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(Illustrated articles are marked with an asterisk.)

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THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 105.

For the Week ending January 5, 1878.

Price 10 cents. To be had at this office and of all newsdealers.

CURIOUS HYDRAULIC EXPERIMENTS.

A disagreement recently occurred in Germany between the Government and a number of manufacturers relative to the classification of certain water courses used by the latter for power purposes. Among other questions was one which involved the determination of the source of the waters of the Aach, the settlement of which was important as affecting the interests of the manufacturers and also from a purely scientific point of view. A French hydrographic engineer was charged with the work, and in his report is detailed the curious way in which the problem was solved.

The Danube River, proceeding from the Black Forest, flows nearly directly from west to east, while the waters of the Rhine move in parallel direction, but inversely, from Lake Constance to Bâle. The altitude of the two streams differs, the relative difference being about 800 feet, and the Danube, in the region referred to, being some 2,000 feet above the sea level. The distance separating the rivers is about 18 miles. The river Aach is a tributary of Lake Constance, and rises near the village of the same name, at a point 9 miles from the Danube and at an elevation some 500 feet lower than the level of the latter. The spring from which the Aach flows is one of the largest in Europe, and its yield is about 1,350 gallons per second. The Danube flows over a calcareous bed, the inclination of which is exactly the same as that of the ground from the Danube to the source of the Aach. The calcareous soil ceases beyond the above named source, and the bed of the river enters the alluvial earth which surrounds Lake Constance. The limestone of the Danube Valley is composed of irregular layers diversely inclined, very friable, stratified, split and divided. The soil is so permeable that it absorbs the greater number of the springs and streams which rise between the Aach and the Danube.

For many years it has been noticed that the Danube loses a portion of its water in this region, and that during dry seasons even the greater part of its flow disappears in crevices or veritable holes in its bed. The owners of factories situated on the Danube, in order to retain their water supply, stopped up these leaks, but in so doing they were at once opposed by the manufacturers whose works were located on the Aach, the latter claiming that the water lost by the Danube fed the Aach, and to check the waste from one river to the other was to interfere with their just enjoyment of the smaller stream. The question, however, was to prove that the assertion of the Aach manufacturers was a true one, namely, does the water from the Danube, by some subterranean infiltration, supply the Aach, located as already stated 9 miles away?

The first plan suggested was to make the Danube water salt. This was proposed by Professor Knop of Karlsruhe, and accordingly 22,000 lbs. of salt were placed in a hole in the bed of the great river. Then water from the source of the Aach was obtained every hour for several days, and this on being analyzed revealed the presence of the salt.

In order to get still better proof, M. Ten Brink decided to take advantage of the wonderful coloring power of fluorescine. This substance is the phtaline of the resorcine obtained by treating at 374° Fah. a mixture of phtalic acid and resorcine. Its formula is $C^{20} H^{12} O^5$, according to the equation of its formation $C^8 H^4 O^6$ (phtalic acid)+2 ($C^6 H^6 O^2$) (resorcine)=$C^{20} H^{12} O^5$ (fluorescene). It is the first of a series of superb coloring matters, according as there is introduced into its constitution bromine, iodine, or chlorine, and its coloring power is so great that 1 part of fluorescine in 20,000,000 parts of water is quite sufficient to be recognized.

On the 9th of October last, at 5 o'clock in the afternoon, fifteen gallons of a solution of fluorescine were thrown into one of the orifices in the bed of the Danube. On October 12, the observers stationed at the source of the Aach observed the coloration of the water. It had, therefore, taken about 60 hours for the colored water to traverse the soil and reappear. It is stated that the Aach as it gushed from its springs presented a magnificent intense green, which in the sun exhibited more or less fluorescent reflections ranging from light green to brilliant yellow. The intensity of the dye augmented from morning until evening of October 12. Its effects were quite visible until about 3 P.M. on the 13th, when it gradually disappeared.

The experiment was certainly a most remarkable one. Its repetition in other localities may prove of great value in the study of subterranean water courses, while it offers a new method of geological investigation worthy of general attention

THE PARIS EXPOSITION.

The bill appropriating $150,000 for the purposes of our representation at the Paris Exposition, and providing for the appointment of twenty assistant commissioners at $1,200 each, in addition to the Commissioner General, has at length, after amendment by the Senate, passed the House of Representatives. Our participation in the show thus being secured, the work of official preparation and organization is now being rapidly pushed forward. Ex-Governor McCormick has been appointed Commissioner General. The assistant commissioners have not yet been named, but they will be designated by the President, under advice of the Secretary of State. Over 700 applications for these positions have already been received. The appointments are allotted among the different States, and also among the various business interests which it is desired to have officially represented, so that the selection of these gentlemen will be made from among the most prominent names in the country. A number of honorary commissioners are also to be appointed.

