arid country, and diversified groves will be developed. But not all the arid lands can be redeemed, as the water of all the living streams is inadequate to the task; but the intervening land will be utilized for pasturage purposes, and will be protected by the people from fire, and groves will be planted, and the face of the country not under cultivation will be forested.

"In the region practically uninhabited the water now flows from the mountains to the sea; but, when the streams are utilized in irrigation, the water will be evaporated, and the humidity of the climate will be increased thereby, and dry winds will no longer desiccate the soil and shrivel the vegetation. As the general humidity is increased, the moister air, as it drifts eastward in great atmospheric currents, will discharge more copious rains, and the humid region will extend farther westward, and the arid region will correspondingly shrink in its proportions. Irrigation will increase the humidity of the climate, and increase protection from fires to the non-irrigated lands; and, as the lands gain more and more water from the heavens by rains, they will need less and less water from canals and reservoirs. When all the water of the arid country is ultimately appropriated for irrigation by using all the streams through the season of irrigation, and by storing the surplus that flows through the non growing season, and by collecting in reservoirs the storm-waters of the streamless valleys, the general humidity of the atmosphere in the arid region will be increased, and hence the rains will be increased, and a smaller amount of artificial irrigation will be needed. By all of these means a large share of the arid lands will be redeemed. But all will not be redeemed: there will still be extensive areas of pasturage-lands not under the plough, for all that man may do will be insufficient to radically change the climate. The non-irrigated lands can be greatly improved by extensive tree-planting; but as these trees are to be supported by the general rainfall, which is scant, it will be necessary to select trees adapted to arid conditions, and this will require extensive experimentation. The wide distribution of the cedar, and of the pinon or nut-pine, throughout the country under consideration, points out the fact that these two trees may be widely used; but there are many others on the Pacific coast which perhaps will be more valuable; and it will probably be found that there are many trees in the arid lands of the eastern hemisphere which can be introduced with advantage. But this tree-planting is a question of a somewhat remote future. At present the trees planted in the arid region will depend for their existence and vigorous growth upon irrigation, and the experiments demanded at the present time must be with such trees.

"The great currents of air which now traverse the plains are impelled by agencies that produce the general circulation of the atmosphere throughout the globe, modified by the general configuration of the plains in its relation to the mountains of the West and the low humid lands of the East. These general conditions cannot be modified by man; and the storms will come and the winds will blow for ages as they now do, unchanged by the puny efforts of mankind; and yet the agricultural conditions of the country may be greatly modified and improved by the efforts of man. Man cannot change the great laws of nature; but he can take advantage of them, and use them for his purposes.

"There is a theory held by some persons in the West that rainfall is largely dependent upon the electrical conditions of the atmosphere, and that these conditions are modified by the various changes wrought by the hand of man in the settlement of the Great Plains. As this appeal is to some occult agency, it becomes quite popular to those who love to revel in the mysteries of nature. Of course, it is never explained. It is a case where cause and effect are confounded. Atmospheric electricity is the result of certain conditions and movements in the atmosphere. To explain atmospheric changes by attributing them to electricity is like explaining the origin of the fire by the light it produces, or like explaining the explosion of the powder in the cannon by attributing it to the roar which may be heard in the distance. The electricity in the air is related to atmospheric changes as effect is related to cause.

"In conclusion let it be said, first, that a large body of the arid lands can be redeemed by irrigation, and that the agriculture resulting therefrom will be in the future, as it has ever been in the past, the highest condition of agriculture, for the agriculture which is dependent upon rains is subject to storms on the one hand, and to droughts upon the other; but, when the water-supply is properly controlled by the arts of man, the soil is made to yield its most abundant returns; second, that, under the culture and protection of man, vineyards, orchards, and groves can be established over vast areas, where, under the control of nature, only deserts are found; third, the siroccos of the Great Plains cannot be tamed, but men may protect their homes, their gardens, and their fields from devastation by them; fourth, the lightnings of heaven cannot be employed to bring rain upon the plains, but electricity may be used to illumine the cities and towns and hamlets that must ultimately spring up over all that land."

HEALTH MATTERS.

Recovery from Lightning-Shock.

