuous. The effluent may be evaporated or spread over irrigation fields, or treated with chemicals or charcoal, and yet the processes are in one way or another defective; and there appears but one solution, not to pass the effluent into the rivers, but take it away in pipes or barges to the sea. In many cases this is quite impracticable, even by the joint action of a number of distilleries; but in some cases the effluent has successfully been taken miles in pipes and discharged into the sea. As is known from large experience in outfall pipes for sewage and paper works effluents, it requires a carefully designed arrangement, the cost of which can only be determined after a minute survey; and usually the cost turns out to be too great, and then there appears to be one solution by passing the effluent out in the form of a fine spray from the top of a high chimney or iron lattice tower. The natural question at once asked is: But you pollute the air instead of the water, and what the better are you for doing so? In the first place, what is discharged is not a gas which, if of a noxious quality, might hurt by being inhaled. It is not like soot, which might leave a black mark on your face or clothes. The spray, if it fell on your skin or clothes, could do you no harm, or at least infinitesimal harm. It is not a poisonous liquid, as cattle can drink it. If it fell on trees or grass, except in large quantities, which would not be the case, it would not burn them. Pollution of air is not objected to unless it be in great excess; indeed, we all pollute the air to our neighbours' and our own disadvantage. We send out gases and smoke from our chimneys, which find their way to our neighbours' carpets and curtains and clothes, and we put out the foulest of gas—viz. sewer gas—daily and hourly from the ventilating pipes of our modern house drains, and many of our factories, electric light stations, &c., pass out gases which individually one would say would be sufficient to affect a whole city. There are many physical reasons which make the great difference on the harmless nature of air pollution from water pollution, and that is the cubic capacity of the polluted substance.

In the case of air the air stream is measured in cubic miles, whereas the water stream is a matter of cubic feet; again, the water flows in one fixed channel, whereas the wind and air stream is constantly varying; again, water pollution is worst just when it is put into the river, whereas air pollution is spread over a large area and is thoroughly mixed up before it comes down, possibly one mile or two miles from where it issued from the chimney.

Again, it may be said that even supposing the spray be harmless, yet it would be very disagreeable to be subjected to a fine rain or Scotch mist when near the distillery. Let us consider a distillery sending out four gallons per minute. An ordinary non-condensing engine uses 20 lb. of water per H.P. per hour, so that the quantity discharged from the top of the chimney is no more than what is sent out from a steam engine (high pressure) of 120 I.H.P., and we know from experience that this can be discharged without being felt, and in most weathers even becoming invisible 100 feet away. If it were practicable to reduce the effluent to a state of fine division as fine as the globules of the so-called white steam, and emit it from the top of a chimney, the solution of the matter would be found at once. It does not at present either appear practicable to reduce the effluent to such a fine state of division, nor fortunately is it necessary to do so, as experiment shows that ordinary sprayed particles are rapidly evaporated and absorbed. Take a spray such as barbers use, and spray it from a height of 5 feet in a still atmosphere, and measure the quantity evaporated in its descent. It will be found that at least 1/8th has been lost. Do the same at 10 feet, and it will be found that 1/4th is lost. Theory points to very rapid evaporation, as the particles get small as the surface becomes rapidly large in comparison with the cubic capacity of the spheres. Another good example of rapid evaporation and absorption by the air is to use the spray over a piece of glass. In ordinary weather only a very short space of time renders the sheet glass quite dry again. These two experiments, and our experience of the discharge from steam engines pointing to this, that instead of experiencing a mist or fine rain, the particles would be so minute and so widespread that no one might suffer any inconvenience, indeed might be quite unconscious of the fact that the spraying was going on except from seeing the white steam mist issuing from the chimney of the distillery.

Coming now to a more practical view as to what would be necessary to obtain the desired effect, and trials lead to this, that for a discharge of four gallons per minute it would be necessary to have a pump to pump up this small quantity, also an air pump to pump about forty times the volume liquid, a 5-H.P. oil engine with air pump attached, such as is used in lighthouses for supplying the air blast to fog signals, being ample. The necessary length of pipes leading up to the spraying apparatus with a number of nozzles, and above all a high point of discharge, completes the arrangement.

The height of discharge is evidently one essential of success. The height will vary with the amount of the effluent, and whether the works be situated on a moor, near a town, or in a cleft in the hills, or among high trees.

