SCIENTIFIC AND PRACTICAL INFORMATION.

TEMPERANCE PROBLEMS.

The French Temperance Society offers prizes for the solution of the following questions: First. To determine by the aid of chemical analysis, repeated on a large number of specimens taken at random, the analogues and differences which exist between spirit of wine and the alcohols of all other derivations supplied to commerce. Prize, two hundred dollars. Second. Is it possible to distinguish positively, by the examination of chemical or physical properties, the wines and natural brandies (that is, those coming from fermentation of grape juice or the distillation of fermented product) from the wines and brandies fabricated or mixed with alcohols of other derivation? Prize, one hundred dollars. Third. To determine, by the aid of clinical observation or experiment, the differences which, in respect to their effects upon the system in similar alcoholic proportion, exist between the natural wines and brandies and the liquors made from alcohol of industrial production. Prize, two hundred dollars.

Papers may be in either French or Latin, and must be submitted before December 1, 1874, to the Secretary of the Society, at Paris.

THE MAXIMUM DENSITY OF WATER.

Recent experiments of Professor Mack at the University of Prague have fixed + 3·945° C (= + 38·901° Fah.) as the temperature at which water arrives at its maximum density. In conducting these researches, Rumford's method of substituting a thermo-electric series for the mercury thermometer was followed, by which means much fuller and more accurate results were obtained.

FATHER SECCHI ON RUTHERFORD'S RULED PLATES.

Father Secchi communicates to *Les Mondes* the result of his observations of the solar protuberances during the latter part of the past year. He says that the coexistence of spots with eruptions on the edges of the sun has been verified 89 times. The reversed lines which have been observed during the eruptions are B, C, D, D', *b* of magnesium, and a large number of the iron bands, besides the ordinary lines of hydrogen and the line D. A spiral movement (quite rare) in the spots has been noted several times in the protuberances, and a rotation around a horizontal axis has also been frequently remarked.

Father Secchi has recently experimented upon the plates of glass ruled by Mr. Rutherford of this city. He states that, ruled with 60,000 lines to the inch, the effect of the plate in the spectroscope was astonishing. The protuberances were obtained even with spectra of the first order, and were observed much more clearly with spectra of the second order. It was found necessary to add a red glass in order to absorb the violet rays. The details of the protuberances were very clear, and the filaments delicately defined. In spectra of the third and fourth orders, the line, C, of one fell very near F of the other, and thus protuberances of two different colors, red and white, in the field of the telescope were obtained.

With these plates, it is added, the first spectrum has a dispersion equal to that of two prisms of ordinary flint glass; the second to that of four prisms, and so on; but the advantage soon disappears, owing to the mixing together of the spectral colors and the enfeeblement of the light.

HYDROGENATED PALLADIUM.

MM. Troost and Hautefeuille have determined that palladium forms with hydrogen a definite combination, of which the formula is Pa_2H. This, once formed, acts upon hydrogen gas in the same manner as platinum, and in quantity variable with its physical condition. Potassium and sodium also form with hydrogen combinations, K_2H, Na_2H (N = 23, K = 39); and the latter with hydrogenated platinum produces a series parallel to that of which Wurtz finds the first term in what he calls hydride of copper, or Cu_2H_2.

NEW MODE OF DETERMINING TANNIN IN ASTRINGENT MATERIALS.

This process, communicated to *Les Mondes* by M. Terreil, is founded on the absorption of oxygen by tannin in the presence of alkaline liquors in a special apparatus. The latter consists of a glass tube, 0·6 inches in diameter and 7·8 cubic inches in capacity, suitably graduated. The upper portion is closed, and below is a glass cock; between which and the zero of graduation is a space of 1·2 cubic inches, in which the alkaline liquor is introduced. The solution contains one third, by weight, of caustic potash, and it is known that 1·5 grains of tannin absorb 1·2 cubic inches of oxygen.

The astringent material is ground as finely as possible, and from 1·5 to 3 grains are enveloped in unsized paper. The alkaline solution is introduced at the tube by plunging the latter into the liquid and opening the cock below. The material is then dropped in and the apparatus carefully shaken, care being taken to note the temperature and pressure of the atmosphere, and also not to warm the air within the tube by the hands. The liquid becomes immediately of a yellowish brown, and the agitation is frequently renewed. The extremity of the tube is plunged in water, and the cock opened. An absorption follows, but the cock is immediately closed, as soon as the colored liquid appears to descend through the lower opening. After twenty-four hours, during which the above operation is frequently repeated, the entire apparatus is plunged in water to bring it to the surrounding temperature, and the cock is opened under the surface to detect the final absorption. When this is complete, the cock is closed, and from the graduation of the tube may be read the quantity of oxygen absorbed; and knowing that 1·5 grains of tannin absorb 1·2 cubic inches of oxygen, it is then easy to determine the richness, in tannin, of the material analyzed.