DR. J. B. PAIGE read before the Medico-Chirurgical Society of Montreal an account of a case of lightning-shock which resulted in recovery.

The accident occurred in Prescott, Mass., during a terrific thunder-storm, July 29, 1887, about five o'clock P.M.

Lightning struck the house, to all appearances the chimney of the upright part first. At the roof the current divided into three parts, one following the chimney down to the floor of the second story, then passed along a stove-pipe out of the chimney, and partly to a nail in the floor by the legs of the stove, and thence by the timbers to the earth. A second subdivision of the current followed a rafter on the north side of the roof, after leaving which it could not be traced. This rafter was completely torn from its place. A third current passed down a rafter on the south side of the roof. At the lower end it divided again, one portion following the finish of the roof, passed along the other side of the L to the opposite corner, followed the track of a rolling-door, and reached the earth by the corner post of the house. The other part coursed along the studding of the house, near the window, and passed to the earth. Attached by a screw to the upper casing of the window was a large iron hook on which was suspended, by a brass chain, a bird-cage. One part of the current, going by this chain to the bird-cage, left it at one corner, entered the body of the subject of the accident, and left the room by a nail in the floor.

That the electrical influence in this quarter was intense, is proved by the fact that the links of the chain in some places were nearly melted apart, while the solder at the corner of the cage, where the fluid left, was completely melted. Again, the nail by which it passed through the floor was considerably roughened. It appeared as if it had been partially melted at a high temperature.

The patient was thrown from the chair in which she was sitting, directly across another chair, a distance of two or three feet. She was taken out to the piazza immediately, and her condition was found to be as follows: completely unconscious; motionless; muscles relaxed; left eye closed, right open; face purple; pulse at wrist imperceptible; neither heart-sounds nor respiratory murmur to be heard.

Later, an examination showed the course of the electric current to be as follows: it struck the head above the left eye, midway between the eyebrow and hair, which was apparently the part nearest the corner of the bird-cage; passed along in front of the ear, then to the central line of the thorax, descending by the stocking-supporter, which was attached to the corsets; thence to the top of the stockings, leaving marks upon both limbs, but more especially upon the left, on the back of which, just above the knee-joint, was a burn about the size of one's hand. It had the appearance of an ordinary burn, and was only superficial. No trace of the current could be detected again until the foot was reached, from which it passed off by the joint of the great toe, tearing a place about two inches in diameter in the stocking and slipper, but not leaving the slightest mark upon the skin. With the exception of the burned spot on the posterior part of the left leg and one or two small burns on the body and the right leg, hyperæmic lines alone marked the course of the electricity in its passage over the body.

After removal of the patient to the piazza, the clothes about the neck and chest were loosened, and artificial respiration commenced.

In from three to five minutes the first sign of life appeared in the flexion of the right leg. The dark color disappeared from the face, and the pulse could be felt at the wrist. It was then weak, rapid, and irregular. The treatment was kept up for ten or fifteen minutes, until the body began to feel cold, when the woman was removed to the house, and placed upon a bed. The moving caused a disturbance of the circulation, as was shown by the pulse, which became very faint and fluttering. In order to encourage the circulation, hot fomentations were applied to the chest, and as soon as they became cold were replaced by fresh ones.

Soon a new train of symptoms set in. There was difficult respiration. The mucus and saliva, which were very abundant, had gravitated back, and could not be swallowed because of complete paralysis of the pharynx, etc. There was, in fact, paralysis of almost all the muscles of the uppermost parts of the body, including the arms. The symptoms were those exhibited by an animal when being asphyxiated: violent muscular contraction, difficult and forced respiration, etc. To remove the saliva and mucus, which caused the obstruction, the head and trunk were lowered. Handkerchiefs were also used. These were placed over the finger and passed back as far as possible into the throat, and in this way large quantities of the saliva and mucus were gotten away.

From one-half to three-quarters of an hour after the accident, consciousness began to return, and the muscles of the arm to regain strength. Sight was restored to the right eye, although it could not be moved. Though the subject could hear, she could not speak. This was shown by the fact, that, when asked to press the hand if she felt better, she responded. About this time paralysis began to disappear gradually from the tongue. Improvement continued: brief intervals of sleep were enjoyed through the night, and there was absence of any considerable pain.

