SCIENCE NOTES.

When a man had more teeth than his jaw could conveniently hold, it used to be the theory of dentists to explain that he had inherited the large teeth of one parent and the small jaw of the other. Recently some good observers, notably Dr. Sim Wallace and Dr. Harry Campbell, of England, stated that the trouble is not hereditary; that it had its beginning in each person's babyhood, and that our teeth are poor and irregular and our jaws contracted because we do not exercise these parts sufficiently during the weaning process. In support of this statement, they point out the fact that the first set of teeth is practically never irregular, never overlaps, and is very seldom defective.

Some years ago several applications of the Thorp plane replica diffraction gratings were exhibited, notably their use with an opera glass for eclipse work. The only disadvantage of these is the necessity of employing glass lenses for collimator and telescope, which not only increase the expense, but render the instrument somewhat limited, in that the ultra-violet region of the spectrum is more or less absorbed. Recent experiments by Mr. C. P. Butler have shown that concave replica gratings can be made to give very satisfactory results; and by slight modifications of the design of mounting, this form of spectroscope may be employed for any investigation for which the ordinary spectroscope is fitted. A valuable feature appears to be that the radius of curvature may be varied within very wide limits, thus providing instruments of different dispersion and light-grasping power.

The old method of determining the temperature of a coal pile by driving pipes and hanging thermometers in them has been greatly improved by means of a special coal auger, similar in form to that used in the mines, but provided with a means of inserting a small maximum thermometer near the point. Extensions four feet in length (for convenience in carrying) may be attached to the auger, so that the thermometer can be readily inserted into any depth in a pile. The point of the auger can be driven 20 feet in three to five minutes. About ten minutes is required for the thermometer to attain the temperature of the surrounding coal. Temperatures taken in this manner are much more accurate than those obtained by hanging a thermometer down a pipe, where there is more or less circulation of air, making it impossible to locate the hottest spot. Temperatures obtained by means of the auger have been found to be 40 deg. Fahr. higher than by the pipe method.

In factories and other places where it is necessary to keep large quantities of quicklime, its preservation becomes an important problem, owing to the rapid deterioration of the substance in contact with the air. Lime becomes air-slaked even when fairly well sheltered. Furthermore, rooms in which quicklime is stored are very unhealthy, as the operations of storing and handling produce large quantities of lime dust, which is extremely injurious to the workmen. An attempt has been made to remedy these evils by the employment of silos similar to those used for wheat. These silos are placed in double rows in the storeroom and are hermetically closed. The lime is brought into the storeroom in covered wagons loaded with buckets, which are raised by a mechanical device, brought over the silo, and emptied by opening the bottom. Thus no dust is produced, and the lime is not exposed to air during transport. Each of these buckets contains 7 or 8 tons. The silo is emptied from below. One German installation includes a storeroom about 80 feet wide and 140 feet long, containing thirty silos with a total capacity of 1,800 tons. The buckets hold 8 tons, and the trucks which transport them have a capacity of 30 tons.

It has been said that a horse is about eight times as powerful as a man, and again it has been estimated that an athlete in a short sprint or in a football game develops for a short period energy at the rate of the so-called horse-power. When thus exerting himself to the utmost a man breathes rapidly and deeply, requiring large volumes of oxygen. On the other hand, while resting quietly or while asleep, the respiration is such that comparatively little oxygen is needed. Midway between these extremes is the moderately active person, moving about in the performance of ordinary duties. The above conditions have their effects on ventilation, for the extent to which the air is vitiated is directly proportional to the carbonic acid gas exhaled, which in turn is proportional to the air breathed. To determine the vitiation of air due to the presence of a man in a room with a gas jet burning, experiments were recently made by the Arthur D. Little, Inc., Laboratory of Engineering Chemistry, Boston, Mass., the results being shown in a curve interpreted to mean that the percentage of carbonic-acid gas exhaled varied with the activity of the man, the gas jet requiring a constant quantity of oxygen. During the first three hours the man moved about moderately, rested, and finally fell asleep. For the two hours (approximately) he was asleep, the vitiation was greatly reduced, but increased again when he awakened and moved about. The observations made during the tests proved also that an active man uses up the oxygen in air at about the same rate as does a gas jet burning five cubic feet of gas per hour, the capacity of the ordinary burner.

