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SCIENTIFIC AMERICAN SUPPLEMENT

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THE FARMER AND MODERN INVENTION.

In modern life one of the most striking features that has been and is being developed more and more rapidly is the interdependence of the members of the human family. As the population increases, the hermit or quasi-hermit life so frequent years ago, when the farmer for months in the winter saw hardly any faces except those of his own family, and when he conducted his farming operations in almost complete independence of the rest of the world, is fast becoming an impossibility. In old times the farm was a self-supporting world in itself. The wells, springs and cisterns supplied water; the domestic animals got all their food from it, and it produced its own fertilizers. By rotation of crops, by letting land lie fallow, and by the use of fertilizing material produced on the farm the land was kept fertile. Rain descended from the clouds without any human agency.

Now the conditions are very different. The greater demands of modern civilization militate against the simple life of the New England farmer of one or two generations ago. The farmer's children wish to compete with city children in education and in general culture. But outside of the personal aspect, of which this is but one element, modern conditions affect his life in a much broader sense. The tendency now is to work the soil in large areas devoted to a single crop, and to use machinery in all farming operations. For many years past the American inventor has been busy inventing most ingenious machines for cultivating the ground, for sowing the seed, and for harvesting the crops. On account of the inventor's work the Western farms, with fields of wheat reaching to the horizon, cultivated by steam-drawn plows, and whose crops are harvested by great machines drawn by teams of many horses, have become a possibility. The great cereal crop of the United States is due to the mechanical inventor.

In the same order of things is the modern fertilizer. For different crops different fertilizers are made in factories. As the great natural sources of phosphoric acid were overdrawn, the European agriculturist has utilized the finely ground slag of the basic steel process. The farmer depends no longer on his barnyard, but purchases his plant food in the most approved form, made in factories from the most unpromising sources of supply. The Atlantic coast is patrolled by steamers whose occupation is the catching of menhaden or bony fish. After the oil is extracted from these fish, the farmer has a claim on what is left as a source of nitrogen for his crops. South American nitrate of soda is another source of nitrogen. The German mines supply him with his potash, and the blending of all the elements is effected in the fertilizer factories, whose processes are guided by the most exact chemical analyses of their materials.

Even in the matter of local transportation the farmer is being taken care of. The electric road, to whose operations, heedless of vested rights, so many highways have been surrendered, bids fair to revolutionize the aspects of rural life. It is believed by many that the electric road will eventually haul the farmer's products to the cities or railroad stations, and the improvement of country roads has actually been discouraged by those who believe in the highest development of this form of traction.

Where the process of development of modern life will end, it is hard to see. The farmer, who would seem to be the last to be subjected to modern scientific advancements, is really, speaking relatively, the one most affected. Mechanical, chemical, and electrical science have changed his entire status. Among inventors the farm is recognized as the field for most useful work in invention. Man may yet learn to dispense with coal, and the steam engine may be relegated to the past. The self-contained energies of the cosmic system may yet be used to replace the motor which during the last decades has replaced them. Windmills and waterwheels represent the utilization of cosmic energy, and mankind may yet be driven to a more extensive use of the mechanical powers of nature. But for food production, it seems as if the soil for many years to come must be the only resource. Synthetic chemistry has to make enormous advances before it can produce palatable food. Already it has done something in producing glucose and saccharine as sugar substitutes, but until the synthesis on the large scale of carbon and hydrogen is effected, the synthetic chemistry will be inchoate.

In the modern march of progress the farmer will hold his own. The changes in his processes, the abolishment of the quiet rural life, and of the farm as an almost self-contained unit of existence, are brought about by the devotion to his interests of the enlightenment of the world, and the world in its turn is more and more dependent on him. His success or failure in the Western States affects the earning of the railroads, and through them the financial condition of the Eastern and European capitalist. The dependence of mankind on the past and present products of the soil is becoming more and more emphasized as modern science daily proves itself incapable of dispensing with the slow processes of nature. The field for science and invention in improving farm processes is one of the greatest. Mechanics and chemistry will, every year, take a larger part in the operations dependent on plant culture, and future years may yet see so systematic a system of farm and tree culture established that the entire country, with definite areas for particular crops, will seem but one great farm, whose fields will be represented by areas of many miles extent. As steam and chemistry now do their most important work in connection with the crops, electricity may yet supplant them, or re-enforce their operations.

