Huan and Chesterfield, of inconsiderable extent, and valuable only for their guano deposits, the "Loyalties," consisting of "Lifu," "Uvea," and "Mari," and the islands of "Belep," and isle of Pins, the latter at the south, the former at northern extremity of the main land; there are numerous other islands, particularly at the northern end, but of course as they lie close to Caledonia they require no special note.

From the small extent of available land the island is not likely to become noted either in a pastoral or agricultural sense. Already the quantity of cattle exceeds the demand, while the sister industry has hitherto failed in every important respect, it being impossible to grow sugar or maize, for which crops the soil and climate seem particularly adapted, on account of the locusts. Coffee grows well in certain places, and its quality, to judge from the exhibition prizes, seems far above the average, but then it is one of those crops that produces fortunes on paper and ruin in practice. Tobacco, I fancy, will be in the future principally cultivated but at present little attention is paid to it.

But if, from the above causes, Caledonia presents little temptation to the ordinary emigrant, to the mining capitalist she offers a splendid field for enterprise. The island has been described as one vast bed of minerals, and allowing a little for exaggeration the description is not inexact. Those dreary red mountains before alluded to, and from which doubtless the island took its name, contain for the most part the real riches of the colony, in the shape of nickel ore, several mines of which are being worked at this moment.

It is now seven or eight years since nickel mining first attracted the attention of local capitalists, but the difficulty of smelting, want of market, etc., caused the whole industry to be suspended for some years. Thanks, however, to the determined spirit and enterprise of the leading mine owner, a company was formed in France who reopened the works about four years ago, and have, in spite of the most extraordinary management, been prospering exceedingly ever since. This company own the only smelting works at present in the colony; they send 50 tons of 70 per cent. metal every month to France, where it undergoes the final refinement. Their mines at "Trio" produce about 600 tons per month. I do not know the average percentage of the ore, but from my own experience in other mines fancy it would be about 7 per cent.

Hitherto no nickel mine has proved permanent, all the ore being found close to the surface; still their number is so great and the quantity of ore that many produce so important, that doubtless nickel mining will become the "specialty" of New Caledonia.

The "Bel Air" nickel mine at "Houailon" gave 7,000 or 8,000 tons of good ore before being declared worked out, and the "Boa kaue" at Canala I suppose about the same.

The cost of extracting ore from the "Tchio" mines, I have been told on good authority, and landing same at smelting works, is just £200 per ton.

There is also a company known as the Scotch company, but if they are doing anything, as yet I have not heard of it.

Messrs. Balland et Cie. possess or work an important mine at "Koua," although the mine has not been working many months. I heard the manager had guaranteed a thousand tons by Christmas.

Copper mining, too, will doubtless become an important industry. Hitherto only one firm have seriously interested themselves in this particular branch of mining, and their operations have been confined to the working of the "Balade" mine, situated on the banks of the largest river of the colony, at the north end; but lately they have become sole possessors of several other rich mines in its immediate vicinity, by the simple but effective process of starving out the other shareholders and then purchasing their scrip at a nominal figure. In one of them, the "Diahot," an extraordinary rich lode was almost immediately discovered on the resumption of work. The Balade mine had, up to date, produced about 40,000 to 50,000 tons of 15% to 18% ore.

There is also a copper mine being worked, or rather prospected, called the "Boinumala," at Koumac, but the results, as yet, have not been satisfactory. The same owners possess another mine, or rather "show," which, to judge from the surface indications—if the account I heard of it was true—will turn out to be very rich; in fact, the northern part of the island seems to be as rich in copper as the south is in nickel. There are several chrome cobalt and antimony mines being worked. I know that considerable quantities of the two first mentioned ores have been shipped, but have no reliable figures to give you.

There are two gold mines declared, one of which, the Fern Hill, has lately resumed work. It was a tolerably good mine on first starting, but having given £28,000 worth of gold, was closed until lately to give time to experiment with the pyrites in which the gold is now found.