The increase in the velocity of the wind with height is an important factor. In measuring the velocity at 50 feet, 100 feet and 200 feet, we find a great increase with height, so that instead of a point of discharge of 200 feet being only capable of doing twice what a height of 100 feet will do, as one might at first suppose, yet a little consideration will show, as the area is a measure of the degree of dispersion, that it will disperse successfully much more. In fact whereas 100 feet might discharge one gallon, 200 feet might discharge eight gallons per minute. It would appear, therefore, that to attempt to deal with the effluent by spraying at a low level, as has been in some quarters suggested, is simply to court failure. The point of discharge must be high, but "how high" is a matter which at present is unknown; nor, indeed, can it be definitely fixed, as has been pointed out, each individual work requiring special consideration of the circumstances. There is one other point that requires to be considered in connection with the whole matter, and that is compensation for water abstraction. At present distillers use the water, and what is not sent off as whisky is returned to the stream. But in the case of carrying the effluent to the sea, compensation would require to be given to the stream by means of reservoirs, and with the spraying apparatus a complicated question would arise as to how much really found its way back into the water-courses of the particular drainage area. This is largely a legal question, but it is not clear how the spraying process could differ from the discharge into the atmosphere of an ordinary steam engine, and so it would appear that water compensation for the stream was with this system unnecessary.

C. A. STEVENSON.

The Nature and Habits of Pliny's Solpuga.

I HAVE never seen one of the Arachnoids in a hive, but have received them several times from trustworthy bee-keepers who have found them in the hives "killing and eating the bees." Other insects do the same thing, especially Formicids and Mutillids. Of course the latter, with more chitine, are better fitted to resist the attack of the bees than are the soft-bodied Datames. It may be that these Solpulgids have some protective scent that makes their entrance to the dark recesses of the hive safe.

A. J. C.

Claremont, Cal., June 23.

THE VACCINATION BILL.

IN connection with the recent discussion on the vaccination question, nothing strikes the inquiring observer more than the shortness of the collective memory of a people, unless, indeed, it be the fact that people are easily led by any small knot of agitators who will shout loudly enough and asseverate with sufficient force and frequency.

That this is true not only of what may be called the masses, but also of their selected representatives in the House of Commons, is evident from what has recently transpired in that august assembly. The career of the Vaccination Bill has been marked by many stormy passages and by very varying fortunes, and now that it has passed through its first stage, there appear to be few who are even partially satisfied. This is a result

such as might have been anticipated. Weak concession is not compromise; whilst, on the other hand, obstinate resistance to amendment, from whichever side of the House the overture is made, cannot be put to the credit of the intelligent statesmanship of some of our legislators.

Looked at dispassionately, this question should be largely one of principle; but granting this to its full extent, it must always be recognised that sentiment under certain circumstances may rout principle entirely. Such being the case, principle must in minor points give way to sentiment.

To a very large extent, the present outcry against vaccination is the direct result of the practical disappearance of small-pox from our midst, such disappearance having been brought about by thorough vaccination. This statement may be traversed by some, but all statistics, British and foreign, go in the same direction on this point. At one time every child was expected to have an attack of small-pox, just as certainly as at the present day it is expected to contract an attack of measles. Indeed, children were often put into the way of being infected in order that they might get the attack over as soon as possible. This was so in spite of the fact that the mortality was frightfully high, and that amongst those who survived the attack, blindness, deafness, scarred features, and even greater deformity was perhaps the rule rather than the exception.

Those who then had experience of this small-pox were ready enough to accept vaccination for their children and for themselves. They had almost daily experience of horrors such as we cannot now realise (unless we have passed through a cholera, a plague, or a severe typhoid epidemic), and they were ready to try anything which would give even promise of some amelioration, however slight, of the severity of the attack. We have it on the authority of medical men who were instrumental in carrying on the earlier vaccinations, that the better a population was vaccinated the fewer were the cases, the less was the mortality, and the slighter were the ensuing deformities. For some time, so long indeed as those lived who had known small-pox before vaccination, there was no agitation against vaccination; but as soon as a people arose who knew not small-pox, and who knew not its terrors, the slight discomfort of vaccination was rebelled against.

Two of the most thoroughly vaccinated people in the world are the Scotch and the Swiss. In Scotland the public vaccinator's post is almost a sinecure in most districts, because the parents, of their own free will, call in their medical attendant, in whom of course it may be assumed they have every confidence, to advise them and to perform the operation for them as soon as it is thought to be necessary. The result is that by the time it is six months of age, almost every child is vaccinated under the very best possible conditions, *i.e.* when it is in good health, and is suffering from no teething, skin, or digestive trouble. If a certificate of vaccination under such conditions, or one that it is deemed by the medical attendant advisable to postpone vaccination, were demanded by the registrar, as is now done in Scotland, more thorough vaccination than is now obtained would undoubtedly be the result.

