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NEW YORK, SATURDAY, SEPTEMBER 13, 1902.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE MOTORMAN.

It was only by a fraction of a second of time that the President of the United States escaped being killed, as the result of the recklessness or stupidity of a trolley-car motorman, who, on being reproved by the Chief Magistrate of the land, proceeded to give a display of that brutal indifference and brazen-faced impertinence with which the public is only too familiar. The fact that it was the President himself who was imperiled has served to draw public attention to the general incompetency of the men who run our modern trolley cars; and the public horror of the accident, with its actual and possible consequences, is, of course, accentuated by the fact that we have been within an ace of losing a President by violence for the second time within a year. Yet, as a matter of fact, the peril of instant death which overtook the President is one which confronts hundreds, and indeed thousands, of the citizens of this country every day of the year. There is no question, and there has been no question in the public mind for several months, that the time is ripe for stringent legislation affecting the selection and appointment of men to the most important position of motorman. The companies will have to make a more careful choice; they will have to give a rate of wage for this work which will attract to it only the best and most skilled men.

It is far from our intention to cast a slight on the large and rapidly-increasing body of motormen as such; for we believe that the majority of them are careful and conscientious men who realize the dangers of their work and its enormous responsibilities, and endeavor to put their cars through on schedule time without riding rough-shod over such rights of the road as are possessed by other traffic, whether vehicular or pedestrian. At the same time, it is a fact that there are many men handling the controller who are in every way unqualified for the task. They are often ignorant, callous, and domineering, and only too ready to assert the brute force which is exemplified in the size, speed and momentum of the cars they run.

Considerations of public safety demand a thorough investigation of the whole subject of the selection and training of motormen; and in considering this question it is necessary to realize at the very outset that the responsibilities of the task assigned to the motorman have been greatly underrated. We venture to assert without fear of contradiction that the driving of a motor car at a moderate speed in a crowded city, or at the higher speeds that obtain in suburban service, calls for closer watchfulness and quicker judgment than the driving of a fast passenger locomotive on a steam railroad. A few considerations will show this. In the first place, the steam locomotive runs on a fenced-in right of way, and has the exclusive use of its own pair of steel rails; its movements are controlled by an elaborate system of signals, which is so arranged that the engineer, except in cases of extraordinary emergency, finds every provision made to assist him in controlling his train and maintaining it in its proper position relative to other trains; there are no cross streets at every 200 to 300 feet, through which other trains may come unheralded to cross his track; nor is there a mass of vehicular or pedestrian traffic that may quickly gather and surge over the track in front of him, necessitating exquisite judgment as to pace and distance if he would avoid continual arrest on the charge of culpable homicide.

The motorman, on the other hand, runs his car on a public thoroughfare; he has no signals to warn him of obstructions; no carefully marked-off distances; no home and distance signals; no clearly-painted signboards giving him the pitch of the hills, or even in some cases the curvature of the line; he has to depend on his own judgment as to speed and distance; and at any time, when he is speeding his car in the effort to keep up with the company's schedule, he is liable to find the track ahead of him obstructed by a lumbering wagon or some unsuspecting or bewildered pedestrian. We venture to repeat that of the two men the motorman holds the more difficult and responsible position; and yet we find that while in the case of the steam railroad, engineers are subjected to an apprenticeship of many years before they graduate to the throttle, and by that time are a highly intelligent and well-paid body of men, the average trolley-car motorman, on the other hand, is rushed into his job with absurdly inadequate preparation; that his pay is barely half as much as that of the locomotive engineer; and that in point of intelligence, training, and reliability, he does not compare with the men who, as a matter of fact, have the less difficult and exacting work to do.