Offices of the American Commission will soon be opened in New York, Philadelphia, and Washington. Three United States vessels will transport the goods for exhibition, namely, the Supply, 750 tons freight capacity, to sail from New York February 1; the Constitution, 1,200 tons, to sail February 15; and the Wyoming, of 250 tons, to sail March 1. We are informed that some 800 cases of American goods are all ready for shipment. The French Minister at Washington has also given assurance that the time fixed by the regulations of the Exposition for the allotment of space will be extended in favor of American exhibitors. The arrangement of the American section will, it is stated, be confided to Mr. Henry Pettit, late superintending engineer of the Centennial Buildings, now in Europe. The headquarters of the Commissioner General in New York are in room 24, Post Office building. He proposes to sail for Europe about March 1. It is hardly necessary to add that those of our readers who intend taking advantage of the facilities offered for dispatching contributions should lose no time in completing their preparations, as a large number of intending exhibitors, who have been holding off to see whether Congress would make the appropriation or not, are now rapidly sending in their exhibits, so that it seems probable that the accommodations in the vessels mentioned will not suffice to meet all the demands.

RUBIES AND SAPPHIRES, ARTIFICIALLY PRODUCED.

MM. Fremy and Feil have recently exhibited to the French Academy of Sciences some magnificent specimens of crystallized silicates, and of corundum, which substances form the basis of the so-called oriental gems, notably rubies and sapphires. The process consists in heating to a red heat for a long period a mixture of aluminate of lead and of silex. Some sixty pounds of these ingredients were treated for twenty days in a glass furnace. The aluminum disengaged little by little, and thus colorless corundum was produced. To this was added 2 or 3 per cent. of bichromate of potash, the material then assuming the color of the ruby, while the addition of oxide of cobalt produced the sapphire. It is stated that in density, hardness, brilliancy, color, and even, as M. Janettaz has discovered, in crystallographic and optic properties, these artificial gems exactly coincide with the natural ones. The crystals exhibited are not microscopic, as were those which have resulted from similar efforts to produce jewels by chemical means—but on the contrary are large enough to be cut by lapidaries and to adapted for watch-making. The discoverers do not intend to patent their process, which was the result of a purely scientific investigation, but give it freely for any industrial uses to which it may be applied.

THE EDUCATION OF A CIVIL ENGINEER.

In an address on the education of a civil engineer Mr. C. Graham-Smith, of Edinburgh, gives much valuable advice, which by slight changes can be made of much use in this country. The term engineer has a very extended application; it includes, among others, men who drive locomotives, attend to the engines of steamboats, look after gas and water arrangements, design and put together mill gearing and machinery of every description, besides those who study it more particularly as a science. It is useless, therefore, to attempt to define an engineer.

Ambition and hope, combined with a strict sense of duty, are necessary antidotes to the self-denial and hardships required to be gone through in endeavoring to overcome all difficulties to be met with in the engineering world; for it must be borne in mind that the word impossible has long been banished from the engineer's vocabulary. Engineers may at any moment be called upon to carry out any of the following works: Railways, roads, canals, docks, piers, breakwaters, landing stages and other harbor works, water, sewage, and gas works. Numerous others of equal importance might be given. In the first instance the engineer will probably be required to report on the project, looking at it from an engineering, and perhaps financial, point of view, and generally to prepare preliminary plans and estimates. More accurate plans, levels and estimates must afterwards be made, to be in turn superseded by the working plans and sections. In performing the foregoing, it will be necessary to have:

First, A sound constitution, proper mastership of his own language; the power of dealing with all classes of men, both individually and collectively, and the tact of readily ascertaining the merits and abilities of those whom it is thought of employing in various capacities in the carrying out of an undertaking.

Second, Command of those theoretical and practical sciences which bear on or affect his profession.

Third, A good mechanical training.

Fourth, A general knowledge of engineering works and special information for the carrying out of each class.

Fifth, The tact of ascertaining and arranging facts, as well as surveying, mapping, and calculations of all kinds.

Parents should fully consider the following questions before allowing a boy to think of becoming a civil engineer.

Is he physically and intellectually capable of undertaking the studies?

Is he possessed of the necessary foresight, self-denial, self-reliance, and indomitable perseverance?