PHOSPHORUS STEEL.

M. Euverte, director of the Terre Noire foundery in France, communicates to the *Société des Ingénieurs Civils* some important results of his researches, carried on over the past two years, with a view to determine to what point it is possible to introduce phosphorus in steels. Phosphorous materials having been placed in sufficiently large proportion in a Siemens-Martin furnace, and the operation having been terminated with ferro-manganese with 42 per cent of manganese, or with spiegeleisen, it was found that the metal obtained was of good quality and malleable. It was established that the cast steels can contain a certain proportion of phosphorus without losing their malleability or their valuable qualities of resistance. A steel containing 0·003 of phosphorus and 0·0015 of carbon may be utilized for making an excellent rail.

The Sewers of Paris.

In Paris, says *Chambers' Journal*, it is quite a common thing to make a trip underground, at any rate from the Place du Chatelet to the Place de la Madeleine. The old guide books are full of the wonders of the catacombs; now-a-days, instead of going into these great gypsum quarries, visitors are allowed to traverse the *égout Rivoli*, and there are always plenty of claimants for the tickets of admission. You sit in a sort of open railway truck, with a lamp at each corner, pushed rapidly on by four men in white blouses; there is no more smell than there is in the streets above—not so much, except just when we are passing (our guide tells us) under the barracks of the Louvre. Under the Place de la Concorde the land journey comes to an end; at this point the Rivoli sewer falls into the main; and so, instead of our cars, we have to take to boats; but the voyage is a short one, and we soon get to the winding iron staircase, by which we emerge among the astonished idlers of the Place de la Madeleine.

This, of course, is the show sewer—widest, loftiest, cleanest of all—just like a canal, with broad, neat footpaths. Between this and the house drain, there are ten kinds of sewers, getting gradually smaller and smaller, but all, except two, having footpath enough for the scavengers to walk along. Beside noting the telegraph lines, wrapped in their gutta percha covering, we see a long pipe, too narrow for water, too wide for gas, inside which every now and then we hear a whiz like the rush of an arrow. This is the pneumatic tube, along which cases full of little parcels are driven by atmospheric pressure. The only other things to be seen (for the journey is rather a dull one) are the shafts, called *régards*, by which the workmen can escape if the sewer gets flooded by heavy rains. As a means of escape, every *régard* has its iron ladder leading to the man hole in the street.

What struck me most was the vaulting of the main sewer. It shone as if covered with chunam, and was so smooth that it carried the voice to a vast distance. There is a whole system of telegraphing which depends on the echo along this vaulting.

How is the main sewer cleaned? There are big barges nearly as wide as the water, each furnished in front with an iron plate fitting almost exactly into the subterranean canal. These plates have each three holes, as big as an octavo volume, cut in their lower edge. The barges are dragged up stream, and the solid matter is all forced through the three holes, leaving the channel completely free. Each of these barges is calculated to do the work of a hundred men. Where the sewer is too narrow for barges, rails are laid along the footpaths, and trucks furnished with some sort of plates do the work just as well. So swift is the stream that one never sees a bit of anything floating along; whatever there is, is swept under the surface. But lower a sluice gate, and stop the current, and within a short time the water will be covered with straw, with dead cats and dogs, with feathers enough to stuff a score of beds, etc. Corks, too, of which there are great numbers, are caught by a grating before they can escape into the Seine, and, after being pared down, are sold to the perfumers. "Wine merchants and scent merchants are both good trades in Paris," said our guide, as he explained to us the future use of the corks. If you can get leave to climb up the ladder of one of the *régards*, you will be able to look into one of the narrower sewers without footpath, which pours its unsavory cataract into the main drain.

Sewers of this type have to be kept clean "by hand." Somehow, nearly all the 630 men employed in the Paris sewers are Gascons "from the sunny South." It is a hard life, and men can rarely stand it more than fifteen years. They get pains in their joints, general weakness—what they call *plomb* (as if their limbs were of lead). "Sewer rats" the poor fellows are called; and their only comfort is that they have waterproof boots, a new pair every six months. The old boots are not thrown away; they are stowed on one of the quays; and when a good many hundred pair are collected, there is a grand auction, and they are sold in lots of a hundred for from 120 to 125 francs. It is almost always the same man who buys them, and he cuts off the feet and sends them to the bogs up the Oise, where they are used by the peat cutters; the legs are subjected to a process which turns them into fine, soft leather. Many a fashionable lady's boots are made of the leather which has been first used by a Gascon scavenger. Of real sewer rats there are comparatively few. They can't work through the hard cement (chunam) with which the new sewers are cased. They keep to the old stone-roofed drains; and of course they still abound in the markets and at the abattoirs and knackers' yards. There are many stories of their fierceness, but of these I need not at present say anything.

