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SCIENTIFIC AMERICAN SUPPLEMENT

No. 598.

For the Week Ending May 14, 1887.

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ELECTRIC ACCUMULATORS.

At the present time, much interest is excited in the electrical world by storage batteries. When first introduced as a practical apparatus, some years ago, they were hailed as providing for the storage of electricity, which was considered a great desideratum. For a while interest in them weakened, but it has revived again. Their acknowledged failure in returning the full quantity of electricity with which they are charged is offset by the consideration that they can be charged from the cheapest possible source of that form of energy, the dynamo. This loss of electricity is due to several causes, some, doubtless, unknown as yet. In charging accumulators, the current has to be maintained at a tension slightly greater than that producible by the discharge. Otherwise the battery would discharge itself through the dynamo. Hence, there is an inevitable loss in voltage. This does not only apply to the natural voltage of the cell. There is a "spurious" voltage, as Prof. Forbes has recently termed it, to contend against. The regular electro-motive force being 2 volts, the initial tension of the cell is sometimes as high as 2¼ volts, and the charging has to be done against this, indicating in such a case a waste of about eleven per cent of the electro-motive force of the charging current. This is not the only loss, for the tension is not alone reduced, but there is also a fall in quantity or intensity. The ampere hours suffer in somewhat the same proportion.

Thus, tests of Faure accumulators have given the following results in electricity returned: Return in quantity (ampere hours), 84·34 per cent; return in electrical work (watts hours), 62·44 per cent; return in mechanical work (foot pounds), 46·50 per cent. The figures in the three cases are the results obtained by Messrs. Monnier & Guitton with Faure-Sellon-Volckmar batteries in October, 1883. They are still considered authoritative. For working figures, 90 per cent, 60 per cent, and 40 per cent are sometimes taken.

The cause of these different losses is not yet satisfactorily ascertained. The spurious electro-motive force has been attributed to hydrogen bubbles sticking to the positive plates. The loss in quantity may be due to local action between the metallic grids and the peroxide. The perfect contact of plates and peroxide is advocated by some as the panacea for the latter. More than one inventor has endeavored to do away with the lead supports in the negative plate, and to substitute therefor a solid mass of lead peroxide. One of the batteries now claiming the public's attention in England, the "Union battery," is thus constructed.* Its negative element consists of a slab of peroxide, mixed with lead sulphate. Strips of platinum are used to form a connection for the binding posts. For positive, a plate of spongy lead is adopted. With such a combination, it is asserted by Prof. Forbes that the spurious voltage is extremely low.

Yet the return question seems not fully solved by any battery, and it seems doubtful if it will be. Investigators are now most interested in obtaining a more favorable ratio of total weight of battery to electrical energy yielded. It is here that one of the many anomalies of the storage battery manifests itself. In a primary battery the zinc can be dissolved to the last grain and be rigorously accounted for. In the usual forms of storage battery only a small portion of the active substances, spongy or formed lead and peroxide of lead, is utilized in the discharge.

Thus, a determination was made of the amount of peroxide reduced during the discharge of a lithanode battery. Two and one-half ounces out of eleven of peroxide were reduced. This gives a basis for a very disadvantageous ratio of weight to power. The other forms of battery in which a metallic frame or grid is used to support the peroxide present a similar, together with an additional, reason for the discrepancy. The metal frame is all idle material, if, as already suggested, it is not worse, in forming the positive element in a destructive local circuit.

The advertised weights of cells of two leading accumulator companies, with their quantity of discharge, illustrate this well. One cell, weighing 125 pounds, is stated to deliver 350 ampere hours with a discharge period of 10 hours. Another cell, weighing thirty-four pounds, is credited with 150 ampere hours in 4¼ hours. The electro-motive force being two volts, the above reduced to electrical horse power represent 133 pounds and 84 pounds of dead weight respectively per hour horse power. Taking the rate of delivery into consideration, in each case about $\frac{1}{10}$ horse power per hour is maintained. Practically speaking, it must be remembered that the weight of a storage battery does not represent the weight of an engine only, but of an engine and its fuel. Thus, to develop one electrical horse power hour, we may say that about one hundred pounds would suffice. This compares favorably with a steam engine and boiler with an hour's fuel and water, but ten times the above weight would be required to advantageously maintain this rate. Again, suppose ten hours horse power were wanted. The same weight of steam engine and boiler would be required, with about forty-five pounds of coal additional. But of the storage battery, ten times the weight would be required, or about nine hundred pounds additional. Not only have the volt-amperes to be considered, but the period of discharge, a practical factor settled by experience only, has to be allowed for. The extremely low resistance cannot be taken full advantage of. The rapid discharge is wasteful and destructive of the plates.