This is all wrong, and we are paying the penalty for it in the ghastly list of tragedies which, during the last summer months, has been growing frightfully in length and in the shocking nature of its fatalities. The fact of the matter is that while the motorman had a comparatively easy task when electric trolleys were first introduced, when cars were small and speeds were low, the motorman of to-day is in a vastly different position, handling as he does a car which is two or three times as heavy and travels at nearly two or three times the speed of the car of fifteen years ago. The great peril through which our President has recently passed will not have been without its due effect, if it leads to a thorough investigation and some stringent laws on the selection and training of trolley-car motormen.

"AMERICA" CUP RACES IN 1903

The announcement that a challenge has been dispatched from the other side for a series of races for the "America" cup in the year 1903 will be welcomed by that large section of the American people that has followed with interest the history of this great aquatic contest. It has been understood for some time that a challenge would be forthcoming, so that the actual announcement has not caused any measure of surprise. At the close of the 1901 races, Mr. Watson, the designer of "Shamrock II.," absolutely refused to undergo again the anxiety and labor attendant upon the designing and tuning up of a challenging yacht. At the same time, he expressed his perfect willingness to render to Mr. Fife, or whatever designer should be chosen for the new boat, all the assistance at his command, and to place at his disposal the valuable data acquired during the preliminary investigation and subsequent construction and sailing of "Shamrock II." The designing of "Shamrock III." has been intrusted to Mr. Fife, who also designed the first "Shamrock"; and it is now announced that the plans have been completed for many months, and that a start on the actual construction of the yacht has been made by the Denny Brothers, the builders of "Shamrock II." Sir Thomas Lipton seems to have learned one of the most important lessons of his previous failures, namely, that a challenger to have any reasonable chance of success must be put into the water many months earlier than previous challengers have been, so as to give ample time to tune her into racing condition. It is expected that the new boat will be launched by the end of the year and tuned up on the Clyde against "Shamrock I." From the Clyde, if the programme is followed out, she is to be taken to the Mediterranean for the spring season, after which she will make an early start for this country, where "Shamrock II." will have been launched and put in racing trim to meet her in a series of tuning-up trials off Sandy Hook. If the plans for the challenger, as thus outlined, can be put through, the new yacht will not enter the races as an untried boat. She will have had an opportunity to measure herself against two previous challengers, and will also have had the advantage of sailing a series of races over the Sandy Hook course, under conditions identical to those which obtain in the actual cup contests. We welcome the announcement that there is to be another series of races; for in the whole field of sport there is none so dignified, none with so clean a record, and none that is marked by more friendly characteristics than that of international cup racing. While the construction of the yachts themselves has come to be a question of science and good mechanics, the handling of the yachts allows to-day, just as much as it did half a century ago in the days of the good old "America," a broad field for the exercise of the sailing skill of the skipper, and the smartness and agility of the yacht crews.

THE DEFENSES OF LONG ISLAND SOUND.

Much cheap satire has been leveled at our army and navy during the past two weeks in connection with the game of war which has been played off our North Atlantic coast—satire which has merely served to measure the ignorance of the would-be humorist of the true meaning, scope and usefulness of these maneuvers. In the first place, it is a fact which the layman too little understands, that even when guns are not shotted and mines and torpedoes are harmless dummies, it is possible to simulate the conditions of actual warfare with a close approach to actual conditions. Naval experts who have given a lifetime to the theoretical study and actual practice of war have been able to draw up a scale of points by which in mimic warfare they can assign to a battleship or a fort a close approximation to the amount of damage inflicted or received. Of course, when it is laid down that if a warship carrying 6 inches of side armor comes within 2,000 or 3,000 yards of a fort armed with 12-inch guns, and is discovered and fired upon, the vessel is put out of action—it is assumed that at such a close range a 12-inch gun will find its mark. In an actual fight, it might do so, or might not. Again, if a fleet of half a dozen torpedo boats can creep up in a fog within striking range of a battleship, and discharge their torpedoes, it is reasonably assumed that such a vessel is sent to the bottom; and so, throughout the whole range of operations involved in an attack such as has recently been made on our Long Island defenses, it is possible, by using a system of points, to reach in the total, a pretty fair estimate of what would happen were the ships those of the enemy, and the guns and torpedoes loaded to destroy.