In addition to the paralysis, the left eye was seriously affected. In discussing the case, Dr. Wesley Mills asked whether the patient would have recovered without the assistance rendered just after the accident. Considering that respiration was suspended, that the circulation, even with artificial respiration, was so feeble that the temperature fell, that consciousness did not return for so long, it does not seem reasonable to believe in the possibility of spontaneous recovery. But the case does seem to teach, in the clearest way, the importance of using such means as those employed in this instance promptly and perseveringly.

DEATH OF PROFESSOR PROCTOR. — That the disease from which the late Prof. Richard A. Proctor died was actually yellow-fever has been questioned by some of his friends. In order to determine the question, a post-mortem examination was made at the hospital on North Brother Island by Drs. T. Mitchell Prudden and H. M. Biggs, pathologists to the Board of Health, in the presence of Dr. Cyrus Edson chief inspector of contagious diseases, Health Commissioner Joseph D. Bryant, and others. The preliminary report of the examination, presented to the president of the Board of Health, is as follows: "Decomposition was so far advanced that it was impossible to arrive at a definite conclusion as to the cause of death. The organs presented no evidence whatever of pernicious remittent-fever, or other form of malarial disease, such as, even in the condition of decomposition presented by the body, would ordinarily be apparent. The only positive change due to disease which could be made out was in the kidneys, which showed the appearances of old, though not advanced disease. The alterations produced in the body by yellow-fever are usually of such a character as to be nearly or completely obliterated by advanced decomposition. We are therefore only able to say in this connection that there was no other evident cause of death, and nothing which could be incompatible with that disease. The final conclusion as to the cause of death must therefore, in our opinion, be largely based upon the clinical history."

PHYSICAL EXERCISE AMONG CELESTIALS. — A correspondent of the Shanghai North China *Herald* says that to the average Celestial it is a matter of indifference how long he remains in one position. He will write all day like an automaton, he will work from morn to eve without any variation and apparently without any consciousness of the monotony. The Chinese school-children will undergo an amount of confinement, unrelieved by recesses or changes of work, which would drive a western pupil to the verge of insanity. Even Chinese infants are said to remain as impassive as 'mud gods.' To the Chinese, exercise appears to be superfluous, and they can sleep anywhere. With a brick for a pillow, the 'heathen Chinee' can lie down on his bed of stalks, or mud bricks, or rattan, and sleep the sleep of the just, with no reference to the rest of creation. He does not want a darkened room, nor does he require others to be still. The 'infant crying in the night' may continue to cry, for all he cares: it does not disturb him. In the case of most working-people, and also in that of many others, position in sleep is of no sort of consequence.