To the reduction of this dead weight, electrical engineers are now devoting themselves. One way of lessening the trouble in house service may be mentioned. To introduce private installations in cities, it is proposed to renew the plates as fast as exhausted. This method does away with the weight of the cells. Only the plates are transported, the cells remaining in the house. A central station would be fitted up to recharge and distribute. In the lighter of the batteries just cited, the plates for an electrical horse power hour would weigh 67 pounds, according to the figures of the company supplying it. One gross ton of such plates would represent nearly 34 electrical horse power hours. The lithanode plates, it is claimed, give still lower weights. For them 56 horse power hours per ton is claimed. This reads very much as if a one horse engine burned forty pounds of fuel an hour, or rather as if the coal contained so little combustible matter that forty pounds were required to keep a one horse engine going for an hour.

The above trouble due to dead weight affects transportation, and use in vehicles and boats, but does not enter to the same extent into installations where a dynamo is included in the plant. Here the weight is of less moment, yet any move to reduce it would be welcomed. Another peculiarity of the storage battery, and one already alluded to, stands in the way of what might seem an obvious method of reduction. A small battery frequently charged and discharged at a high intensity would solve the problem in at least some cases. But the storage battery cannot be so discharged with economy. For the ends of efficiency and durability the rates already instanced in the case of two particular forms of accumulators cannot be exceeded. In practice the lighter one of the two is used at a far less intensity of current than that given, or about one ampere per hour to two pounds of battery. No more startling spectacle in electricity than the work of a storage battery on a circuit of infinitesimal resistance can be witnessed. To see a heavy copper wire a foot or more in length heated to full redness by a secondary battery no larger than a pocket book gives an exalted idea of the power of the accumulator. But wonderful as it is, it is a mere *tour de force*. It is done at the expense and utter sacrifice of durability and efficiency.

It is clear that a vast field is open for improvements in this class of batteries. The electrodes need to possess a larger percentage of active material. Polarization and the spurious voltage need reduction. Finally, a battery that can be quickly discharged without injury to its durability, even at the sacrifice of efficiency, would certainly have a definite field of work, where its services would be highly valued.

* For description of this battery see SUPPLEMENT, No. 598.

HEADWAY OF GREAT SHIPS.

To the Editor of the Scientific American:

In vol. liii., No. 10, page 144, I saw an article under the heading, "Speed on the Ocean," in which it says: "A great ship while at full speed will run several miles before she can be brought to a full stop or turned a few degrees to the port or starboard."

Some time ago I related this statement to a friend of mine who is in the New York Custom House, and he declared it untrue, and has since made inquiries of several officers and captains, and they tell him such a statement is absurd—that they can stop their vessels when at full speed in going three or four times their length.

I write this, asking you, for the satisfaction of others as well as myself, to ascertain the facts if possible.

WILL. P. SESSIONS.

Brandon, Vt., April 26, 1887.

[The question as to how far a fast steamer would run with engines stopped was referred to Mr. Nash, the secretary of the Board of Pilots. Mr. Nash has been connected with the Board for fifteen years, and been present at many of the trials which pilots are subjected to for running ships ashore and like mishaps. He calculated that if the engines of a ship running 19 knots an hour in dead water were stopped and reversed, she would not begin to gather sternway until she had covered a distance of at least two miles, and perhaps even as much as three miles. Two of the best pilots of the port being called into the office, each made separate estimates, and the result agreed with the calculations of the secretary. One of them said that long experience aboard these fast ships had proved to him that if two such vessels were approaching each other, each making 19 knots an hour, and the danger signal was heard when they were four miles apart, it could not avail to avert the impending danger, if the weather was thick, because they could not be stopped until the point of meeting had been reached, and all their masters could do would be to "trust to luck" to slip safely by.