Of the value of these maneuvers to the ships and forts themselves there can be no question. Everything is present during a sham fight except the destruction wrought in the ship or fort itself by the enemy's gun fire; and surely that is worth much in training both to officers and crews. So also, to judge from the standpoint of defense, most valuable experience must necessarily be gained, say, by the Signal Corps, when they know that a hostile fleet is endeavoring to force a passage and that on their eternal vigilance and early finding of the enemy will the result of the operations greatly depend. Similar maneuvers are carried out every year by the great navies of Europe, and for a quarter of a century or more have formed a regular and important part of the year's routine. Evidently they have proved to be of practical value, else, on account of the great expense involved, they would surely have been long ago discontinued. Of the result of the maneuvers themselves, it is impossible to offer any opinion for the very good reason that they are a matter of secret official record, and known to no one outside of government circles. The publication of these results, which will take place in due course, will be made probably through the official journals of the army and navy, and they cannot fail to prove most instructive reading. For the present it is sufficient to say that the ordinary press comment on the maneuvers is necessarily as futile, as much of it is foolish and misleading.

ELECTRICAL TREATMENT FOR LEAD POISONING.

An installation of electric baths for the treatment of lead-poisoning in the pottery industries of England has been carried out at Stoke-on-Trent. One of the most prevalent maladies contracted in the pottery factories is lead poisoning, and paralysis, and the complaint has become so great during late years that it was resolved to establish electric baths, since electro-therapeutics is conceded to be the only efficacious means of combating the disease. The installation provides for continuous and alternating-current baths. The necessary current is taken from the street mains to charge a large accumulator, which is capable, when fully charged, of working the baths for fifteen hours. The accumulator is controlled by a switch which completely isolates it from the bath apparatus when charging, and so avoids any possible connection between the high potential of the current from the street mains, which is utilized for the tram-car service, and the baths. A pair of wires are run from this switch to a board, where they are divided up into six pairs. One pair is for the machine that converts the continuous current from the accumulator into an alternating current; one pair goes to the controlling board for the large bath; two other pairs go to two arm baths, and the remaining two pairs are in reserve. The machine consists of a motor and a dynamo coupled together, and running at 3,000 revolutions per minute, this high speed being necessary in order to obtain the requisite number of alternations per second of the current. The alternating current is carried by a pair of wires from this dynamo to a board, where they are divided into five pairs, one pair being for the large bath, two other pairs for the two arm baths, and the remaining pairs are held in reserve. Thus there are four wires going to each controlling board, two carrying continuous and two alternating current. By means of a switch on these boards either the alternating or the continuous current can be turned on to the bath as required. A regulator is mounted on the boards for adjusting the current to the proper potential, and on the controlling board for the large bath a voltmeter and an ammeter are attached. The current is passed through the water in the bath from two tin plates, one at the head and one at the foot, a third plate like a paddle being provided to concentrate the current on any particular portion of the patient's body. The Roentgen rays are worked from an induction coil, capable of giving a 10-inch spark, the current being supplied from a separate set of portable batteries. This apparatus is in a separate room from the baths, and partitioned off by heavy curtains to exclude all light, and by its use many surgical questions have already been decided which have resulted in the relief of much suffering. It is hoped that this electrical treatment will prove a panacea for lead-poisoning, and for other muscular, nervous and rheumatic affections.

NEW WAYS OF MEASURING WATER.

Director Samuel Fortier, of the Montana Experimental Station, gives out some very interesting information for the use of every farmer who is compelled to irrigate his land in order to grow crops.

The standard unit for flowing water in Montana, as well as in most of the Western States and Territories, is a solid or cubic foot of water, moving at the rate of a lineal foot in one second of time, says Mr. Fortier. Each foot in length of a flume one foot wide and one foot high (inside measurement) flowing full of water would contain a solid or cubic foot of water. Now, if this flume were placed on such a grade that the average rate of flow of water within it would be just one foot of distance for each second of time, it would carry a volume equal to the standard unit. This is often abbreviated into the two words second-foot.