After going through the ordinary high school system of education, he must be sent forthwith to a good mechanical works, to go through a regular pupilage, for it is a delusion to suppose that the requisite mechanical knowledge can be gained in the course pursued at some colleges. The pupil may object to menial duties, but it is necessary to do such things when told by the foreman, if only to gain their confidence. Providing he does his work accurately and moderately quickly, he will soon be asked to undertake more difficult work. The discipline exercised in the works, the thorough, systematic, and accurate way in which things are done, the strict attention to all small matters of detail, and the habit of punctuality acquired, will do much to form the character and fit the pupil for further pursuing his studies, conducting himself, and controlling assistants in after life.

On the termination of this mechanical apprenticeship he may at once become a student with a civil engineer, or he should go to some good scientific college. Care must be taken not to overtax the mind, and to keep the body in good physical training. The student may now be considered to have completed his preliminary training, but his education as an engineer will only be terminated by death.

NEW YORK ACADEMY OF SCIENCES.

A meeting of the Chemical Section of the New York Academy of Sciences was held Monday, December 10, at the Stevens Institute of Technology, Professor Newberry presiding.

DISCOVERY OF NEW ELEMENTS.

An important letter from Professor G. A. Koenig of the University of Pennsylvania was read, in which he makes the following communication: "I am engaged and have been for a considerable time past in a study of titanium. The investigation is one absorbing much time and the progress is very slow. My results hitherto obtained convince me that all natural $Ti\ O_2$ is capable of being separated into compounds yielding different reactions, and hence that titanium must be considered as composed of two metals at least, but I think three. The trimorphism of $Ti\ O_2$ led me into this investigation and will find finally its explanation in the above sense. I am unwilling however to publish partial results."

Professor Henry Wurtz of Hoboken exhibited some curious specimens of flint, whose density he had carefully determined and which he had thus found to contain the "opal molecule" instead of that of ordinary silica. He also exhibited a number of shells.

The first paper read was entitled Contributions from the Laboratory of the University of Minnesota, by Professor S. F. Peckham.

ANALYSES OF THE ASHES OF WHEAT BRAN.

A substance having the appearance of a vesicular limestone and stated to be the ash of wheat bran that had been placed under a boiler was analyzed by Miss Cora I. Brown in the University laboratory. It was of a uniform gray color, appeared to be completely fused and had a density of 2·34 and a hardness of 3½–4. Its composition was found to be

Potassium Chloride.......	$K\ Cl$	1·2887	per cent
" Silicate	$K_4\ Si\ O_4$	2·5936	"
" Phosphate	$K_3\ PO_4$	5·8337	"
Sodium "	$Na_3\ PO_4$	11·7370	"
Hydrogen " ...	$H_3\ PO_4$	9·3721	"
Calcium "	$Ca_3\ P_2\ O_8$	18·2342	"
Magnesium "	$Mg_3\ P_2\ O_8$	41·4600	"
Ferric "	$Fe_2\ P_2\ O_8$	3·8058	"
Calcium Sulphate..........	$Ca\ SO_4$	1·9567	"
Water (hygroscopic)........	$H_2\ O$	·4379	"
Sand and insoluble residue.		3·1700	"
		99·8897	

The professor bestowed the highest praise upon the above determination by Miss Brown, as having been performed by the most accurate and skillful manipulator he ever had under his instruction.

ANALYSES OF GLAUCONITE.

An analysis was made of a species of glauconite imbedded in what is called the St. Laurence limestone, found at several points in the valley of the Minnesota river and quarried for a building stone. This is a hard silicious limestone containing sufficient iron to give it an ocherous shade of color with yellowish streaks. The glauconite is distributed through this rock in the form of small green grains which are obtained by dissolving the stone in hydrochloric acid and separating them from the undissolved quartz. Their composition was found to be: $Si\ O_2$, 48·20 per cent; $Fe\ O$, 27·09 per cent; $Al_2\ O_3$, 6·94 per cent; $K_2\ O$, 7·54 per cent; $Na_2\ O$, 1·02 per cent; $H_2\ O$, 8·72 per cent; total 99·51.

THE RUSSELL MINERAL SPRING.

The analysis of a clear and sparkling water of a slight greenish color and hydrosulphuric acid taste, taken from the cellar of a house in Minneapolis, proved it to contains $Ca\ CO_3$ $Mg\ CO_3$, NCl, $Ca\ SO_4$, $Si\ O_2$, $Mn\ CO_3$, $Fe\ CO_3$, $Ca Cl$, KCl, $Ca_3\ (PO_4)_2$, with traces of other substances, amounting in all to 19·065 grains in a gallon of 231 cubic inches. It has a temperature of 45·5° F., at which it contains 15·386261 cubic inches of free CO_2 in solution. The amount of $H_2\ S$ varies from a trace to a few cubic inches per gallon. The reputation which this water has attained as a remedial agent may be in part due to the presence of the relatively large amount of calcium phosphate, or it may be due to the peculiar combination presented by the simultaneous presence of phosphate of lime, protocarbonate of iron and sulphide of hydrogen. It may be said, however, that the causes producing certain physiological effects are very obscure; and when these effects are observed to follow the use of complex mixtures dissolved in large quantities of water, but little satisfaction can be gained from theoretical speculations of one or the other ingredient of the mixture. But little more can be said than that the water contains small quantities of substances, that give, when found in large proportions, the specific characters to seltzer, chalybeate and white sulphur springs, and that its use in many instances has been attended with beneficial results.