ENGINEERING NOTES.

The explosive range of marsh gas varies from 6 to 14½ per cent; the explosive range of carbon monoxide is much wider than this. The maximum explosive mixture of the above gas is one volume of CH to 9.5 volumes of air, and one volume CO to 2.4 volumes of air. Carbon monoxide gas is always found after the firing of shots. This gas has much greater power to elongate a flame than fire damp has, on account of its wider explosive range. Most of our miners can verify the statement, that they have on several occasions returned to the working face after firing a shot, applied their lighted lamps to the smoke, as it was issuing out from the coal, or between the coal and roof, from a shot that had failed to throw the coal, the result being a flame or small explosion.

In a paper recently read before the Iron and Steel Institute, Prof. H. C. H. Carpenter drew attention to the discrepancies in the readings by the three scales (the gas, the thermo-electric, and the optical scales) in use in the determination of high temperatures. The first is available to about 1,200 deg. C., and the thermo-electric agrees with this between 400 deg. and 1,200 deg. C. The optical scale, however, gives temperatures higher than those given in terms of the scale of the thermo-electric calculated by the formula which gives accord with the gas scale. The freezing point of iron calculated from several closely agreeing determinations by the thermo-electric method is 1,505 deg. C. on the thermo-electric scale, corresponding to 1,519 deg. C. on the optical scale; it is, moreover, independent of the atmosphere in contact with the iron, whether this be air, O, N, CO, CO_2, H, or mixtures of these.

A comprehensive table referring to large gas engines developing over 1,000 horse-power appeared in a recent issue of the Zeitschrift des Vereines deutscher Ingenieure. According to this table 628 gas engines of 1,000 horse-power and larger and representing a total amount of power equal to 1,035,700 horse-power have been built or are under construction at the present time. Of this total, 412 engines of 613,200 horse-power, or considerably more than one-half of the total, have been built in Germany; 154 engines with 337,500 horse-power in the United States; 33, with 42,200 horse-power in Belgium; 9, with 16,800 horse-power in France; 10, with 13,600 horse-power in Austria; and 11, with 12,400 horse-power in Great Britain. It is rather difficult to explain why the building of large gas engines has made so little progress in so highly developed a country as Great Britain, unless we ascribe this to the traditional conservatism of the Briton. The average size of the engines built in Germany was 1,500 horse-power; in the United States, 2,200; in Belgium, 1,300; in France, 1,900; in Austria, 1,400; and in Great Britain, 1,100 horse-power.

A new process for the commercial utilization of the solid residuum of sewage, the invention of Dr. Grossman, is being carried out in the north of England. The system is both hygienic and effectual, while the resultant product is distinctly valuable from the commercial point of view. The disposal of this solid matter is under existing conditions a somewhat difficult matter, the general practice in vogue being to consume it in dust destructors. In the Grossman process, however, the sludge is distilled, and therefrom are obtained large quantities of grease and dry odorless fertilizer in sufficient quantities and of a value to more than defray the cost of production. The process is simple. The sewage after being freed of its coarsest suspended matter is passed along to the settling tanks, where the solids in course of a few weeks sink to the bottom, forming a thick sediment. The superfluous liquid is then drawn off. As the solid matter is, however, still associated with about 90 per cent of water, it is subjected to pressure, which results in about 30 or 40 per cent of the loose water being eliminated. After pressure the sludge is thrown into a retort in conjunction with certain chemicals, where it is distilled at a certain temperature with superheated steam. The escaping steam carries off all the grease, which is afterward recovered in cooling towers, the grease being blown out into cool water, upon the surface of which it floats in thin white flakes, a fine dry black odorless powder, rich in nitrogen, remaining in the retort. The quantity of grease recovered from the residuum is about 5 per cent, and finds a ready market at about $35 per ton. The presence of such a high proportion of grease is due to the extensive amount of soap that is consumed, the greater part of which finds its way into the sewers. The yield of dry fertilizer from a ton of pressed sludge is from 7 to 8 hundredweight, and this finds an easy sale among the artificial manure manufacturers at an average price of $1.50 per ton. Where it combines with phosphates on the spot, after its withdrawal from the retorts, it could easily command a price of $6 per ton sold direct to the farmers. With a flow of 3,000,000 gallons of raw sewage per day, about 20 tons of pressed sewage is available. The inclusive cost of the process carried on continuously is about $1.25 per ton of pressed residuum; and as the net sale of the products realizes $1.83, a profit of 58 cents per ton of pressed sludge is thus available.