In considering this standard for flowing water, irrigators should not conclude that a volume of a certain definite size is necessary. It will be apparent to all that a flume six inches wide and six inches high full of water flowing at the average rate of four feet per second should also deliver one cubic foot per second. In general, the flow of any stream may be obtained by multiplying the width and depth of the water channel in feet by the average rate of flow in feet.

For small streams of water such as are applied to orchards and garden tracts the miners' inch is a convenient unit, and there are advantages in continuing its use. In adopting a new standard the members of our State Legislature pursue the extended use of the old unit and so defined it in accurate terms. Forty Montana miners' inches are the exact equivalent of one cubic foot per second. An irrigation stream containing eighty miners' inches would be described as two second-feet by the new standard, one containing one hundred and twenty miners' inches as three second-feet and so on.

The second-foot and the miners' inch can only be used for water in motion. It is often convenient in irrigation to describe a certain volume of water in a state of rest. The cubic foot might have been adopted for this purpose had it not been too small. It would have been but a drop in a bucket when compared with large quantities used in irrigation. Accordingly the acre-foot has been quite generally adopted.

This unit represents the quantity of water which would cover an acre to the depth of one foot. Since there are 43,560 square feet in an acre, an acre-foot contains 43,560 cubic feet. Rainfall is measured in depth over the surface, and of late years the tendency has been to measure water for irrigation in the same way. One frequently hears it stated by practical irrigators that 40 acres of spring wheat will require 40 miners' inches. But this statement conveys no definite idea as to the actual amount of water applied to the wheat field, because the number of days the stream has been allowed to run on the field is not given. When, however, one states that 60 acre-feet were applied in two irrigations it shows that at certain stated periods this volume was sufficient to have covered the 40-acre field to a depth of 1.5 feet.

How much water does it require for one irrigation? The amount will, of course, vary with a score or more of conditions. It may interest the reader to know that of forty-four experiments made by the Montana station in different parts of Montana the average was 10 inches of water over the surface irrigated. This amount included all waste incurred on the field, but did not include the losses in conveying the water from the natural channel to the borders of the field. I have found that with well-made field laterals and skilled irrigators 6 inches of water will suffice to wet the soil to an average depth of one foot.

Throughout the irrigated portions of Montana 40 acres of land with 20 miners' inches of water will produce more than 80 without water. If this be true, and the statement would seem to be extremely conservative, a miners' inch of water, apart from the cost of irrigation, is equal in value to two acres of land. Still one finds that land is measured and mapped, and when sold the purchaser is careful to see that the deed is valid and properly recorded. Whereas, in the case of irrigation water probably less than 5 per cent of the total volume used in the State has ever been measured.

I am often asked to explain the new way of measuring water. The Montana Legislature has prescribed no new method. It has merely adopted a standard unit in which all volumes of running water are hereafter to be expressed. The citizens of the State may measure irrigation water by any accurate method, provided the results are expressed in cubic feet per second.

Of late years small instruments called current meters have been manufactured by several firms at prices ranging from $50 to $200 each. These meters indicate the velocity of the water in any open channel by the mean velocity. When multiplied by the area of the section they give the discharge. This mode of measuring water has become quite popular owing to the ease and rapidity with which it can be done, and also the fact that fairly accurate results can be obtained without the use of flumes, boxes or other devices.

A weir box usually consists of a flume with the lower end inclosed. In the middle of the top of the lower end a notch is cut, through which the water to be measured flows. Weirs require no instruments other than a foot-rule; they are easily and cheaply made, and measure flowing water within 2 per cent of accuracy when all the requisite conditions are fulfilled. Weir boxes as compared with miners' inch boxes are more accurate, can be built for the same if not for less money, and can be used to measure much larger volumes. The chief defects of this device are that the box often fills with sediment, which must be removed, and that the water as it issues from the notch requires a drop of at least the depth of water flowing through the notch.