A Vessel Difficult to Sink or Destroy.

On July 20 last the schooner Golden Rule was cut to the water's edge by the steamer Chattahoochee, which took off her crew of seven men and one passenger. She was then off South Nantucket Shoals, from Ponce for Boston, with molasses.

Since that time the wrecked schooner has been floating about on the coast, forming a danger to navigation, and the United States cruiser Atlanta, Captain J. R. Bartlett, was sent out to search for and destroy the wreck.

On August 4 the Atlanta arrived at Newport. Her bow presents a much marred appearance, the white paint being scraped off in streaks where she rammed the floating wreck of the Golden Rule, about twenty-five miles southeast of the New South Shoal light. She sighted the wreck, bottom up, about 100 feet off her course. It had the appearance of being anchored by the bow, and was a dangerous obstruction to navigation. The Atlanta was cleared for action, and a couple of broadsides were fired at the derelict, but the shot went clear through the hull without doing much damage.

Having no torpedoes on board, Captain Bartlett decided to try the ramming tactics. First a light blow was delivered at the stern to see what condition the vessel was in. She was found to be practically new, but gave way readily to the ram. Another blow was made upon her quarter to learn what her cargo consisted of, and it proved to be empty barrels. Next the Atlanta drew off and approached the schooner under full speed, striking her amidships. The schooner was so light and the ram so deep that she was thrown away from the Atlanta and righted, though the blow cut a gash half through her. A second ram was made, and the schooner was cut in two. The Atlanta's engines were disabled, being in poor condition, and the warship was obliged to withdraw under sail, while the stern post of the schooner drifted off toward George's Banks, and the bow still remained anchored. Captain Bartlett would have destroyed the whole craft if possible, but the crippled condition of his vessel prevented. About two hours were consumed in the work.

The net results appear to be that there are now two floating wrecks instead of one. The problem how to build an unsinkable ship appears to have been realized in the case of the Golden Rule, and perhaps naval architects may derive useful hints from the example. Something practical seems to have been learned concerning the Atlanta as a ram, which is that her engines are not suited to the work. We have had examples of passenger steamers going at full speed against solid icebergs, the result being damage to bows but not to machinery.

Depreciation of a Canal.

The Somersetshire Coal Canal was put up for sale recently at Tokenhouse Yard. The canal is about 10½ miles in length. The actual rents received from the cottages and surplus lands amount to about £75 per annum. The canal was opened in 1800. It had a prosperous career down to 1872, at which time tolls were taken on 157,000 tons yearly. From 1884 to 1888 the tonnage was taken on a yearly average of about 24,000 tons, producing £1,547 in tolls, while the average yearly expenditure was £1,284. In 1889 considerable difficulties were caused by strikes, etc., and the collieries feeding the canal remained idle for some time. This state of things occurred more or less in subsequent years, and the company eventually went into liquidation. The original cost of the canal was about £200,000, and the auctioneer said that a bid of £20,000 would not be refused. A railway company was, he said, almost certain to acquire the property sooner or later, but it afforded opportunities in connection with many speculative undertakings. The highest bid was only £3,900, and the auctioneer withdrew the property from sale.

Enlistments in the United States Army.

The law approved February 27, 1893, provides that all enlistments in the army shall be for the term of three years, and no soldier shall be again enlisted in the army whose service during his last preceding term of enlistment has not been honest and faithful; and in time of peace no person who is not a citizen of the United States, or who has not made legal declaration of his intention to become a citizen of the United States, or who cannot speak, read, and write the English language, or who is over thirty years of age, shall be enlisted for the first enlistment in the army.

The Modern Incandescent Lamp.