The geological formation of Caledonia is not in favor, theoretically, of its ever becoming a great gold producing country. The island seems to have remained untouched by those causes which in other lands have produced so abundantly the Silurian and other metamorphic gold bearing strata, while the formations belonging to the Tertiary system, so rich in Australia in alluvial gold found in the beds of drift, ancient river courses, made hills, etc., are altogether absent; neither have I observed the usual evidences of the glacial epoch shown by boulder drift, furrowed or glacier grooved boulders, and Pleistocene accumulation generally.

Volcanic action, as far as can be gathered from surface indication, seems to have been confined to the original upheaval of the island, since when the usual recent igneous rocks met with elsewhere, as erupting, interstratifying, or overlying the original strata, are completely wanting.

While the primary rocks, represented by serpentine, occupy fully one-third of the island, producing nickel, chrome cobalt, antimony, etc., the middle part is formed as a rule by the oldest metamorphic rocks, such as gneiss, mica schist, with their varieties, although in places, particularly on the west coast, slates of seemingly later origin may be seen flanking the older strata.

Generally speaking, it may be said that Caledonia is of very ancient formation; even the sandstones are decidedly metamorphic.

The Carboniferous system is represented by strata (sandstone) showing coal in the neighborhood of "Noumea" and "Uraïl," but clearly confined to a narrow coast strip at places, as at "Mont d'Or," it can be traced from the sea until, at a short distance, merely superimposed on the Plutonic rock.

The government is essentially autocratic, considering its nature and the great power placed in the hands of a few individuals. The fact that we are governed so well as we are, speaks much in favor of the French national character.

Governors are appointed for a term of years; hitherto, with

one or two exceptions—notably Governor Guillan—they have ranged from bad to indifferent.

The present gentleman, Monsieur Pallu de la Barriere, a naval officer of distinguished merit, has so far realized the hopes raised by his appointment, where his predecessors were content to serve the time necessary to attain their promotions in their respective services, in the manner most suitable to their own ease and interests. The present Governor has brought to bear on the Augean work he has undertaken a grand fund of energy and earnestness of purpose, while his honesty and good intentions are above suspicion.

Although the French have been in possession of the island since 1843, the native tracks still remain, with the exception of a few score miles of road leading from the capital, the only means of communication by land; but this state of things will in two months more be considerably modified, as by that time a bridge track will be completed round the island, and his Excellency has declared his intention of making the tour on horseback.

Doubtless a marine road will shortly also be made to enable coasters to sail between the reef and mainland on the west coast. A little dynamite and intelligence would, I think, soon work wonders in this respect. The blasting of a few rocks in some places would open up miles of clear channel.

RARE FISHES.

A LARGE number of rare and curious specimens of deep sea fishes have just been received by Prof. Gill, of the Smithsonian Institution. They were caught by the crew of the Fish Commission steamer Albatross, the latter having just returned from an exploring expedition in mid-ocean. The Albatross was absent two months, during which time fish were captured representing thirty new species, twenty new genera and three families. The British exploring steamer Challenger during a three years' cruise only secured specimens representing fourteen new genera. The wonderful success of the Albatross is therefore emphasized by scientific men in this city. The fish are caught by means of a dredge or net, which is sunk very often to a depth of 3,000 fathoms.

