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**No. 1114.**

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### A GRACEFUL ACT OF INTERNATIONAL COURTESY.

We mentioned in our previous issue that the manuscript log of the Mayflower had been delivered to the United States through its representative, Ambassador Bayard, on an order given in the Consistory Court of London. In this issue we present our readers with a photographic reproduction of this priceless relic, which, in point of its unrivaled historic interest, may be said to stand quite alone.

The manuscript volume of the log, at the time of the petition for its removal to the United States, formed part of the library of Fulham Palace, the residence of the Bishop of London, and among the precedents which were quoted on behalf of the petition was the case of the Library Company of Philadelphia. This company discovered that certain manuscript volumes presented to the library in 1799 formed part of the national archives of Great Britain, as was proved by the fact that they consisted of official correspondence which bore the sign manual of James I and of Elizabeth. The volumes were at once restored to Great Britain, and the Master of the Rolls, Lord Romilly, into whose official care they passed, acknowledged the great obligation under which the British nation had been placed, and expressed his conviction that such acts of courtesy and friendliness would tend to draw closer the ties connecting the two countries.

The return of the log of the Mayflower to this country has been made with the same readiness and in the same friendly spirit which characterized the Philadelphia transfer, and, if anything, we are placed under an even greater debt of obligation than that which Lard Romilly acknowledged on behalf of England in the previous instance. Without depreciating in the least degree the generous spirit in which the Philadelphia transfer was made, it may be pointed out that the British archives which were voluntarily surrendered related to England alone, and had no historical interest to connect them with this country. The records of the Mayflower, on the other hand, have naturally a great intrinsic interest for the English people, as being the story of the struggles of early English colonists who had the full sympathy of the middle English classes, from which they came and of whose sterling qualities they were faithful exponents.

The fact that there was no opposition to the request of Ambassador Bayard, and that, after this valuable document had been over a century in their undisputed possession, it should be so freely surrendered at our first request, is another striking evidence of the friendly feeling unselfishly entertained by the English people toward this country.

### FREE DISTRIBUTION OF SEEDS BY THE GOVERNMENT.

There is a growing agitation against what is known as the free distribution of seed by the government. The system is too well known to the majority of our readers to need any explanation; but for the benefit of city residents it may be said that the government has been in the habit of doling out annually to Congressmen for distribution among their constituents about $140,000 worth of seeds. This has been done with the expressed object of securing reports from the users as to the results obtained. Whatever theoretical advantage there may have been in the proposal, it has failed utterly to produce any practical results, and according to all reports the experiment has degenerated into a positive farce. The United States Agricultural Department in its report on this subject says: "While one purpose of the law was to secure reports from the receivers as to the results of actual experiment, the reports actually received did not amount to one-hundredth of one per cent of the persons supplied. A careful review of the department reports, especially those of the chiefs of the seed division during the past decade, in which over $1,000,000 was expended for free seed distribution, fails to reveal a single instance of benefit to agriculture attributable to this distribution." In the face of this official statement, one asks with no small amount of bewilderment, why did the last agricultural bill, which recently passed both houses of Congress, contain an appropriation of $150,000 for carrying on this palpable folly? If Congressmen can see any sound ethical or political reasons for a paternal distribution of seeds, why should they stop just here? Why not appropriate another $150,000 for spades, plows and fertilizers? As a matter of fact, the system is wrong in principle as well as a failure in practice, and it is to be hoped that this year will see the last of it.

### THE FASTEST VESSEL AFLOAT.

It is a great triumph for the "rotary impact" form of steam engine that the first one of this type fitted to a steamship should have driven it at a speed far in excess of the world's record, yet this is what has recently been achieved by the engines of the torpedo boat Turbinia. This little vessel of 100 feet length, 9 feet beam, and 44½ tons displacement, was built at Newcastle, England, specially for a marine trial of the compound steam turbine designed by the Hon. Charles Parsons. The Parsons turbine utilizes the steam in three stages and has shown remarkable economy, an engine of this type which is at work in the electric works, Cambridge, England, having achieved a consumption of 15·1 pounds of steam per indicated horse power per hour. The Turbinia was at first fitted with a single engine and screw, and in the trials the "cavitation," or vacuum formed behind the propeller, was such that very disappointing results followed. The single turbine was removed and replaced by three separate turbines directly coupled to three screw shafts, the turbines being respectively the high pressure, intermediate and low pressure elements of a triple expansion engine. The results were truly remarkable, a speed of 29·6 knots being realized. After further experiment to determine the proper pitch for the screws, a series of trial runs were made on April 1 of this year, when a mean speed of 31·01 knots an hour was realized. The particulars of the run were as follows:

| | |
|---|---|
| Revolutions of engines (mean) | 2,100 |
| Steam pressure | 200 lb. |
| Thrust, horse power (calculated) | 946 |
| Indicated " " | 1,576 |
| Consumption of steam per indicated horse power per hour | 15 86 |
| Indicated horse power per ton of total machinery | 72·1 |

Nine days later the Turbinia realized a speed of 32¾ knots an hour, thus surpassing the world's record by about a knot and a half. This is equivalent to 37¾ miles an hour, or equal to the average speed of many so-called express trains.

### WAR MEASURES IN TIME OF PEACE.

The naval armor question seems to be getting into a state of hopeless entanglement, and the proposal of Senator Chandler that the government shall forcibly seize the plant of the Bethlehem Iron Company and proceed to make its own armor plate therewith simply makes "confusion worse confounded." The law by which the government would be enabled to take possession of these works for the manufacture of war material is intended to cover cases of emergency in time of war; but it has never been construed to give the government the same right in a period of profound peace such as the present. It is reassuring to learn that the bill is likely to receive very little, if any, support. Secretary Long's letter to Congress relative to the bids in answer to the department's advertisement of March 10 states that the department did not feel justified in accepting or rejecting the bid of the Illinois Steel Company, and points out that the government is liable to incur heavy expense due to the delay in furnishing armor for the three battleships recently laid down, if some steps are not immediately taken to procure the needed supply. The secretary closes by recommending that authority be given the department to make contracts at a price not exceeding $400 per ton, "the rate recommended by my predecessor." This figure was arrived at as being a just price after the question had been carefully investigated by a board of experts, and under the circumstances it looks as though the recommendation of Secretary Long was the easiest way out of the deadlock.

### HIGH SPEED TELEGRAPHY.

By making use of the alternating current and special designs of receiver and transmitter, two well-known American specialists have succeeded in sending messages over a wire at the rate of twelve hundred words a minute, and they confidently assert that between three thousand and six thousand words a minute may be dispatched by the same system between points that are a thousand miles apart. The new telegraphy marks a wonderful advance over existing methods. An operator using the Morse key sends only forty words a minute, and by the Wheatstone system about one hundred and fifty words can be sent over a single wire in the same time.

This epoch-marking invention, which, if it fulfills its early promise, will rank as one of the greatest of the century, is the result of the joint labors of Lieutenant G. O. Squier and Prof. A. C. Crehore, and it was first announced in a paper which was read at the New York meeting of the American Institute of Electrical Engineers on April 20. The paper, with complete illustrations, is published in the current issue of the SUPPLEMENT, and it will be found to be one of the most valuable contributions ever made to the literature upon this subject.

The new scheme, as we have said, uses an alternating in place of a constant current. In the latter, a break in the contact of two wire terminals causes the emission of a spark; but if an alternating current be broken at the zero line, that is just where the alternation takes place between a positive and negative wave, there will be no spark. The Squier and Crehore device takes advantage of this feature and interrupts and restores the current at the zero points of oscillation. The operator adjusts his instrument until the sparking disappears, at which point he knows that its action is synchronous with the frequency of the current employed. Hence these gentlemen have given their telegraph the name of synchronograph. If the Morse alphabet of dots and dashes is employed, a break in the current lasting from the beginning of a positive wave to its end would signify a dot, and a break lasting from the beginning of a posi-

tive wave to the end of the following negative wave would signify a dash. The interruption must last just half a cycle or a whole cycle, a positive and a negative wave together constituting a cycle. The intervals between dots and dashes must also, of course, be either half cycles or multiples of a half cycle.