An unvaccinated family or colony is a danger to the community. How firmly this is held in Switzerland is evidenced by the fact that no child is allowed to receive its education at the hands of the State until it has been vaccinated. What is the result? That in Switzerland almost every child which has reached school age is fully vaccinated, and in order to save trouble, *i.e.* to take the best period for the performance of the operation, the child is usually vaccinated before the process of "teething" commences. As is well known, vaccination during this early period has many advantages. In the first place the child is protected during the period when it is otherwise most susceptible to attack by the disease, and at a period when the percentage mortality is highest. Then, too, this is the period when the child can most easily be kept clean and at rest, *i.e.* before it is able to walk and knock its arms about. The irritating and irritable teething period has not commenced, and perhaps most important of all, the child is, or should be, taking chiefly milk foods, so that intestinal and cutaneous irritations and eruptions are of comparatively infrequent occurrence. If in this country these points were more carefully attended to, we should hear far less of eruptions and convulsions "due to vaccination."

It is all very well to talk of the liberty of the subject—the parent—in connection with vaccination, but is it right that this should interfere with the rights of the child? By the Factory Acts children of tender years are protected (more or less efficiently) against the cruelty and greed of parents. Under the Educational Act children are sent to school and prepared to take some respectable part in the world's work. It has even been suggested (often by those who are loudest in their denunciations of compulsory vaccination) that children should be clothed and fed as well as educated at the expense of the State; but as soon as the State steps in to put the child in a position to preserve its life or its sight in the presence of an epidemic of small-pox, there is an outcry by these same people against the invasion of the liberty of the subject and the rights of the individual. Under the Public Health Act a Medical Officer of Health has certain powers that override such liberty or license of the individual as may by its manifestation be dangerous to his neighbours; and even the common law steps in to prevent the cruel or ill treatment of children. It is therefore surely reasonable that helpless children should not be handicapped in life, or be made centres of danger for those around, by being left absolutely unprotected against the attack of a disease which, if unmodified, usually leaves marks both deep and lasting on its victim.

Under the circumstances it is a matter for consideration whether some concession should not be made to sentiment. The days for martyrdom are over, and many of the vaccination "martyrs" have developed and bloomed, because in the first instance they have been too careless to conform to the requirements of the law; once a martyr, however, always a martyr. Is it not a politic suggestion that the onus of objection should be thrown on the shoulders of those who do not wish to have their children vaccinated? If a man takes the trouble to go before a magistrate (or two), and affirm in open court that he has a deeply-rooted objection to vaccination, he may be looked upon as a faddist; but his children might be exempted from vaccination until such time as an epidemic of small-pox made its appearance, when the compulsory rule should at once be put into force. In order that this might be done, the onus of reporting unvaccinated children should rest with the objector, who would be in the position of a ticket-of-leave man who would come up for judgment, and whose children would at the same time come up for vaccination in the presence of an epidemic. Those who would take this trouble might be exempt; but those who would not, could no longer pose as martyrs when failing to comply with such reasonable regulations, and so they would come under the lash of the law.

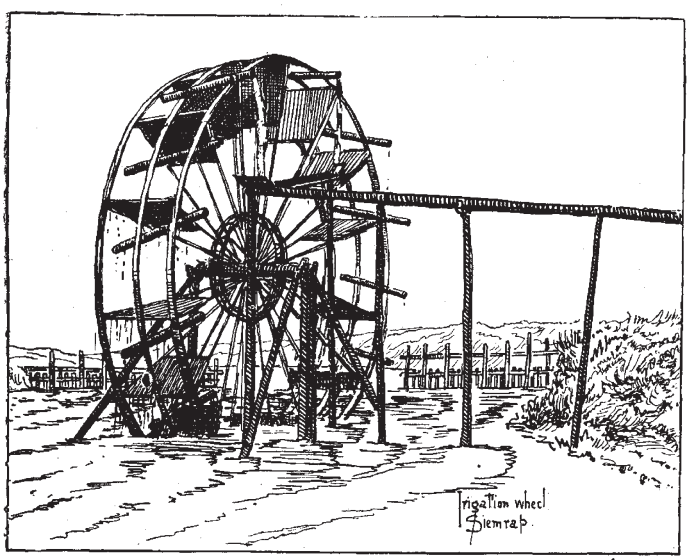
The Vaccination Bill can scarcely pass into law in its present form; its passage in such form would afford evidence that however able a large body of men may be, and however well endowed with common sense, they have not as a body the capacity to legislate, or the backbone to stand out where expert evidence, which is the only evidence that is of any value in this case, is placed in opposition to a fad—not a popular fad—but a fad held by a very small but noisy and self-assertive, and therefore, from the parliamentary point of view, powerful minority. The country as a whole is not against vaccination;

Parliament might therefore legislate for the few, at the same time keeping a very tight grip on those to whom, for sentimental reasons, it grants any indulgences.