Among the strange denizens of the deep caught during the cruise are following: The *Auchenichthys*, or fish with a neck. This specimen resembles an eel, has a well formed neck, and was caught at a great depth. The *Gastrosomus Bairdi* (named after Prof. Baird). This odd looking fish was described in the *Popular Science Monthly* as "the wonder of the deep sea." It is a variety of the devil fish. The jaw bones are seven times as long as the cranium, and are attached to wings resembling fine black silk, which come together, forming a broad pouch. The fish swims about with its pouch open, acting in the capacity of a seine. Small fish are caught in the latter, and transferred to the mouth by means of suction. The "Baird fish" resembles a leather wing bat in some particulars, and has a long and scaly tail. The *Cryptosaras*, or "angler with concealed rod," is a most remarkable specimen. It has a very large mouth, and extending from a concealed rod on the back is a baited line, which floats above the body. Small fish nibble at the line, and are captured by the "angler." The bait is a ball of jelly-like matter, which is so sensitive that instant notice is given when a fish touches it. Another member of the "angler" family is perfectly blind. It is known as the *Typlopiasaras*, or "blind angler." This remarkable fish was never heard of until the recent cruise of the Albatross, and it is said to inhabit the sea 2,000 fathoms below the surface. The *Hypercharistus Tannert*, or fish with upper pectoral rays or finger separate, is a queer shaped and vicious little fish. It inhabits deep water and is named after Capt. Tanner, of the Albatross, whose hand the little creature tried to bite when landed on the deck of the steamer with the deep sea seine. It is jet black, and has teeth like a circular saw. The *Neurichthys*, or snipe eel, is a genuine curiosity. Its body resembles that of an ordinary eel, while the head is a facsimile of that of the common marsh snipe which abounds in Maryland and Virginia. The tape fish is another interesting fish. It is of the size and thickness of ordinary tape, and when in the water is perfectly transparent and can only be seen by its little red eyes.

There are several other remarkable specimens. They are kept in jars of alcohol in Prof. Gill's office, and will appear in the illustrated annual reports as fish discovered thousands of fathoms below the surface of the Atlantic by the United States Fish Commission. They will also probably be placed upon exhibition in the National Museum or Smithsonian.—*National Republican*.

TROUT AND TROUT CULTURE.*

By R. A. Koss.

THE brook trout belongs to a family of fish the members of which are distinguished for their delicate flavor, and among which the salmon, the king among all food-fish, occupies the most prominent place. The trout is one of our most valuable fresh water fish, and recommends itself to the pisciculturist by many excellent qualities. The clearer, colder, and more rapid in their flow the waters are in which the trout lives the darker is its peculiar, many colored skin. It seems as if nature took special care not to make its appearance too striking, so as to attract the attention of its enemies, of whom man, after all, is not the worst. The trout, which in brooks reaches a weight of about three pounds, seldom more, is a very hardy fish, and not very choice in its food. It is not timid, and can even be easily tamed, in which case, on account of its voracity, it can be accustomed to take its food from a man's hand. It is particularly well adapted to pisciculture, because its eggs are very hardy and can easily be transported a considerable distance. Its power of digestion is very extraordinary, and when well fed it grows quicker than most other fish. Its food is exclusively animal, consisting principally of insects, larvæ, snails, and other small animals. All these water animals need aquatic plants for their existence, and these plants are, therefore, necessary indirectly to the trout. It occasionally eats fish but never shows as much liking for them as for the other articles of food mentioned above. When a number of trout living together have sufficient food, there will be among them but very few which eat fish, perhaps only one in a hundred, provided that the difference of size is not too great. The trout which eat fish grow quicker than their comrades; in retired places they lead the life of hermits, and their flesh is less delicate than that of other trout. If one succeeds in catching these destructive individuals no more fish will be eaten, for in the shallow brooks there will rarely be any other fish of prey. Trout do not like the company of other fish; it is well, there-

*Forellen und Forellenzucht." Translated from the German by Hermann Jacobson.

fore, to keep them separate from other fish as much as possible.

For spawning places the trout prefers shallow spots with a gravelly bottom, over which the water flows slowly and with broken force; the fecundity of the trout in a certain body of water depends altogether upon the extent of suitable spawning places. Whenever a brook has large stretches of gravelly bottom over which the water flows gently, it may be assumed with a great deal of probability that it contains trout. For supplying trout with food it is well if there are occasionally places where the bottom is muddy or peaty; a slow current is also much to be preferred to a rapid current flowing over a rocky bottom, because the former favors the development of water plants and small aquatic animals. Trout are very numerous in clear mountain streams, flowing rapidly over their rocky beds, because they like the character of the water; but they remain small, and do not get very fat; while slowly flowing rivers, having muddy bottoms, but fed by many gravelly brooks, where the fish can retire for spawning, produce the largest, fleshiest, and best flavored trout, which fetch the highest price in the market. It is a very general, but nevertheless erroneous, notion that trout only live in water which is clear and transparent as crystal; on the contrary, they seem not in the least disturbed by the water being muddy, and, as we have seen, a muddy bottom even favors their growth. In Norway, which is famous for its delicate trout, they flourish most in rivers and brooks with muddy bottoms, provided suitable spawning brooks are within easy reach. If there are in a body of water many stagnant places where aquatic plants grow in profusion, and hollow banks with entangled roots of trees and similar hiding places, the trout will flourish, even if the water does not flow very freely. Thus the river Leith, in Scotland, for example, is so shallow in many places during the summer that one can almost walk from bank to bank without wetting his feet; but it possesses a series of stagnant puddles extending for miles, which harbor an abundance of very large and delicately flavored trout.