During the winter of 1870 the Parisians were dreadfully frightened lest the Prussians should get into the drains, and suddenly show themselves in the middle of the city, as Camillus did in Veli. So they actually walled up the main sewer in two or three places, leaving just space enough for one man to squeeze through. These walls were pulled down as soon as the armistice was signed, and were not rebuilt during the commune, though the Versailles troops, holding Asnières, might have marched in a dozen abreast if they had cared to do so. After the fall of the commune the cry was "search the sewers;" and stories got into the papers of bands of desperadoes holding out below, and selling their lives even more dearly than their friends had done above ground. What was there not in Paris papers at that time? Who is to know the truth? The officials say that not a single human being was found down there. Rifles were found in plenty, not only those dropped down street traps by runaway communists, but those hidden by quiet citizens, lest the possession of them should bring about a domiciliary visit from the commune. But more numerous still were the *képis*, red sashes, and scarfs, cartridge boxes, etc., of which there was quite a heap under each man hole in the quarter of the barricades. As the fellows ran off they got rid of all their badges, hoping thus to escape the savage fury of the Versailles troops.

Blue Sky and White Clouds.

The ethereal blue color of the sky is due to minute particles of matter which float in the air. Were these particles removed, the appearance of the sky would be dead black. It is a fact in optics that exceedingly fine portions of matter disperse or scatter the blue rays of light, coarser portions scatter red rays, still coarser portions scatter all the rays, making white light. An atmosphere is full of aqueous vapor, the particles of which diffuse white light in all directions. When these particles are enlarged, they become visible in the form of clouds. The vapor particles of the white clouds are supposed to be finer and lighter than those of the dark clouds.

That the diffusion of light in our atmosphere, the blue coloring of the sky and the colors of the clouds, are due to the presence of matter floating in the air, has been conclusively proven by Tyndall. On passing a beam of sunlight through a glass tube, the beam is rendered brilliantly visible by the reflection of light from the dust particles floating in the air contained in the tube. But on removing the dust particles, which is done by filtering the air by cotton wool, or causing the air to pass over a flame, the beam of light is no longer visible in the tube.

Liquid Carbonic Acid.

Cailletel has, by use of an apparatus very similar in principle and construction to that devised by Professor Andrews, of Belfast, succeeded in liquefying carbonic acid, under conditions which enable him to test many of its properties, while still in the liquid state. His apparatus consists of a hydrostatic press, by which mercury can be forced, under a pressure of 900 atmospheres, if necessary, into a cylindrical glass reservoir, terminating in a narrower thick tube. Liquid carbonic acid he finds to be colorless, mobile, and a non-conductor of electricity. It is not decomposed by a powerful induction spark, but the spark has, in the liquid, a very white dazzling appearance. Salt, sulphate of soda, chloride of calcium, sulphur, phosphorus, stearin, and paraffin are quite insoluble in liquid carbonic acid. Iodine is slightly soluble. Liquid carbonic acid is but slightly soluble in water; petroleum, however, dissolves five or six times its bulk. Bisulphide of carbon dissolves sparingly. Ether mixes with it, in all proportions, with great readiness. Liquid fats dissolve in it, but not solid fats. Sodium does not reduce it.

The Fireless Locomotive.

This consists of a locomotive intended for drawing street cars, for tunnel service, etc. The boiler is charged with highly heated water before leaving the station; and from this water steam rises, sufficient to work the engine without using fuel during the trip.

A new fireless locomotive, built at the Grant Locomotive Works, was recently tried at Paterson, N. J. It has four wheels, 36 inches in diameter, and 7x10 inch cylinders. The boiler is 37 inches in diameter and 9 feet 6 inches long, and the whole engine empty weighs 6 tuns. On the trial, with the water heated to a temperature equivalent to a pressure of 150 pounds per square inch, the engine ran, with an ordinary loaded horse car, a distance of 7 miles. The track on which the trial was made is an ordinary horse car track, laid on a common road, with very heavy grades for short distances in some portions. The steam pressure after running the distance named was reduced to 40 pounds.

BACTERIA IN DISEASE.—Dr. Hiller, of Winden, has come to the conclusion, after many experiments, that bacteria are incapable of exciting inflammatory action of fever, that they cannot multiply unless in the presence of putrid material, or after death, through the stoppage of the circulation; but when present after death, this is no proof of their existence before that time, but for reasons as given.

HOW a railroad opens up a new country is demonstrated very remarkably by a comparison of the United States census of 1870 with the territorial census of 1873. This shows that between those years all the counties on the line of the Denver and Rio Grande have either trebled or quadrupled in assessed wealth and population.