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.