It is likewise an erroneous idea that trout require very cold mountain water; they are, on the contrary, very well able to stand warm water, such as is found in the plains during the hot season. It has been observed in Germany that trout streams reached a temperature of 21, and even 26, degrees Reaumur, without in the least injuring the fish. A warm temperature of the water is even beneficial to trout, as it increases their food very considerably, which is an important item, considering their voracity. It is well, however, for trout streams flowing through a plain to have here and there along their banks bushes and shade trees, for during the heat of the day trout love to stay in such shady places, as under the overhanging branches and among the roots they find an ample supply of food, principally insects, which generally live on the leaves and are thrown into the water by the wind.

Trout culture is made comparatively easy by the circumstance that no other fish stays as steadily in one place without ever going far from it as the trout. Any person who lives near a stream, and is in the least observant, will be able to indicate the exact place of sojourn of this or that particularly striking individual trout. Apart from the spawning season the trout live permanently in a body of water extending frequently not more than 50 to 100 feet, which enables the proprietors of small bodies of water to use them advantageously for trout culture. When trout are well taken care of, they prefer to stay within narrowly confined limits; they learn to know man, approach him without fear, and even jump out of the water to get some food which is held out to them, in which case, however, one has to be careful not to get hurt by their sharp teeth.

If trout are well fed they begin to spawn when two years old, and it has even happened that trout only one year old have been known to discharge mature spawn. Two year old trout lay from two hundred to five hundred eggs, three year old ones about a thousand, and those from four to five years old even as many as two thousand. To stock a moderately sized stream with trout requires at least ten thousand young fish per annum. If this has been continued for three years one may, with tolerable certainty, count on good trout fishing. As a general rule trout flourish better in brooks, where they take care of themselves, than in ponds, where they have to be fed artificially. They need human protection only until they are able to seek their own food. Where there is no running water they can be kept in that which is still, provided that the latter is constantly kept pure by inflowing springs.

If there are no suitable natural spawning places, a spawning and hatching establishment may take their place; and it is well known that during the last decades a great deal has been done in the way of artificial trout culture. It requires a good deal of technical knowledge to start and superintend such establishments, but the expenses are very trifling compared with the great profit. Natural trout culture is much less profitable, because it has been calculated that, left to themselves, one thousand eggs will produce, on an average, only one fish, while in a well conducted piscicultural establishment eight to nine hundred fish may be raised from the same number of eggs. The very waters in which trout flourish most have frequently no suitable spawning places, and if the supply is limited to the result of natural propagation the trout must soon die out, or, at any rate, become very scarce. Young fry from a piscicultural establishment are best placed at first in small streams or brooks with a gravelly bottom and retained there for some time by means of a wire grating.

As trout find much more food in the brooks and streams above-referred to (sluggish, well-shaded waters) than in gravelly mountain streams, and consequently grow faster and acquire a more delicate flavor, a wide and exceedingly profitable field is here opened to the pisciculturist. The prejudice that trout are difficult to raise and that they are very choice in the selection of water cannot be sufficiently combated. As soon as they are able to forage for themselves they will be satisfied with almost any kind of water, provided it contains sufficient food. A brook containing pike and perch, but no spawning places for trout, will have to be stocked with ten times as many young fry, if any good fishing is looked for, as are required for an open mountain stream which is free from those two fish; but by means of artificial pisciculture the necessary quantity of young fry can easily be procured.