POISONOUS EFFECT OF PETROLEUM. — In a letter to the *Medical News*, Dr. W. H. Sharp of Volcano, W.Va., discusses the poisonous effects of petroleum. For nineteen years he has practised medicine in an oil town, surrounded by oil-wells, and in daily contact with laborers connected with the oil-industry. He says that in considering the effects of petroleum it is necessary to know clearly which kind of oil is indicated, as there are different grades of natural oil, which must have different effects as they are richer or poorer in the lighter products, as gasoline, benzene, naphtha, and carbon-oil. The heavier natural oils, of specific gravities ranging from 26° B. to 35° B., such as are produced in West Virginia at this point, in Pennsylvania at Franklin, and at a few other points, are very different in composition from the lighter petroleum oils which range from 35° B. to 50° B., such as are so largely produced in Pennsylvania and Ohio, and are used for refining for illuminating purposes. The former are almost devoid of the gasoline, naphtha, and benzene found in the latter, and do not make a satisfactory carbon-oil. Where this heavy oil is produced, there is found less gas than accompanies the light oils. The worker in these heavy natural oils runs no risk at any time from the inhalation of gas, even in the tank-sheds where the oil is stored, and the engineers at the pumping-stations of the transportation companies are exposed to no dangers from inhalation of gas. In all the light-oil districts serious accidents are quite frequent from the inhalation of gas. It is the practice to have the receiving-tanks at the wells closely housed with wooden sheds, at the roofs of which are ventilators for the escape of gas. This past spring an oil-man who had gone to North Baltimore, O., for work, was suffocated in one of these tank-sheds while making a run of oil; viz., running the oil from the receiving-tank to the transportation or pipe-line company's tanks. It is said that the men employed in this work by the transportation companies become somewhat accustomed to this gas, and can then remain longer exposed to it before feeling its effects. Oil-well drillers affirm that the sense of suffocation comes on very suddenly. When the gas is very plenty around drilling-wells, and if there be any delay in getting pure air, suffocation ensues. In the section around Volcano, even when drilling in light-oil territory, there is little danger from this, as the derricks are seldom tightly housed, as is the practice in other regions. Heavy lubricating-oils applied locally are not irritating: they are as bland to the skin as the best petroleum jelly or ointment. They have had a well-deserved reputation as soothing applications to burns and wounds: the heavier the oil, the better it is suited for this purpose. These oils do not irritate any inflamed surface, but relieve the pain as well as does the *linimentum calcis*, or white-lead dressing. The only disadvantages in its use are, that the cloths become stiff from drying, and the application is a dirty one, penetrating the bedding, etc., if applied freely. A light oil 40° to 50° gravity would probably prove irritating from the presence of benzene, etc. Internally these heavy natural oils have been used in pulmonary troubles, viz., bronchitis and phthisis; persons taking them in doses of from 1 to 4 f3 several times a day. Dr. Sharp has never known or heard of any ill effects from their administration. He has made a careful search in the *American Journal of the Medical Sciences* since 1869, and in other journals, and finds only two cases of poisoning by petroleum recorded; viz., in the April number of the *American Journal of the Medical Sciences* for 1873, and in the *Medical Record*, Sept. 26, 1885. From these two cases petroleum would not seem to be very poisonous, and to be chiefly eliminated by the skin and kidneys, especially the latter, unchanged by transudation. That it is the lighter oils in the crude petroleum which produce the intoxicating effects, and that the *acne* seen in workmen is due to something used in the process of refin-

ing, are highly probable: certainly they do not arise from contact with the natural oils of the heavier gravities, viz., 26° B. to 35° B.

THE VALUE OF VACCINATION. — Zürich, according to *The Lancet*, is beginning to suffer from the effects of neglect of vaccination. Until 1883 a compulsory vaccination law was in force, but in that year it was repealed; the success of the anti-vaccinationists depending, it is said, upon the fact that not a single case of small-pox occurred in 1882. But in 1883, in every 1,000 deaths, 2 were caused by small-pox; in 1884 there were 3 in every 1,000; in 1885, 17; and in the first quarter of 1886 there were 85 deaths. While Europe is exhibiting folly by showing in some localities opposition to vaccination, Japan is deriving benefits from the recognition of its value. Nagasaki possesses a governor, named Kusaka, who is bent upon ridding the town of the diseases which formerly infested it. By means of a system of compulsory vaccination, rigorously enforced by the governor, small-pox, long a familiar scourge in the old town, has been practically stamped out. Germany, too, is showing the effects of revaccination, and hitherto the freedom of German towns from small-pox has contrasted in a marked degree with a larger prevalence of this disease in other European towns where revaccination is not enforced. Probably the outcome of the experience of the present generation will be the enforcement of revaccination in the majority of civilized countries.

ELECTRICAL SCIENCE.

Is the Velocity of Light in an Electrolytic Fluid influenced by an Electric Current in the Direction of Propagation?

THE following description of Lord Rayleigh's experiment on this subject is given in Professor Lodge's sketch of the papers read before the last meeting of the British Association: —

It is well known, that, when an electric current flows through an electrolyte, an actual transfer of matter accompanies it, — two opposite transfers, in fact, as evidenced by the continuous appearance and escape of the travellers, one at each electrode. It is also known by a refined experiment of Fizeau, confirmed by Michelson, that, when a beam of light travels down a stream of moving matter, its velocity is slightly increased; whereas, if light travels against a stream of matter, it is slightly retarded. These things being so, it may be held as probable, that, whenever the two ions taking part in an electrolytic current differ in momentum, a slight effect may be exerted on the velocity of light travelling with or against the current; but then, according to the calculations of Kohlrausch, confirmed by some experiments of Professor Lodge, the speed of the electrolytic ions is extremely small, the quickest being thirty microns per second, or about four inches an hour, for an applied slope of potential of one volt per centimetre.

