THE REDUCTION OF CHLORIDE ORES.

For the benefit of those not familiar with the processes of reducing gold and silver ores, a brief explanation of what is meant by "free milling," an expression so often used by mining men, may not be out of place. In separating, by amalgamation, the precious metals from gangue or waste rock with which they are almost always associated, it is necessary to the success of the process to present the particles of gold or silver contained in the ore to the mercury with which they are to be alloyed, in such form that the latter can seize upon them readily. If these metals always occurred in nature in their pure metallic state, this would be a very easy matter. In free milling gold ores it is frequently only necessary to place the quicksilver beneath the stamps of the battery in which the ore is crushed, and upon an inclined copper plate over which the pulp is carried by water after it leaves the battery. The stamps, by reducing the rock to fine particles, release the minute scales and crystals of gold, which are readily taken up by the quicksilver, while the rock, for which the mercury has no affinity, is carried away as "tailings."

But silver rarely occurs in a native or pure metallic state. It is usually mixed with clorine, lead, iron, sulphur, manganese, copper, antimony and other base metals, and is found in the form of chloride of silver, argentiferous galena, in which the silver is in the form of a sulphide, and in many other compounds, for most of which quicksilver has no more affinity than it has for the common rock of the gangue. In most cases, therefore, if the silver ore was simply crushed and brought into contact with an amalgamating surface, little or none of the metal would be caught by the quicksilver and saved. Mercury has a strong affinity for metallic silver. stronger even than that of chloride, so that ff chloride of silver and quicksilver are brought together the mercury will seize the silver, forming an amalgam, and the chlorine which is released will escape as gas or unite with some other substance which presents itself and for which it has an affinity; but sulphur will not give up silver, with which it is chemically mixed, to mercury, unless the sulphur has first been driven off by fire. This process of converting chloride of silver into an amalgam is not an instantaneous one like the amalgamation of free gold, but requires several hours to be perfected, and it is hastened by the presence of other chemicals, such as sulphate of copper, sulphuric acid, and cyanide of potassium, the action of which it is unnecessary to explain here.

In order to reduce silver ores by amalgamation, it is necessary, as will be understood from the above explanation, to have the particles of metal either in a pure or chloritic state. When they are found in nature in either of these conditions they need no special treatment before being put into the mill, and the treatment of them is called "raw amalgamation." The process employed is to crush the ore to a fine pulp, and then transfer it to a large round iron tub, where it is agitated for several hours in hot water with quicksilver, some or all the chemicals I have named being added with common salt to promote the union of the mercury and the silver. If the silver in the ore is in the form of a sulphide, as it frequently is, and the amalgamation process of reduction is to be employed, the ores have to be roasted with common salt for several hours after they are crushed. Without explaining in full the chemical reactions, I may simply say that the heat volatilizes the sulphur mixed with the silver, and separates the salt into its constituents of chlorine and sodium, the first of which unites with the silver from which the sulphur has been driven off, and forms a chloride which is then ready for the amalgamating pan. The desulphurization and chlorination of an ore is an expensive process, and greatly increases the cost of reduction.

When such metals as lead, zinc, or copper are present in ores in large quantities, it is usually cheaper to reduce them by smelting, and by that process the lead and copper are generally saved and add to the value of the product. Almost any ore can be reduced by fire, if it is mixed in small proportions with other smelting ores. In large smelting establishments like those at Denver, Omaha, and Newark, N. J., where great varieties of ores are purchased, even free milling rock can be used to advantage; but the reduction of most free milling ores by fire, without mixture with others, would be ruinously expensive if not physically mpracticable.

ON CURRENTS PRODUCED BY FRICTION BETWEEN CONDUCTING SUBSTANCES AND ON A NEW FORM OF TELEPHONE RECEIVER.*

In a communication to the Royal Society of Edinburgh of date January 6, 1879, I showed that "electric currents were produced by the mere friction between conducting substances." The existence of these currents can be easily demonstrated either by a telephone or a Thomson's galvanometer. I have since found that these currents are, for all pairs of metals which I have yet tried, in the same direction as the thermo-electric current got by heating the junction of the same two metals. They are also approximately at least, stronger in proportion as the metals rubbed are far apart on the thermo-electric scale—the strongest current, as far as I have yet observed, being got by rubbing antimony and bismuth together. These observations clearly point to a thermo-electric origin for the currents; but it is possible that they may be due partly to the currents suggested by Sir William Thomson as the cause of friction, and partly, also, to contact force between films of air or oxide adhering to the surfaces of the metals.