The transmitter in the experiments consisted of a narrow wheel with a flat metallic periphery, which was rotated at a high rate of speed, which was such that it was an exact multiple of the length of one cycle. The current was transmitted to the wheel by two metallic brushes, which were arranged side by side in contact with the periphery of the wheel. It is evident that the current would ordinarily flow from one brush through the wheel to the other brush; but if a strip of insulating material were pasted on the wheel in the line of one brush, every time it came round and passed under that brush the current would be broken. A strip of paper was perforated with holes of various length corresponding to the Continental Code, which was used in the experiments, and it was carried over the wheel in much the same way as a belt is by a pulley. Just as long as the brushes were separated by the paper the current was intercepted, and whenever the brush reached a hole and touched the wheel the current was restored. The breaks and contacts were arranged so as to occur exactly at the zero point of the alternations, as explained above, so that no sparking occurred.

The receiver was the polarizing photo-chronograph which Messrs. Squier and Crehore designed for use in timing the flights of projectiles. This ingenious instrument was fully described in a paper contributed to the SCIENTIFIC AMERICAN SUPPLEMENT by these gentlemen and published in the issue of January 2, to which our readers are referred for the full details and illustrations. The current in this instrument passes through a coil of wire which surrounds an instrument called an "analyzer." A ray of polarized light from an arc lamp passes through a series of lenses, and when no current is flowing the analyzer is in such a position as to shut out the ray. When the current passes through the coil the plane of polarization is rotated in such a way as to permit the light to pass again, and the very rapid flashes of light are recorded upon a photographic plate.

The paper of Messrs. Squier and Crehore closes with a suggestion as to the changes that will be effected by introducing a telegraph postal system. It is estimated, for instance, that it would require only two lines working on their system, if they were in continuous operation, to handle the entire postal business between New York and Chicago, which amounts to about 40,000 letters daily. By the present system it takes three days to receive a business reply between the cities named, but by the aid of machine telegraphy working at the rate of 3,000 words a minute, a letter could be sent and a reply received on the same day.

Our readers will recognize in this proposal some of the features of the Delany system, and the inventors of the "synchronograph" have given very generous credit to this ingenious system in the course of the paper under discussion.

## OUR SALTPETER CAVES IN TIME OF WAR.

BY HORACE C. HOVEY.

Saltpeter, literally rock salt, chemically potassium nitrate, also known as niter, is remarkable for storing oxygen in a solid form. One volume of it has three thousand times as much oxygen as a like volume of atmospheric air. At a certain degree of heat this immense quantity of oxygen combines violently with carbon, thus forming carbonic acid gas, and also setting free a quantity of nitrogen. Gunpowder contains about 75 parts of niter to 15 of charcoal and 10 of sulphur. If ignited in vacuo, the powder quietly resolves itself into gas. But in the chamber of a gun, behind a ball, it explodes with energy and hurls the missile with deadly effect. For this reason saltpeter is essential to any nation engaged in warfare.

Edward Rawson was the first to attempt the manufacture of gunpowder in the New England colonies. In 1639 the General Court of Massachusetts granted him five hundred acres at Pequod, "so he go on with the business of powder, if the saltpeter come." By act of June 14, 1642, all towns and families were ordered to promote the manufacture of saltpeter. But nothing was accomplished, and in 1648 the General Court voted to indemnify Rawson for his losses in the experiments made. I am indebted to Mr. R. N. Toppan for this authentic information, not found in local histories. Rawson was deputy from Newbury, and secretary of the colony.

At the opening of the revolutionary war the military stores of New England were mainly kept at Quarry Hill, near Medford, Mass, where they had two hundred and fifty barrels of powder, which was seized by the British on September 1, 1774. The act set the country aflame, and stirred the indignation of Burke, Pitt and Fox. After the news from Lexington and Concord, in 1775, the colonies were scoured for powder, and less than sixty-eight barrels were found. New York had but one hundred pounds. Lord Dunmore had seized the entire supply in Virginia, and when Patrick Henry demanded its restoration at the head of troops, he only got its money value and not the powder. When Washington took command of the troops raised by the colonies he "made the alarming discovery that there was not more powder than sufficient to furnish each man with nine cartridges. By great address this dangerous deficiency was concealed from the enemy." (Holmes' Annals, vol. ii, p. 240.)

It is remarkable that no American history, so far as I know, tells us whence the robbed and impoverished colonies got their powder wherewith to wage the war of the revolution. A similar gap exists concerning the war of 1812, when an embargo cut us off from foreign supplies. We are told about almost everything else, but not where we found our saltpeter. That question is now answered.