Another pilot gave the following instance of the diffi-

culty of stopping a big iron tramp steamer: "Her master told me that once, when he had the ocean all to himself, he determined to make some experiments, so that, should he ever be called up and questioned by the Board of Trade Committee, he would be prepared to answer intelligently. His ship had low power engines, and could not do much better than 12 knots an hour in dead water. While running her at full speed, he ordered the engines stopped and reversed, and with his log and time piece he discovered that she ran fully four knots before she began to gather sternway. As to the sluggish manner in which these long, wedge-shaped ships answer their helms, it seems unnecessary to say anything, because their defects in this respect are so well known. We had an instance of this only last week, when the large Cunard steamship Aurania, with plenty of sea room and fair warning at the helm when a long way off, could not weather the Southwest Spit at the entrance to this harbor, because the current was a little stronger than usual on account of the spring tides.

The captain of the Aurania says he can stop his ship when running at full speed in a distance not much over a mile, and an officer of the Alaska calculated the distance at a mile and a half.]

Many Items of Interest.

The newspaper *Fire and Water*, devoted to fire protection, water supply, etc., in cities, relates a singular accident, which came near being serious. In a dyeing establishment near this city a man was cleaning a flannel gown in a tub of benzine, fully 100 feet removed from a flame of any kind. He was simply rubbing the garment with his bare hands, when, as he describes it, "suddenly the whole tubful of stuff went up in a blaze," and he escaped death or serious injury only by an instinctive and instantaneous backward leap. The friction caused by handling the flannel generated electricity, which ignited the vapors arising from the benzine. This, the editor says, is in its details the first instance of the kind which has yet come to our knowledge, and the fire having been quickly extinguished by the employes, would probably never have been reported had not one of them casually mentioned it.

The *American Architect* relates the following incident of England's architect, Mr. John Ruskin. The other day some incautious Christians, who had built a cheap mission chapel in the suburbs of London, applied to this great man to help them pay for it. Instead of money they received some advice, of greater value, probably, than any pecuniary gift that the critic could bestow. "Why," he asked them, "did they build churches that they could not pay for?" "Why did not they preach behind the hedges, rather than run into debt?" "And of all manner of churches thus idiotically built," he was kind enough to add, "an iron church was to him the damnablest." Mr. Ruskin is said to have just joined the Roman Catholic Church, and this may account for his asperity in talking to evangelical Protestants; but the story shows how cautious one must be in dealing with such persons.

The *Real Estate Record*, of this city, repeats what it has said before, that there are the very best reasons for believing that the New York Central Railroad has decided to build an underground railroad from the Grand Central Depot to the Brooklyn Bridge. The tunnel in which the tracks will be laid will run under Elm street, which is to be widened and extended on one end to the bridge and on the other to Lafayette place and Fourth avenue. The work, the *Record* says, is to be undertaken at once, and will be forwarded in the most expeditious manner, so that the trains may be running in the early summer of 1888. There will be four tracks; two for through and two for way travel.

The cultivation of beets for sugar is making rapid progress in Chili. In one of the largest factories for making the sugar the diffusion process is employed with such good results that the daily production is estimated by the *Mexican Financier* at 150,000 kilogrammes.

On Mount Whitney, the highest mountain in California, at a level of 14,000 feet above the sea and 1,500 feet above the timber line, where there is no soil and no moisture save snow and hail and ice, there grows a little flower shaped like a bell flower, gaudy in colors of red, purple, and blue. It is called Jacob's ladder, and its fragrance partakes of the white jasmine. It blooms alone, for it not only has no floral associates, but there is no creature, not even bird or insect, to keep it company.

It has been discovered how the wholesale milk poisoning occurred at Long Branch last summer. It has been conclusively shown for the first time, says *Health Monthly*, that milk warm from the cow, when placed in tight cans under conditions which greatly retard the dispersion of its heat, will undergo change, with the development, in the course of five hours, of a poison called tyrotoxicon. Fortunately, it is customary among milkmen to cool down before transportation, and now it appears that it is dangerous to deviate from this wise custom. Boiling milk dissipates even tyrotoxicon, and, as boiling also destroys the germs of acid fermentation, it is a good precaution for the summer time.