L'Industrie Electrique contains a very full account of a communication delivered on June 6 by M. Larnaude before the Société International des Electriciens. The title of the article, says the Electrical Review, conveys to the mind the hope that the communication would contain new and important information on this subject, but its real purport is rather to set forth in a popular manner a comparison between modern attainments in lamp manufacture and the attainments reached some years ago, manufacturing details being wholly omitted.

M. Larnaude, who is the technical expert of the French Edison-Swan Company, commences by referring to the price of incandescent lamps. Only a few years ago the usual price at which it was sold was 5 francs, whereas now the price is only 1 franc; and, further, the quality of the cheap lamp of to-day is far superior to its more expensive predecessor. Several causes have brought about the perfection which has now been arrived at, to wit, competition with other illuminants and the general demand for electric incandescent lighting, but in the factory, the principal reason which has enabled the lamp to be made at so reduced a price lies in the perfection of detail in the various processes and the small amount of waste which now attends the manufacture. Formerly, to make 1,000 uniform lamps of a given voltage and candle power, it was necessary to start making 4,000 or 5,000 lamps, while to-day the waste is reduced to about 10 per cent. The price of the lamp is now so low that any further reduction that may in the future be effected will be quite insignificant to the consumer. What is of importance, however, to the consumer, is the return of light which he obtains from his lamp and the current it consumes. By tables such as have often been printed, it was demonstrated how the cost of the current formed a far more important item than that of the lamp. It was therefore economical to run the lamps brightly at the sacrifice of their lives. But unfortunately a third factor enters—the lowering of the candle power as a result of the blackening of the bulb and the disintegration of the filament. M. Larnaude has ascertained in an interesting manner that the depreciation in illuminating power is due in about equal proportion to those two causes. His method of investigation is to first measure a lamp on the photometer, and then, after it has become blackened by use and the diminution in illuminating power has been noted, to slowly let the air into the bulb by cracking off the pip. He then exposes the bulb to about a red heat (how, he does not say, but presumably by turning it about in a blowpipe flame), when the thin film of carbon burns away, the bulb becoming clear again. The lamp is finally re-exhausted and re-measured on the photometer. With old types of blackened lamps he has found the loss of light due to the carbon film to amount to 25 per cent to 30 per cent. In some instances the blackening may be due to special causes, but there can be no doubt that the usual phenomenon is the projection of particles from the filament. Owing to the perfection of the processes now employed, the blackening of lamps has been much decreased, and instead of forming rapidly in the early part of the run, the film now forms slowly and equally throughout the life of the lamp. As regards specific consumption of energy, the old types of lamps were started at 4 watts per C. P., and this rose after a run of 500 hours to 6 watts per C. P., and to 7 watts after 1,000 hours. Now it is common to find lamps which start at 2·5 to 3 watts per candle, and do not exceed 3·5 watts after a run of 400 to 500 hours. At about this point it attains its economical limit of age as defined by Mr. O'Keenan a few years ago. In connection with economy of using lamps, M. Larnaude says that if two lamps are giving the same candle power according to photometric measurement, but are running respectively at different watts per candle, the brighter one will be more agreeable to the eye, and at the same time will appear to give sensibly more light. Every one, however, will not, we think, agree with the former of these contentions.

The various parts of the lamp are next considered. The filament is naturally the most important of these. Two conditions are essential: one is that the substance must conduct electricity, the other that it must stand a high temperature without fusing or changing in an appreciable manner. The hope is expressed that through the researches of M. Moissan it may eventually be possible to use for the incandescent medium certain homogeneous compounds of carbon with other elements, such as silicide of carbon. But so far nothing has been employed on a commercial scale excepting carbon. Up to a few years ago the carbons usually employed were made from vegetable fibers, either natural as used by Edison, or parchmentized cotton, as devised by Swan. Owing, however, to the lack of thorough homogeneity and uniformity of size of the carbons, the lamps were not very satisfactory or uniform, and the breakage during manufacture was heavy. It was true that the flashing or heating process, i. e., heating a filament in a hydrocarbon gas or vapor, cured many evils of the foundation carbons; but at best it was only a palliative, and the evils were not cured as well as might appear at first sight. The root of the matter was to get a homogeneous foundation of hard and elastic carbon. This is usually done now by completely dissolving the vegetable or other compound containing carbon, and squirting the solution into a liquid which precipitates the material in the form of a homogeneous thread of uniform size. Or the material may be precipitated from solution in the form of sheets, and the sheets then shred into lengths of the requisite size. Another method, which it seems is being successfully employed, is, make a paste of finely divided carbon, with some decomposable binding material, and squirt the paste by means of pressure. The modern homogeneous carbon used for filaments has a much lower specific resistance and higher specific gravity than the carbon formerly employed. Owing to the hardness, the breakage in manufacture is slight, premature fracture of the filaments in the lamps is greatly diminished, and the lamps may be run at a higher temperature.