The reading of the above paper was followed by illustrations of

SOME RECENT DEVELOPMENTS OF THE SINGING TELEPHONE, by President Henry Morton. He described briefly a series of experiments made under his direction at the Stevens Institute by Messrs. Geyer, Beckmeyer and Ayres. Taking the mouthpiece of Reiss as a starting point, they tried a great variety of materials to receive the impulse of the voice, and finally concluded that the best results are produced with common note paper. To increase the volume of the sound received, sounding boards of musical instruments were tried and a guitar was found to be best adapted. The professor exhibited several telephones made on this principle. A strip of iron is cemented to the guitar and the poles of the magnet are placed opposite this strip and as near it as possible without actually touching. By the aid of a current from a very weak battery a tune sung in another room of the Institute was transmitted through half a mile of wire to the guitar receiver and became distinctly audible, filling the large hall without difficulty. The same effect is produced with an intermittent current from a coil and break circuit.

Professor Albert R. Leeds followed with a series of communications on the examination of drinking water.

RELATIONS BETWEEN FISH AND PLANT LIFE AND THE POTABILITY OF DRINKING WATER.

The subject of the wholesomeness of drinking waters was brought prominently before the public of this section by the excessive mortality of the fish in the Passaic river during last June. This appeared of such importance to the professor that he made two visits to Paterson to collect information. No naturalist appears to have examined into the nature of the disease. Its external indication was the formation of a soft spot on the side of the fish, and death speedily followed the rapid growth of this spot. That the refuse of factories was not the cause was plain from the fact that fish had died in great numbers above the Falls even in the tributaries of the Passaic, and also in isolated bodies of water like Rockland Lake. Mr. John Roe, one of the fish wardens, stated that the water was unusually low during the epidemic and the weather had been excessively hot. Where the disease was most prevalent, the depth of the water varied from 3 to 8 feet. It appeared also that at this time unusual amount of aquatic plants of a low order had invaded the stream. The following inferences may be drawn: 1. That the rapid development of vegetable growth may be attended with the production of spores or gemmicles forming a specific poison to fish life. 3. That the organic impurities arising from the action of the sun upon shallow water and the gases evolved may originate disease. 3. The supply of oxygen might fall below the point requisite to the support of life by being consumed in the oxidation of vegetable matter; by the partial exclusion of the air from the water by the crust of floating algæ; and by a diminution in the supply of highly aerated water from higher levels by reasons of the draught. A very heavy rain put an end to the epidemic. The third hypothesis seems the strongest. During the prevalence of the epidemic no complaint was made at Paterson, Newark, Jersey city, or Hoboken, in reference to the appearance, taste or smell of the water.

Disagreeable smells in water may be due to several lyngbyæ and oscillatoriæ which produce an indescribably suffocating odor; to some species of beggiatoa which emit a sulphurous exhalation; or to certain species of decaying nostocs, whose odor resembles that of the pig pen. These are oscillatoriæ which appear as bluish green masses on mud or shallow water. A thorough study of the fresh water algæ will be found of the utmost importance in the solution of the problem of water purification.

The "combustion process" is the best method of chemically determining the true nature of organic impurities in water, and an organic analysis of the residue the true ground of comparison between waters, whether impure from natural or artificial sources. The determination of the dissolved oxygen may also be of much sanitary importance.

The paper concluded with

NEW METHODS OF DETERMINING AMMONIA, CHLORINE, NITRIC AND NITROUS ACIDS IN DRINKING WATER.

Having shown that Bunsen's method of determining ammonia by the use of iron and platinum leads to erroneous results from the presence of nitrogen in iron which is not perfectly pure, Professor Leeds described the following ingenious method of detecting minute quantities of ammonia. The distillates from different samples of waters are placed in test tubes and diluted to the same volume. A small quantity of a standard solution of iodide of mercury in water containing iodide of potassium is then added, and the faint yellowish coloration so produced is compared with that obtained in a series of solutions containing known quantities of ammonia. Instead of using the latter, a much more rapid comparison is effected by means of a wedge-shaped prism filled with a liquid of the same tint. The test tubes are placed in a rack provided with mirrors, so that the light transmitted through the solutions may be compared with that transmitted through the prism. The latter is then moved to and fro until depth of the tints produced is the same. The amount of ammonia corresponding to the thickness of the prism is then read off on a carefully prepared scale. By means of this apparatus the writer just determined the presence of ·000035 of a gramme of ammonia.