Having ascertained that these friction-currents are of some strength and fairly constant, I proceeded to make several kinds of machines for producing currents on this principle. One of them consists of a cylinder of antimony, which can be rotated rapidly, while a plate of bismuth is pressed hard against it by a stiff spring. When this machine is included in the same circuit with a microphone and a Bell telephone, the current got from it is quite sufficient to serve for the transmission of musical sounds and also loud speaking. The transmitter, which I have found most serviceable in my experiments, is made by screwing two small cubes of gas-carbon to a violin, and placing between them a long stick of carbon pointed at both ends, the points being made to rest in conical holes in the carbon cubes. The looseness of the contact is regulated by a paper spring. This forms an excellent and handy transmitter for all kinds of musical sounds, and also serves very well for transmitting speech.

Seeing that friction between metals clearly produces a current, it seemed natural to inquire if the converse held good, that is, if a current from a battery sent across the junction of two metals affected the friction of the one upon the other. I have tested for this in a variety of ways, and the results obtained leave me in doubt whether to attribute them to variations in the friction, or to actual sticking porduced by fusion of the points of contact through which the current passes. The most noticable effect is produced when one of the rubbing bodies is a mere point, and the other a smooth surface of metal. This led me to make a modification of the loud speaking telephone of Mr. Edison, in order to get audible indications of changes of friction produced by the passing of a variable current. It consists of a cylinder of bismuth accurately turned and revolving on centres. The rubber-point is made of a sewing-needle with its point bent at right angles, and its other end attached to the centre of the mica disk of a phonograph mouthpiece. It is evident that this is only a loose contact, which can be perpetually changed. When this apparatus is included in the circuit with the violin-microphone and three or four Bunsen cells, the violin sounds, as was to be expected, are heard proceeding from the loose contact, even when the cylinder is not rotated. They are increased, however, in a remarkable degree by rotating the cylinder slowly, so much so that a tune played on the violin can, with proper care, be distinctly heard all over an ordinary room.

With regard to the explanation of this effect, it is evident that electrolysis can in no sense come into play, as is supposed to be the case in Edison's instrument. I am inclined to look for the explanation rather in the direction of the Trevelyan rocker, although the circumstances are considerably different in the two cases. In the rocker we have the heat passing from a mass of hot metal through two points of support to a cold block, whereas, in the other case, the heat is only intense at the points of contact, the rest of the metals being comparatively unaffected. The variations n the current produced by the transmitting microphone must

* Abstract of a paper read before the Royal Society of Edinburgh by James Blyth, M. A., F.R.S.E., on May 3, 1880.

cause corresponding variations in the heat at the point of contact of the needle with the cylinder, and this again produces a mechanical movement of the pressing point, as well as of the air surrounding it, sufficient to give forth sound-waves. If such be the case the effect should be different for different metals, those answering best which have the lowest thermal conductivity and also the lowest specific heat. That this is really so, is showing by substituting cylinders of other metals for the bismuth, all other things remaining the same. In this way I have compared lead, tin, iron, copper, carbon, and find that they all give forth the simple loose contact sound when the cylinder is stationary, but that it is only with bismuth that there is any very great intensification of the sound when the cylinder is rotated. Now, by consulting the appropriate tables I find that bismuth is a fraction lower than any other common metal in specific, while heat is much below them all, in thermal conductivity. This seems to bear out my explanation to a certain extent.

THE subject of a depraved taste in animals is an interesting one, which has not been studied as much perhaps as it might. In human beings it would seem to depend on ill-health of either body or mind, but in animals it would seem as if it might be present and the animal enjoy good health. One remarkable instance in an herbivorous animal we can vouch for. It occurred in a sheep that had been shipped on board one of the P. and O. steamers to help to supply the kitchen on board, but while fattening it developed an inordinate taste for tobacco, which it would eat in any quantity that was given to it. It did not much care for cigars, and altogether objected to burnt ends ; but it would greedily devour the half-chewed quid of a sailor or a handful of roll tobacco. While chewing there was apparently no undue flow of saliva, and its taste was so peculiar that most of the passengers on board amused themselves by feeding it, to see for themselves if it were really so. As a consequence, though in fair condition, the cook was afraid to kill the sheep, believing that the mutton would have the flavor of tobacco. Another very remarkable case has just been communicated to us by Mr. Francis Goodlake: this time a flesh-eating animal in the shape of a kitten, about five months old, who shows a passionate fondness for salads. It eats no end of sliced cucumber dressed with vinegar, even when hot with cayenne pepper. After a little fencing it has eaten a piece of boiled beef with mustard. Its mother was at least once seen to eat a slice of cucumber which had salt, pepper and vinegar on it. The kitten is apparently in good health, and its extraordinary taste is not easily accounted for. Even supposing it once got a feed of salmon mayonaise, why should it now select to prefer the dressing to the fish ?—*Nature.*