Various other technical points were next briefly touched upon, such as the calibration of filaments, the considerations attending the manufacture of lamps of small candle power at high voltage, multiple filament lamps, and, finally, the most recent development of incandescent lighting, viz., lamps of large candle power. Light for light, this latter type of lamp costs about double that of the arc lamp, but it possesses many advantages over its more economical rival. It requires no attention, and it can be placed in any position and used exactly where it is needed. It can be lit up and extinguished without trouble, gives a perfectly steady light, requires no enveloping shade, and produces a pleasanter light than the arc lamp.

With regard to the bulbs, which were formerly often blown in the blowpipe from tubing, the universal practice now is to blow them in a mould. The pumps used for exhausting the lamps are now very perfect, and consist of a combination of a preliminary exhaust by means of a mechanical pump, and then completed by means of the mercury pump, the whole being worked automatically by mechanical power. Finally, the leading-in wires which pass through the glass are always of platinum, though the length is now reduced to the smallest possible amount, the filament being supported by some other cheaper metal.

Black Hills Minerals.

REV. R. T. CROSS.

Last June I spent a two weeks' vacation collecting minerals in the Black Hills of South Dakota. I was impressed with two things, the lack of many minerals found in Colorado and the great abundance of a few species. I found many specimens, but not many different species. I will mention such as I found.

Quartz.—The granites among the archean rocks are exceedingly coarse. There is plenty of quartz, but quartz crystals are scarce. I saw a few small smoky ones found within the town limits of Custer. I saw quartz crystals in Wind Cave. In Spearfish Canon I found fine drusy quartz and a few quartz geodes. I also found coarsely crystallized quartz embedded in mica. Beautiful massive rose quartz is found in veins among the archean rocks. The finest is found near Custer. In many yards in Custer there are rockeries that are richly colored with specimens of it. Pieces of good rose quartz give life and color, like Brazilian agates, to a collection. To my eyes it has the same restful effect as fire opal. Near Custer I found some beautiful fragments of transparent opaline quartz, which I think would cut nicely.

Mica.—This mineral is very abundant in the Hills. Many mines have been opened and some of them extensively worked. At the Lost Bonanza mine, near Custer, there were many tons on the dump waiting the completion of the axle grease works at Custer. It was of too poor a quality for other uses. I found many specimens with embedded tourmaline. At a mica mine near Sylvan Lake I found a curious combination of black mica (biotite) and muscovite in the same plates. The line of separation between the two varieties is generally well defined, both on the surface of the mica plate and also between the layers. The biotite seems to be embedded in the muscovite. They make interesting specimens.

Tourmaline.—This mineral is very abundant among the archean rocks. In many places it is found in large masses. The crystals are much like those found in white quartz near Puma Pass in Colorado. The prism has twelve planes with a low, three-sided, beveled termination. I found very few doubly terminated crystals. Many of the prisms taper to a point, like many of the Colorado smoky quartz crystals. They are not, however, very regular or smooth. I saw one such tapering crystal a foot and a half long. It is the first time that I have ever found tourmaline tapering. In one specimen that I found the crystals are about the size of a pipe stem, and are so thickly arranged, parallel to each other, that in a space of eight inches square are seen the ends of some sixty crystals.