SILVERING GLASS.

In reply to various correspondents who are desirous of ascertaining the best methods of coating glass with silver, we would say that we give in our SUPPLEMENT of this week (No. 105) a collection of the best methods, all of which we think will be found practical and useful. The method described by Chapman will be found especially convenient. By its use almost any experimenter, old or young, may make excellent mirrors, either of plane, concave, or convex glass, and produce a great variety of silver ornamentation for home objects, that will well repay the trouble, and in some cases result in substantial profit.

Professor Huxley on Technical Education.

Professor Huxley has recently delivered a lecture on technical Education before an English working men's association, in the course of which he gives his views as to what working men should know. He defines technical education as the teaching of handicrafts, and the requirements thereof he sums up to be reading, writing, and ciphering, a taste for one's calling, an acquaintance with the elements of physical science, a knowledge of a foreign language, and the scrupulous avoidance of the practice known as "cramming."

As to the means for carrying out this ideal education, Professor Huxley strongly advocates the more extended teaching of natural science in the public schools, and he thinks that the mode of instruction should be especially practical and experimental. He also recommends some special means for utilizing in the public interest unusual talent or genius found in schools.

It was Edward Everett, we believe, who regarded anyone who could read, write, and cipher as well educated, and if to that a knowledge of a foreign language was added, the education, he considered fine. Professor Huxley goes a step beyond this, it would seem; and besides his recommendations while excellent, appear rather too general to be susceptible of ready practical application.

The New Museum of Natural History in New York City.

The new American Museum of Natural History, the corner stone of which was laid by Ex-President Grant in 1874, was formally opened recently by President Hayes. The ceremonies consisted in addresses by the President of the Board of Trustees, the President of the Association for the Advancement of Science, and others.

It is not generally known that the fine structure now open, and which is located at 77th street and Eighth avenue in this city is but a small portion—one eighteenth—of the colossal edifice ultimately to be erected. Four entire city blocks have been purchased and set apart for the building, which will be 850 feet wide and 650 feet long, surmounted by a dome 120 feet in diameter. The structure now finished contains the various collections of objects of natural history hitherto kept in the Arsenal in Central Park, besides a large number of new and rare specimens lately added. It is of brick trimmed with granite, and is 70 feet wide and 200 feet long. There are four exhibition stories, and the entire structure is built of iron, concrete and other fireproof material.

A Remarkable Little Steamer.

The small steam yacht Estelle was lately tried at Bristol, R. I., under the direction of Mr. C. E. Emery, C.E. The test lasted eight hours through the waters of the bay as far at times as Beaver Tail, where they met quite a heavy sea.

The thermometer stood at 35° Fah. when the torch was applied to the furnace fires. In four minutes afterward the engines worked water out of her cylinders, with a steam pressure of 25 lbs. to the square inch. One minute later the large cylinder moved. At the expiration of ten minutes from the time the fires were lighted, the Estelle had been backed out of the wharf, turned, and was on her course. During the trip of eight hours she made 103 statute miles, including five sharp turns. Her average pressure of steam was 65 lbs. only, at a temperature of 345°. Her average revolutions of propeller per minute were 130. The expenditure of fuel was considerably under two tons.

On the return trip, after the course to be run was finished, the blower was put on the fire, running steam up to over a hundred pounds, and the little craft showed her heels on a spurt at the rate of sixteen miles an hour.

AMERICAN LOCOMOTIVES FOR RUSSIA.—We understand that the Baldwin Locomotive Works, Philadelphia, Pa., are now proceeding with the construction of fifty large-sized, first-class locomotives, lately ordered for Russia. They are to be completed during March next. In all, nearly 2,000 men will be required on the job, for which about $500,000 are to be paid.

NEW STEAM FOG WHISTLE.—A new fog whistle was lately tried at Bristol, R. I., and in just four minutes after the fire was lighted, it gave a blast which was heard ten miles distant.

SUCCESS OF THE PHONOGRAPH.—Mr. Thomas A. Edison, the inventor of the talking phonograph which we recently described, informs us that he has constructed a new and larger machine which not merely speaks with all the clearness which we predicted would be obtained, but loud enough to be audible at a distance of 175 feet.