A writer in one of our medical journals says that it is considered by all physicians impossible to lay down any rules for health which may be followed safely by all persons. Health depends largely upon the diet. Some people cannot eat newly baked bread; others cannot eat it when stale. Much fresh meat with some constitutions induces fullness of the head and a feverish state of the system, because it makes blood too fast. It should therefore be discarded, and a little salt meat or fish, if the appetite craves it, with fresh fruit and vegetables, will be found probably to be just what the system requires. In truth, with health, as in many other things, each person must be a law unto himself.

Some months ago a number of persons went from Glasgow to Loch Fyne to see a large blasting operation, in which six and one-half tons of gunpowder were exploded. A short time after the explosion many of the observers became faint, six of the number died almost immediately, one died shortly after, and five others were very ill, but recovered. The editor of *Science* says the cause of death is believed to have been the carbonic oxide generated from the gunpowder. It is estimated that the amount must have been 468 pounds, a quantity sufficient to occupy 6,333 cubic feet of air space, or to vitiate for respiratory purposes a space one hundred times as great. There were also generated 3,575 pounds of carbonic anhydride; so that, in all, there were 1,266,000 cubic feet of air rendered irrespirable.

One who claims to have tried it, says that rubber may be fastened to iron by means of a paint composed of powdered shellac steeped in about ten times its weight of concentrated ammonia. It should be allowed to stand three or four weeks before being used.

This was the way a country blacksmith was seen removing that portion of an ax handle from the ax that remained in the eye, the break being close to the iron. The wood could not be driven out, and as nails had been driven in at the end, it could not be bored out. He drove the bit of sharp edge into some moist earth, and then built a fire around the projecting part. The wood was soon charred so that it was easily removed. The moist earth so protected the tempered part of the ax that it sustained no injury.

Mary E. Tousey, on the study of insects in the *American Teacher*, concludes that every insect has its use in the world. Many live very romantic lives—some are wanderers and some are social in their habits, all are wonderful. It is possible for us to discover the secrets of their lives and the mysteries of their homes, if we carefully study them.

The *Sanitary Enigneer*, in reply to an architect's inquiry, how to obtain the ivory finish used so much for producing the colonial wood work effect, says that from five to seven coats of oil paint are applied. With the last two Japan varnish and ivory white are mixed, so as to give the polish. Each coat of paint is rubbed down before the next is applied. With the last two coats, pumice stone is used for rubbing down. With cherry wood, five coats will do; with pine, seven are needed to get the same finish.

The American Exhibition in London has added to its attraction Buffalo Bill's Wild West show, which attracted such crowds at the Madison Square Garden, in this city, during the past winter. A correspondent writes that everything in the neighborhood of the exhibition is becoming Americanized. The shops are all labeled on the signs "The American Cigar Store," "The American Photographers," "The American Grocery," etc.

The public will be greatly benefited if the scheme under consideration by the Hon. A. W. McLelan, Postmaster-General, for creating a parcel post system between Canada and the United States. At present there is no system whereby parcels can be sent direct to their destination. Ignorance of postal laws has caused much inconvenience to the department, as well as to thousands of people, who are daily being notified that their respective packages have finally reached the Custom House.

The Relative Digestibility of the Chief Albuminoids.

Dr. James Fraser has made a series of experiments (*The Lancet*) to determine the digestibility of various proteids. The substances experimented upon were: Raw albumen, serum and egg; cooked albumen, also serum and egg; globulins, raw and cooked; myosin; derived albumen, viz., syntonin, alkali albumen, casein; vegetable albumen, impure gluten. Each of these was subjected to six hours' peptic digestion, then for six hours to pancreatic digestion. At the end of this time they were placed in a temperature of 176° F., and dialysis was allowed to proceed for twenty-four hours. The author gives the result of his researches in a tabulated form, and estimates the amount of peptones dialyzed as nitrogen. The most digestible albuminoid was found to be cooked myosin; then came raw serum albumen, after which the order was as follows: syntonin, alkali albumen, raw egg albumen, casein, cooked egg albumen, cooked serum albumen, raw myosin, and gluten. It might have been expected that syntonin would have headed the list, as it is partly digested beforehand, yet it was not far from being ahead of the others. These results apply to the albuminoids after they had gone through the processes of peptic and pancreatic digestion, as well as dialysis.