For nearly half a century Western irrigators have tried to devise a way by which water might be measured as it flows through a headgate. They hope to make one structure answer two purposes. In this they have failed, for the reason that the water is so much agitated and so irregular in flow as it passes through a headgate as to render it impossible to secure an accurate measurement. Of late years measuring boxes have been placed at the most suitable points below the headgates, and the latter control the stream while the former indicate the volumes. This rule applies to weirs. It is well to have a space of at least 50 feet between the two structures, and if a better site can be secured further down the ditch the intervening distance may be increased to several hundred feet.

The weir box should be placed on a level in both directions, having the floor at the lower end on a level with the bottom of the ditch. The ditch banks above the weir box should be raised in order that the water may flow through the notch in the weir board. When the weir box is in position the apron is inserted in front and moist earth carefully tamped round the side. The ditch for a distance of 50 feet or more above the weir box should be regular and equal in depth and width to the inner dimensions of the box. Care must be taken that no water escapes either beneath or at the sides of the box.

The method to follow in measuring water in a weir can best be shown by examples. Let us suppose that a farmer has made and placed a box similar to the above. After turning in the water and allowing it some time to attain a uniform flow he proceeds to the weir box and with an ordinary rule measures the depth of water flowing through the water notch. Bear in mind that this measurement is not made at the weir board, but at the regular gage, whether it be a nail, brass plate or post, as described under that head. We will assume that the depth as found by the rule is 3.5 inches. Now by referring to the table he follows down the first column until 3½ is reached. The weir used is 1 foot, and under the column marked '1-foot weir' and opposite the figure 3½ already found he finds the number 21, which indicates the number of miners' inches flowing over a 1-foot weir when the depth of water is 3½ inches. If the depth had been 4 inches, the flow would have been 26 miners' inches; if 6 inches, 48 miners' inches, and so on.

DISCHARGE OF FARMERS' WEIRS OF DIFFERENT LENGTHS EXPRESSED IN MINERS' INCHES.

Depth of Water on Crest	1 ft. weir.	1½ ft. weir.	2 ft. weir.	3 ft. weir.	4 ft. weir.	5 ft. weir.	6 ft. weir.	7 ft. weir.	8 ft. weir.	9 ft. weir.	10 ft. weir.
In.	Min. In.	Min. In.	Min. In.	Min. In.	Min. In.	Min. In.	Min. In.	Min. In.	Min. In.	Min. In.	Min. In.
1	3	5	6	10	13	16	19	23	26	29	32
1⅛	4	6	8	12	15	19	23	27	31	35	39
1¼	5	7	9	14	18	23	27	32	36	41	45
1⅜	5	8	10	16	21	26	31	37	42	47	52
1½	6	9	12	18	24	30	36	42	48	54	60
1⅝	7	10	13	20	27	34	40	47	54	60	67
1¾	7	11	15	22	30	38	45	52	60	67	75
1⅞	8	12	17	25	33	42	50	58	67	75	83
2	9	14	18	27	37	46	55	64	73	83	92
2¼	11	16	22	33	44	55	66	77	87	98	109
2½	13	19	26	38	51	64	77	90	102	115	128
2¾	15	22	30	44	59	74	89	103	118	133	148
3	17	25	34	51	68	85	102	119	136	152	169
3¼	19	28	38	57	76	95	114	133	152	171	190
3½	21	32	42	64	85	106	127	149	169	191	212
3¾	24	35	47	71	94	118	141	165	188	212	235
4	26	39	52	78	104	130	155	181	207	233	259
4¼	28	43	57	85	114	142	170	199	227	255	284
4½	31	46	62	93	124	155	185	216	247	278	309
4¾	34	50	67	101	134	167	201	235	268	302	335
5	36	54	72	109	145	181	217	254	290	326	362

THE DEATH OF PROF. VIRCHOW.