Among those who resisted the tyranny of Lord Dunmore in stealing the ammunition of Virginia were two young men named Thomas Jefferson and James Madison. They were not only patriots and statesmen, but were also cave hunters. Among the caves found by Jefferson was one that he named for his friend, "Madison's Cave," located in the Grottoes Ridge, in which also occur Weyer's Cave and the Cave of Fountains. Major Jed Hotchkiss, the veteran map maker and geologist, is my authority for saying that Madison's Cave was mined for saltpeter during the three great wars, of the revolution, of 1812, and of the rebellion—probably the only cave on the continent of which that can be said. But Jefferson found many other and richer saltpeter caves, which he describes in his "Notes on Virginia," page 44. He says that one of the largest was on Rich Creek, a branch of the Kanawha, from which more than eleven thousand pounds of niter were obtained. Others were on the Cumberland River, and at least fifty were in the Greenbrier Valley, in one of which Jefferson found the typical megalonyx made famous by Cuvier. His account is all the more valuable because written while the war of the revolution was going on, and thus showing us whence the patriots obtained their means to carry it forward. To a limited extent gunpowder was seized from the enemy, and a few pounds of saltpeter were made from excavations under old stables, and by artificial processes, but the bulk of it undoubtedly came from the caves of Virginia.

Kentucky was originally set off from Augusta County, Virginia, as Kentucky County, in 1776, and was made a State in 1792. Among its early settlers were strolling chemists who knew of the caves in the Greenbrier Valley and elsewhere, and hunted for similar ones in the newly organized State. They were richly rewarded. Under ledges, in "rock houses" and "rock castles," they found solid masses of niter weighing from 100 to 1,600 pounds. Previous to 1800 there had been found 28 saltpeter caves in Kentucky, from which more than 100,000 pounds of saltpeter had been obtained. These facts led Dr. Samuel Brown, of Lexington, Ky., to make a journey of 1,000 miles on horseback, in 1806, in order to lay them before the American Philosophical Society at Philadelphia. He closed his able paper, probably the first of its kind, with these words: "A concern for the glory and defense of our country should prompt such of our chemists as have talents and leisure to investigate this interesting subject. I suspect that we have much to learn with regard to this salt, so valuable in time of peace, so indispensable in time of war." The time of war was nearer at hand than he may have thought, for it burst upon us in 1812, and we were cut off from foreign supplies. Dr. Brown had estimated that what he termed the Great Cave contained 1,000,000 pounds of saltpeter; Scott's Cave, 200,000; Davis' Cave, 50,000; three others not named, 30,000. Since then the Mammoth Cave has been discovered, and the Wyandot Cave and others in Indiana, and the niter fever almost rivaled the subsequent gold fever of 1849. We have the authority of Flint's Geography for the statement that, during the war of 1812-15, the annual yield of manufactured saltpeter from Kentucky alone was 400,000 pounds, besides what was made in Indiana, Tennessee and elsewhere. Part of this was used at home; but most of it was carried by ox carts, or on pack mules, across the Alleghanies to the seaboard to be used in making gunpowder.

The term "saltpeter caves" is a misnomer only justified by the general usage. That which is found in these caves, and which is colloquially called "peter dirt," is soil impregnated with the nitrate of lime, whereas true saltpeter is the nitrate of potash.

Prof. W. B. Rogers holds that the "peter dirt" is derived directly from the overhanging rocks, which agrees with Dr. Samuel Brown's observation that the water trickling from rocky crevices has the same properties as the liquor got by lixiviating the cave clay. Dr. Brown says: "The nitric acid is formed within the caves and is condensed upon the rocks, the lime of which it dissolves."

The fact seems to have been generally overlooked that the strata of sandstone overlying the cavernous limestone is rich in niter. It was from this source that the first supplies of Kentucky saltpeter came. The process was to blast the sandrock and break it into small fragments for the boilers, thus getting niter directly without the aid of lye. The reason it was given up was that the best sandrock was extremely hard, because of the presence of iron, and it was practically easier and cheaper to treat the nitrous earth found in the caverns.