Each albuminoid substance was reduced to a dry solid state, and on taking the percentage relation between the amounts dialyzed and the amount of albuminoid actually used, it was found that in no case did fifty per cent of the dry solids pass through the dialyzer, this depending rather on the short period of dialysis than on imperfect peptonization, On examining the tables showing the amounts of nitrogen dialyzed in each stage of the experiment, it is seen that in no case did two per cent pass through the dialyzer during peptic digestion. The uncooked albumens gave the highest peptic results, and syntonin next. Turning to tryptic digestion, cooked myosin heads the list, then the order is as follows: Raw serum albumen, raw egg albumen, syntonin, cooked serum albumen, raw myosin, caseine, gluten, and cooked egg albumen last. This experiment being conducted in an alkaline menstruum, those substances which are most easily soluble in an alkaline solution have naturally an advantage in digestion. Hence the high position of raw albumens and of syntonin.

During the two stages of peptic and pancreatic digestion, peptones were formed more rapidly than they could pass away through the parchment paper, and accumulated in the dialyzers, so that when the ferment was killed by heating to 176° Fah., and dialysis was continued for twenty-four hours, a larger proportion of crystalloid matter passed through than in the former stages; these peptones were both of peptic and tryptic formations, as in the case of those under the head of pancreatic digestion. The largest proportionate result was found in the case of cooked myosin, which was not far ahead of raw serum albumen; then came cooked egg albumen, alkali albumen, caseine, cooked serum albumen, raw egg albumen, raw myosin, and lastly gluten. Many of these albuminoids are not ordinarily used as foods; for instance, serum albumen, raw myosin, syntonin, alkali albumen, though they are the most digestible of the albuminoids.

By utilizing the results of these experiments, much valuable aid can be given to those who require good, nutritious diet for invalids unable to digest solid food. Beef tea, as ordinarily prepared, is of little nutritive value; but if the white of an egg be mixed with a cup of beef tea and heated to about 160° F., the value of the beef tea is greatly enhanced. Again, if minced raw beef be just covered with very weak hydrochloric acid (four drops of acid to one pint of water) and left to macerate for the night, the liquid strained off and squeezed out of the flesh by wringing in a cloth contains so much syntonin as to make it highly nutritious when neutralized; such a liquid will remain clear after boiling to remove the raw flavor.

In cases where the digestive powers are not in abeyance, one may give by mouth or by enemata one or more of the various forms of peptonized foods or fluids that are now in the market. In cases where the digestive powers are lost in the stomach, but retained in the intestine, or where some obstruction to the passage of food into the stomach exists, the above experiments will give much help in treatment. The experiments with casein and gluten show that there are very few worse foods for a delicate stomach than the usual bread and milk; whey is a mildly nutritive fluid, and easily digested. In cases where it is desired to feed the patient through the intestine, those substances found soluble in alkaline fluids, and therefore easily acted on by the pancreatic juice, viz., raw albumen, syntonin, or alkali albumen, may be used alone or dissolved in some meat tea.

Oliver Hoyt.

One of the most respected and influential of the merchants and manufacturers in the leather industry of the country was Mr. Oliver Hoyt, of New York City, who died at his home in Stamford, Conn., May 5, from injuries received by a fall from his carriage two or three days previously. Mr. Hoyt was in his sixty-fourth year, and had been for more than forty years engaged in the leather business in New York. The firm of Hoyt Brothers, of which he was a member, was one of the largest manufacturers of sole leather in the world, there being only two or three other firms which approached them in the magnitude of their business. In 1882 we published an illustrated description of a new tannery then built by the firm in Pennsylvania. Mr. Hoyt served three terms as Senator in the Connecticut Legislature, and was an active member of the Methodist Episcopal Church, with whose educational and missionary enterprises he was prominently identified. He was a director in the National Park Bank and in the Home fire and Phœnix insurance companies of New York. He leaves a widow and four sons.

To keep postage stamps in the pocket or memorandum book without sticking, a New Orleans Post Office clerk advises people to rub the sticky side over the hair two or three times. The oil of the hair coats the mucilage and prevents it from sticking.