Re-vaccination, though not so important as primary vaccination, will at some time have to be considered. Vaccinators are taunted with the fact that, although Jenner maintained that vaccination would confer life-long immunity against small-pox, they are now asking for re-vaccination. Jenner could speak only for his time. Where he goes beyond his facts his theories have not all been confirmed as the result of a wider experience; but where he kept to facts, and argued from his own observations, he has been proved to be right in almost every instance. It would, indeed, be a dark look-out for medicine if whilst accepting all that is true of the work of our predecessors, we find ourselves by tradition looking out for nothing that is new. The fact that all Jenner's statements have not been implicitly accepted, should be an argument in favour of those that have been confirmed.

MR. WARINGTON SMYTH ON SIAM.[1]

THE good use which Mr. Warington Smyth has made of his five years in Siam is already familiar to geographical readers from several papers published by the Royal Geographical Society, and a wider public will welcome the two volumes which tell in greater detail, and in a more ambitious literary style, of his journeys in that interesting country. Although to a reader unversed in the classical languages the occasional Greek and Latin quotations seem to savour of pedantry, no one can help being attracted by the manly and modest way in which Mr. Smyth recounts his adventures. He disclaims anything in the way of original exploration, and the fulness with which he renders their due to every previous traveller and to all his companions and his assistants, may perhaps lead careless readers to imagine that there is little new or original in the book. Perusal of the chapters will soon dissipate such an idea. Very few travellers have brought to their task more individual energy and enthusiasm, and some have made for themselves a reputation for vast acuteness and reckless daring with less solid basis than that which Mr. Smyth leaves his readers to discover.



Irrigation Wheel at Siemrap.

The professional aspects of the work of the Director of the Department of Mines ("the other half of the Department" is incidentally referred to) have been touched on very lightly, as is proper in a popular book, but enough is said to impart a solid interest to the journeys which are described. Mr. Smyth does not conceal his enthusiasm as a yachtsman, and his exploits in a small sailing-boat, cruising along the stormy shores of the Gulf of Siam for weeks at a time, are much more remarkable than the quiet record of them might lead a landsman to suppose.

The book, of course, contains some chapters on the political situation in Siam, concerning which nothing need be said here, and for the rest it consists of the narratives of journeys interspersed with remarks on the various peoples and customs of the country. A resolute attempt is made to adopt a systematic spelling of Siamese names, and the result is at first sight a little disquieting. *Mekawng* is no doubt preferable on principle to the familiar *Mekong*, but until the eye gets used to it, it suggests Mr. Rudyard Kipling's efforts to phoneticise the language of the young British soldier. We are not sure whether the rule of established custom, which saved Calcutta from its Hunterian disguise, might not also be invoked in favour of Mekong, as appears to have been done for Bangkok.

Mr. Smyth commences with a description of the river and port of Bangkok, the mud-bar at the mouth of which he describes in considerable detail. The advance of the land at the head of the Gulf of Siam is very rapid, on account of the immense quantity of silt carried down by the Menam. Had the water been clear enough to allow of coral growth, the shoals might possibly have rendered the harbour impossible of approach, so that the muddy water in a measure neutralises the effect which it produces. The Menam valley is next described, and an excellent point is made as to the introduction of railways in such a country as Siam. The author is strongly of opinion that the Siamese—a race of born watermen—would benefit more by the improvement of the natural waterways and the construction of canals, than by introducing railways, for which there is no pressing demand. That railways are valuable as means of conveying traffic past interruptions to rivers, or connecting places not already united by water, is not contested.

A series of chapters on the Lao States and the Mekawng gives opportunity for much pleasant description of places and people. The gold of the river valley, which is obtained by washing the gravel, is not likely in Mr. Smyth's opinion to pay Europeans for working. The Mekawng boat, however, is a thing to admire if not to imitate. Its foundation is a great tree-trunk hollowed by the adze, then sunk in the river until water-logged, next steamed over a fire until soft enough to stretch and have the knees and frames put in. A hull so fashioned will never leak, draws little water, is handy to manage, and lasts for twenty years without requiring substantial repairs.

The coasting trip along both shores of the Malay peninsula was of almost greater interest, as fewer Europeans have passed that way. The remarkable weathering of the limestone rocks is described, and several of the structures confidently assigned by previous travellers to volcanic action are shown by the author to be simply the result of weathering. The tin workings of the coast were visited and are admirably described. The Chinaman rules on the tin fields, and constitutes a

[1] "Five Years in Siam, from 1891 to 1896." By H. Warington Smyth, M.A., LL.B., F.G.S., F.R.G.S., formerly Director of the Department of Mines in Siam. With maps and illustrations by the author. In two volumes. Pp. 330, 338. (London: John Murray, 1898.)