In order to give some idea of what was once a vital industry of our country, though now wholly abandoned, I shall briefly describe the work done at the Mammoth Cave, which may be taken as typical of the rest. This includes what was done at the Salts Cave and Dixon's Cave, belonging to the same estate. Dixon's Cave was, at some prehistoric time, a part of the Mammoth Cave. As measured by me it is 1,500 feet long, from 60 to 80 feet wide, and about 100 feet high. The floor of this enormous hall is ridged by eighteen transverse rocky piles some 40 feet high and as many thick, cut by passageways for convenience. And every block and fragment of those massive ridges was laid there by the old saltpeter miners. By this means they got at the peter dirt to be carried outside for further treatment.

The main works, however, were at the entrance to the Mammoth Cave. Cart roads were made through the more accessible avenues, and from the more distant places, even from rooms three miles under ground, the negro miners brought the dirt in sacks. Hardly a yard of the cave as then known was left undisturbed. Audubon Avenue was particularly rich in nitrous earth. So was Bat Avenue, near the end of which is the Crevice Pit, the ugliest black hole mortal ever looked into, and at whose bottom the men thought there must be a nitrous mine. The story has been often told of the miner's lamp dropped into that black chasm, and the sprightly negro let down as an animated plummet, who brought back, not the missing lamp, but a marvelous story whose truth was confirmed thirty years later by the discovery of the so-called Egyptian Temple. The Gothic Avenue was also diligently worked. The shovel and pick were plied from room to room of the main cave, and out through the windings of the Blue Spring Avenue. Abundant aboriginal relics were found.

The nitrous earth thus collected was put in hoppers with each a capacity of fifty bushels, and which are still to be seen in the rotunda and vicinity, a few hundred feet within the cave, where may also be seen the pumps and double set of wooden pipes, one set to bring water from the cascade at the mouth of the cave and the other to convey to the surface the liquor obtained by solution from the hoppers. The floors of the latter were peculiarly grooved to allow the saturated water to run into the basins, whence it was pumped out to the great iron boilers. When the lixiviated earth had been exhausted, it was cast aside and a new charge put into the hoppers. These piles of indurated earth extend for a long distance like miniature mountain chains. The liquor, after sufficient boiling, was poured into another set of hoppers containing wood ashes, whence, by filtration, a clear solution of the nitrate of potash was obtained. This was again boiled down to the right condition for crystallization in troughs, whence, after twenty-four hours, the crystals were taken and packed for transportation.

The proportion of ashes to be used to the nitrified liquor was a source of much perplexity. Too much would "kill" the saltpeter, and too little would leave it "in the grease;" and in either case the salts would have to be run through the hopper again. Ashes from oak are three times as rich in potash as those from pine; and only half as rich as those from elm or maple. Best of all were the ashes made by burning the dry wood in hollow trees, two bushels of which, according to Dr. Brown, were equal in strength to eighteen of oak ashes. It is stated that "the contract for the supply of the fixed alkali alone for Mammoth Cave, for the year 1814, was $20,000." That, if correct, gives us an idea of the extent to which saltpeter was manufactured here in the days when Gratz and Wilkins carried on the business exclusively for the Philadelphia market.

Many curious facts might be added as to the antiseptic and sanitary value of the atmosphere in Mammoth Cave, which is both chemically and optically pure, except as tainted by torches. None of the deep pits contain foul air. Indeed, the interior air is purer than that which is exterior, showing that its purity is not due to ventilation, but probably to the disengaging of free oxygen in the formation of the nitrate of lime, a theory advanced by Professor Silliman.

In time of peace it is cheaper to import saltpeter from Chile, India and elsewhere than to make it at home. But when the Southern Confederacy was cut off by the blockade of all its ports, it resorted to the caves of Virginia, Tennessee and Alabama, particularly to the great Nicojack Cave, near Chattanooga, for the means of making gunpowder, the process being substantially like what has already been described.

It is strange that these interesting materials of American history seem to have completely escaped the attention of our best historians. It is certainly of historic moment that, when the fate of the nation trembled in the balances, the mineral contents of our numerous caverns enabled a waning force to gather new strength, and to prolong war far beyond what would otherwise have been possible. We doubt if victory could have been won in the war of the revolution, or in the war of 1812, without the aid of the saltpeter caves of Virginia and Kentucky.