The effect of such a creep as this was not what Lord Rayleigh looked for. It was quite within the range of possibility that the existence of an electric current in an electrolyte should so disturb the ether inside it as to produce quite a notable change in its index of refraction. Were such an effect discovered, it would be a distinctly new fact, not taken into account, or even rendered probable, by existing theories; and it is very well to have the question experimentally examined, and to a certain extent set at rest.

The method adopted was a beautiful interference arrangement of Michelson, whereby a beam of light is split up into two halves, which are sent along a certain route, or circular tour, and are then recombined into one at the point whence they originally split off, and are examined by a magnifying eye-piece. The result is a set of interference-bands more or less well defined. Tubes containing dilute sulphuric acid supplied with an electric current are then placed along the route taken by the two half-beams of light, so that one half the beam will be helped and the other half hindered by the current, if it produce any effect at all. The thing looked for is to see if the interference-fringes shift along microscopically when the current is supplied, stopped, or reversed. The result is negative; and, by considering carefully how much of an effect could have been certainly perceived if it had existed, the definite statement is made, that a current of intensity of one ampère per square centimetre through dilute sulphuric acid does not affect the velocity of light in its own direction by so much as one part in thirteen million, or by fifteen metres per second.

THE TUDOR ACCUMULATOR. — Some details of tests of the Tudor accumulator have already been given in this journal, but the following data are more complete than any hitherto obtainable. In the Tudor accumulators a crystalline coating of peroxide of lead is formed on the positive plates by a process that lasts two or three months, while the negatives are produced by the application of red lead, as in the ordinary types. Two of these cells, said to have been in use from November, 1881, to December, 1887, were tested by Prof. W. Kohlrausch. They were submitted to thirty-four charges and thirty-four discharges, there being a mean interval between the two of fifteen hours. The weight of the plates in a cell is 13.6 kilograms; the volume of the liquid, 3.4 litres; there are four positive plates with a surface of 12 square decimetres; the normal charging current is 5 ampères; discharge current, 6.5 ampères. The following figures give some results of the tests: —

	Charge.	Discharge.
Intensity of current	5.00	6.50
Difference of potential at terminals	2.15	1.88
Mean capacity	50.80	47.70 ampère hours.
	109.00	90.00 watt hours.
Mean duration	10.16	7.35 hours.
Efficiency	94 % in ampère hours.	
	82.40 in watt hours.	

The following figures are also of value in comparing with other types of secondary batteries: —

	Charged.	Discharged.
Density of liquid	1.147	1.115
Internal resistance	0.015	0.020
Current density per square decimetre	.417	.542
Capacity in ampère hours per kilogram of plate	3.500	-
Capacity in watt hours per kilogram of plate	6.600	-

Let us compare the capacity and discharge-rate of this cell with a Julien cell, the weight of the plates being about the same. The figures given for the Julien cell are approximate.

	Tudor.	Julien.
Useful capacity (watt)	90.0	190
Discharge-rate	6.5	20
Efficiency	82.4	70 (about)

The Tudor accumulator is, then, inferior to the well-known 'grid type' in storage-capacity and discharge-rate, — two very important factors. Its greater efficiency is partly due to the low discharge-rate. As far as length of life and ability to resist rough usage go, the Tudor cell is, if we are to believe the report, superior. The cells under test were said to have been in use for six years, and were in good condition. During the experiments they were several times allowed to become completely discharged — an operation that severely injures an ordinary cell — without apparent ill effect; and once the cells were completely reversed, and then charged again in the right direction, still without apparent injury. In considering the value of new types of accumulators, the main points to be considered are, leaving out questions of first cost, discharge-rate, length of life, storage-capacity, and ability to resist rough usage. In length of life and ability to resist rough usage the Tudor batteries seem to give better results than any for which reliable figures have been given. In storage-capacity and discharge-rate they are distinctly inferior to the ordinary type; and it is these defects, especially the latter, that render them unfit for traction-work, and for most cases of central-station lighting.