On September 5, Prof. Rudolf Virchow, the Nestor of German pathologists, passed away. Only on October 13 last he had celebrated his 80th birthday.

Virchow was born at Schievelbein, Pomerania, in 1821, the son of a shopkeeper. After an education in the school of his native village and at the gymnasium of Köslin he graduated at the age of 21 as a Doctor. Later he became an Assistant Professor at the Charity Hospital of Berlin. In 1847 Virchow became a Professor at the University of Berlin, and two years later accepted the chair of Pathological Anatomy at the University of Würzburg. Before his Würzburg appointment Virchow had won his spurs as a Government Scientist in a mission to investigate the epidemic of typhus fever among the starving Highlanders of Silesia. His report attracted attention to him, and at once opened not only his pathological but his political career.

Not content with devoting his energy to scientific investigation, Virchow early entered political life, distinguishing himself as an enthusiastic ultra-liberal.

Associated with Reinhardt, Virchow founded the Archives of Pathological Anatomy and Medical Clinic, the Medical Reformer, and a democratic club, of which he was the leading orator. He was elected to the National Assembly, but could not take his seat because he was under age, and likewise lost his chair in the Berlin University. He left Würzburg in 1856 to return to Berlin.

Passing over his active political career, and proceeding to his scientific attainments, it must be stated that Virchow never became a practitioner of medicine to any extent, but the teacher of practitioners. His memory will live in the annals of medicine for the research which he carried on in physiology, pathology, and ethnology. Among his works are: The Rheumate Cornea, Phlebitis, Thrombosis, Embolism, Cellular Pathology, Morbid Tumors, Amyloid Degeneration, On Typhus in Hungary, Lectures on Life and Disease, Nourishment and Well-Being, A Handbook of Special Pathology and Therapeutics, Collections of Contributions of Scientific Medicine, The Movement in Favor of Unity in Scientific Medicine, Origin and Coagulation of Fibrin, White Blood Corpuscles, Inflammation of Blood Vessels, Contributions to the Pathology of the Skull and Brain, Granular Appearance of the Walls of Cerebral Ventricles, Cretinism, and New Formation of Gray Cerebral Substance.

Virchow's greatest discovery was the self-propagating power of the cells in animal tissue, showing that whatever acted upon a cell from without produced a change, either chemical or mechanical, in the cell structure. These changes were the cause of disease. When Pasteur first made his startling discoveries of the bacteriological origin of disease, it was thought for a time that Virchow's theory was unfounded. But later research showed that the two doctrines really supplemented each other. The debt which physicians owe to Virchow can be no better illustrated than by stating that the modern practitioner starts with the work of Virchow, whereas the great German scientist had to beat his own path and evolve new pathological theories. Pathology as we know it to-day is Virchow's work.

Something of the man's personality may not be without interest. As a parliamentarian, he made for himself many a distinguished enemy. Indeed, so bitter were his attacks on the government that he was once challenged to a duel by Count Bismarck. In war Virchow saw most of the causes of political disease. For that reason the Kaiser once snubbed Virchow with royal ostentation, by writing to another scientist a letter, complimenting him upon his good sense in keeping out of politics. It was Virchow who coined the word "Kulturkampf," the war of civilization.

Virchow lived to a ripe age on five hours sleep a night. His luncheon consisted only of beer and two sandwiches. The floor of his workroom was usually littered with skeletons and skulls. As a pathologist he naturally became an ardent collector. In his museum were 20,000 pathological specimens. He had a bacteriological laboratory which was both large and well equipped.

On the occasion of his eightieth birthday, which was celebrated enthusiastically throughout the world, Dr. Mommsen said: "You have broken new ground and laid new foundations for medical science. Your name is written boldly upon the tablets of history, and is honored far beyond the borders of the Fatherland." It was on the occasion of this anniversary that Prof. Virchow told a delegation of Americans that he would repay their visit when he was ninety years old.