NATURAL ENEMIES OF THE TELEGRAPH.—There is, apparently, no apparatus so liable to be interfered with by what we may call natural causes as the electric telegraph. Fish gnaw and mollusks overweight the submarine conductors of the subterranean wires ; while there is at least one instance of a frolicsome whale entangling himself in a deep sea cable, to its utter disorganization. It is stated that within the three years ending 1878, there have been sixty serious interruptions to telegraphic communication in Summatra, by elephants. In one instance, these sagacious animals, most likely fearing snares, destroyed a considerable portion of the line, hiding away the wires and insulators in a canebreak. Monkeys of all tribes and sizes, too, in that favored island, use the poles and wires as gymnasia, occasionally breaking them and carrying off the insulators ; while the numerous tigers, bears and buffaloes on the track render the watching and repair of the line a duty of great danger. In Australia, where there are no wild animals to injure the wires, which are carried great distances overland, they are said to be frequently cut down by the scarcely less wild aborigines, who manufacture from them rings, armlets and other varieties of barbaric ornament It has been suggested as a means of protection in this case that the posts should be constucted of iron, when the battery could be used to astonish any native climbing them with felonious intent.—*Scientific American.*

PHYSICAL NOTES.

IN an article of great length, extending through the last three numbers of the *Annalen der Physik und Chemie*, which exhibits extraordinary scope of research and ingenuity, the learned Professor Quincke exhausts the subject of electrical expansion. The following results are drawn from his investigation :

1. Solid and liquid bodies alter their volume when they are acted upon, the same as Leyden jars, by electrical forces.

2. This change of volume is not the effect of heat, but is mostly an expansion ; though it may also be a contraction, as in the case of the fatty oils.

3. No change of volume was observable in gases under the action of electrical forces. If such occurred it was smaller than $\frac{1}{30000000000}$ of the original volume.

4. There was an instantaneous change of volume in flint glass, but it took longer in German glass, which is a better conductor of electricity. By discharge of the coatings of spherical and tubular condensers, the glass resumes its original volume.

5. There is a simultaneous change of length and volume in tubular condensers.

6. The change of volume and length increases as the difference of potential in the coatings, and inversely as the thickness of the insulating substance of the condenser ; and they are nearly proportional to the square of strength of potential and thickness.

7. Under otherwise equal conditions the expansion in volume and length differ according to the insulating substance of the condenser.

8. After the discharge of the coatings of the condensers, there is a residue, so to speak, of this change of volume, which is very small in the case of flint glass, but greater in German glass, and which seems to have some connection with the electrical polarization of the mass of the glass itself.

9. The change of mass and volume does not result from an electrical compression of the insulating substance.

10. In flint glass electrical expansion takes place equally in all directions, as in the expansions produced by increase of temperature, independent of the character and direction of the electrical forces.

11. Electrical change of length and volume takes place in glass nearly in the same way with increase of temperature, as the dialectric constants, or the electrical conductivity of the glass.

12. Action of electrical forces diminish the elasticity of flint glass, German glass, and caoutchouc, but increase that of mica and gutta percha.

13. The electrical piercing of glass and other substances is a result of the unequal electrical expansion of the insulator in different places.

14. By unequal electrical expansion solid and liquid substances are unequally dilated and become double refracting, as other similar substances do when heated.

15. Glass, when equally expanded, shows no electrical double refraction under electrical forces.

16. The relation of substances with positive and negative double refraction (to which Dr. Kerr first called attention), is explained by the way in which different substances change their exponents of refraction with their density and volume.

17. With a constant difference of potential in the coating of a condenser, after long charging, the electrical force varies in different layers of the insulative substance at the same time, or in the same place at different times.

M. BERTHELOT has recently made an apparatus for measuring the heat of combustion of gases by detonation, which consists essentially of a bomb suspended in a calorimeter.

MR. W. E. HIDDEN, the mineral collector, has discovered in Burke County, N. C., a new locality of Furgusonite. The mineral was chemically determined by Dr. J. Lawrence Smith.