At the Lost Bonanza mine I found fine specimens of tourmaline embedded in mica, with occasional instances of mica embedded in the tourmaline. The crystals are flattened between the layers of mica, and some of them are so thin that they are transparent. They will serve me in the place of smoked glass for looking at the sun. The terminations of these crystals are generally misshapen and flat. In one place at least, the New York mine, dark green tourmaline is found in a greenish mica. The smaller crystals are transparent. I secured a few specimens only.

Garnets.—In the gulch mines around Custer are found vast numbers of very small garnets. They come from decomposed mica-schist, and are found in the tailings of the washings. They are heavy and settle to the bottom along with the gold and stream tin. The largest one that we found is about a half inch in diameter, but most of them are so small that they are seen to best advantage under a common pocket magnifying glass. Thus seen they are very beautiful, being blood red, and some of them having twenty-four sides. Many of them have been worn into perfect spheres. A vial full of this garnet sand makes a good specimen for one's collection. In the neighborhood where they are found everybody calls them rubies. Larger garnets, but not very perfect ones, are found in the rock not far from Custer. Very perfect small garnets were found in the bottom of a spring.

Calcite.—In the streets of Deadwood I found limestone containing small cavities lined with calcite crystals. In the rock thrown out from a railroad cut in Spearfish Canon I found fine clusters of calcite in the same place that I found drusy quartz. In a bed of shale in the same canon I found good geodes of calcite. The shell of the geodes is composed of iron and quartz. Some of them contain only quartz crystals, or quartz with calcite crystals deposited on their surface. In Wind Cave, near Hot Springs, I saw many beautiful calcite geodes, but could, of course, secure them only by purchase or exchange. These geodes and the beautiful box-work formation seem peculiar to that cave, in which I saw very few stalactites. Crystal Cave, which I was unable to visit, is about twenty miles from Deadwood. It has very extensive and beautiful deposits of dog tooth spar. Various forms of calcite crystallizations are found in the Bad Lands, near the Black Hills.

Gypsum is abundant in the "Red Valley," which extends round the Hills, but selenite or crystallized gypsum is not very common.

In the gold gravel in Warren's Gulch I found one good crystal of staurotide. Tin and gold are found all through that region, but neither of them in immense quantities. My boy, however, who was with me, picked up in the streets of Custer a piece of quartz that was rich in free gold.

Cost of War and Education.

There is no better proof, says the Journal of Education, of the essential barbarism of even the most civilized nations of the world than is afforded by a comparison of the money they expend for the maintenance of physical supremacy as against the expenditure for mental improvement. Though it be assumed that brain is better than brawn, there is no evidence that statesmen so regard it. In some tables recently compiled, the amount per capita expended by various governments for military and educational purposes is set down as follows:

	Military.	Education.
France	$4 00	$0 70
England	3 72	62
Holland	3 58	64
Saxony	2 38	38
Wurtemberg	2 38	38
Bavaria	2 38	40
Prussia	2 04	50
Russia	2 04	3
Denmark	1 76	94
Italy	1 52	36
Belgium	1 38	46
Austria	1 36	32
Switzerland	82	84
United States	30	1 35

Memory of Movement.

Dr. Schneider, of Jurieff (Dorpat), acting on the advice of Professor Ciz, has made a series of observations on the effect of the lapse of time upon the memory of movements. These are published as a graduation dissertation (in Russian). The method adopted was to fix the right arm of an intelligent person so that only the wrist could move, and to tie a pencil to the forefinger so that a curved line could be marked on a piece of paper ruled in millimeters. The person was blindfolded and requested to draw a line, and, after a definite interval of time, he was asked to draw another as nearly as possible of similar length; the length of this was compared with that of the first line and the error noted. Altogether 4,000 experiments were made with three individuals, the mean error after half a minute being one twenty-ninth; after two minutes, one twenty-eighth; after six minutes, one twenty-fourth; after ten minutes, one twenty-first; after fifteen minutes, one seventeenth of the length of the original stroke; thus showing that the memory of movements grows rapidly less and less accurate even during the first few succeeding minutes.