TRADE NOTES AND FORMULÆ.

Indelible Ink.—Two parts each of yellow prussiate of potash, ammonia, and tartaric acid are dissolved in 240 parts of water, the solution filtered and then 160 parts of ferro-citrate of ammonia, 40 parts of ammonia, 8 parts of aniline blue, 70 parts of gum, and finally, 20 parts of pyrogallic acid added.

Grease-proof Paper and Cardboard.—According to the Randolph patent, 11 parts of water glass, ¼ part mica, ⅝ part glycerine are thoroughly mixed in a suitable vessel, add ¼ part of brown sugar dissolved in hot water, ¼ part of rice flour washed in water, ¼ part of gum arabic dissolved in hot water to make a thin fluid, and ⅓ part prepared chalk. The mixture is applied by means of a soft brush to the paper or card and allowed to dry; the paper is then ready for use.

Cellulith.—According to an English patent, cellulose is ground finely in water, until no more fibers are visible. A portion of the water is then removed by filtration, pressing, or in any other manner, and the material transferred to molds. It is then dried in the air, or at a temperature of about 105 deg. F., at which it contracts, becomes hard and dense. Other substances may be added to the pulp, such as coloring matters, heavy-spar, lamp-black or salts, which can afterward be washed out, rubber or dissolved shellac, in order to produce a water-proof product. Cellulith is said to be adapted for use as a substitute for horn, wood or vegetable ivory.

Varnish for Wood That Will Withstand Boiling Water.—Boil in a strong copper kettle 750 parts of linseed oil and hang in a bag, that must not touch the bottom, containing 150 parts of litharge and 92 parts of pulverized red lead. The boiling of the oil is continued until it has assumed a dark brown color. The bag is then withdrawn and replaced with another, in which a clove of garlic is contained; this to be repeated several times with fresh cloves of garlic. Then place 500 parts of amber in a finely pulverized condition and 60 parts of linseed oil over the fire, allow it to melt and introduce it, while still boiling, into the boiled linseed oil, allowing the whole, stirring vigorously, to boil 2 to 3 minutes, then take it off, pour off what is clear, and after cooling pour it into closely-corked vessels for keeping.

Enamel Paper.—For this purpose, says a German writer, the glacé paper employed by lithographers is used. It has a shining white coating, the pigment of which consists of sulphate of baryta. This coating is very sensitive to fluids, softening at once in contact with them, which fault, where the paper is to be used for photographic purposes, into which fluids largely enter, must be removed. The paper is for this purpose floated on a mixture of 1 part of albumen and 1 part of water and then dried. Then we take a shallow iron vessel, fill it about 2 centimeters (¾ of an inch) deep with water and stretch over it first coarse linen and then flannel. On this the paper sheets are laid, one on the other, the whole is covered with flannel, and the water allowed to boil. After a few minutes the albumen is coagulated, the sheets of paper are taken off and redried. The coating is now completely impervious to water, acids, alkalies, alcohol, and ether. Finally, the paper, like albumen paper, is treated with salt and albumen and is then ready for use.

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