Mr. Peard, an Englishman, has made very practical suggestions for improving small trout-brooks. As we have seen, trout flourish best in streams which have not only a gentle current of water flowing over even places, but also a considerable number of large, deep, and calm pools. These are the favorite hiding places and winter quarters of the fish, as the aquatic plants grow in profusion in quiet water, supplying ample nourishment for insect life, and quantities of food are usually brought together in such places by the cur-

rents. Whenever there are no such pools they can easily be made artificially, for which purpose cross dikes are constructed in the bed of the stream, at a distance of one hundred to one hundred and fifty feet, and strengthened by sod, sand, and stones. Below these dikes holes are dug, three to five feet deep and six to seven feet long, in each of which are placed some large and several small stones, or flagstones. The fish are thus provided with suitable hiding places, and fish thieves are foiled in their endeavors to catch trout with nets. As these dikes produce small waterfalls, the pools are increased by every high water, if proper care is only taken that the floods do not carry the dikes away. They should extend several feet on the bank, so as to prevent the water from flowing past them; and then the soil carried along by the stream will continually make the dikes stronger and stronger.

In our age, when it is often so exceedingly difficult for a man to make a living, it is absolutely necessary for the farmer and landed proprietor to husband his resources, and to derive the greatest possible benefit from his property. A stream or a pond, unless used for purposes of irrigation, was formerly considered almost like dead capital, and attempts were even made to lay it dry, with the view of using the land thus gained to greater advantage. In our days no landed proprietor should be found guilty of such folly. By utilizing such waters for pisciculture, the first expenses of which are, as a general rule, very slight, a tenfold greater profit can be realized than by laying them dry and using them for agricultural purposes. In nearly every part of our country there are thousands of such ponds and streams which at present are entirely useless, but which if stocked with fine food fish would become a rich source of income to their owners. Of all the various branches of pisciculture, trout culture is certainly the easiest and most profitable, and all persons who are in any way in a condition to carry on this business should give all possible attention to it.—*Bulletin U. S. Fish Commission.*

EXPERIMENTS ON THE COLORS OF GEMS.

LT.-COL. W. A. ROSS, 1871, tried to obtain a blue color by dissolving pure alumina in a pearl of borax. After a half-day's work he obtained a very pale blue pearl, hard enough to scratch glass. T is experiment led him to think that the blue color of sapphire is due to its 98 per cent. of alumina, and not to the traces of any metallic oxide. In the following year experiments with lime which had been freshly calcined and with hydrate lime, showed a remarkable influence of the water upon the coloring, both of the flame and of the pearl. In 1873 he found that by dissolving pure alumina, under the blow-pipe, in a pearl of boric acid which had been opalized by means of platinum, and adding a small proportion of hydrate of potassium, he obtained a bluish pearl, much more rapidly and easily than by his first experiment. Some years later he bought, in London, a little American wavelite. On treating the powder of this mineral under the blow-pipe, in an opalized or hydrated pearl of borax, with a little hydrate of potash, he was astonished to see that his pearl became purple, then blue, and finally of a brilliant green. Subsequent experiments satisfied him that although phosphoric acid had not been discovered in sapphire or in lapis lazuli, it may have contributed to their coloring; for lazulite, which is similarly blue, is essentially a phosphate of aluminum, and pure phosphoric acid is well known to be one of the most deliquescent substances in nature. The color which can be produced by the aid of these three colorless substances, hydrated phosphate of aluminum, hydrated boric acid, and hydrate of potassium, are purple, or amethyst, green, blue. Heintz has proved that the color of amethyst is not due to manganese or to titanate acid. Some chemists erroneously attribute the green color of the emerald to a trace of chromic acid; but chrome dissolved in the blow-pipe pearls invariably gives a pinkish hue.—*Ann. de Chem. et de Phys.*

ON THE CONDENSATION OF GASES.

A PAPER detailing results has appeared in the *Anzeiger der Wiener Akademie der Wissenschaften* and the *Compt. Rendus*, xvi., 1140. It treats of the facts arrived at by S. Von Wroblewski and K. Olszewski.

They say that the results which Cailletet and R. Pictet obtained in their valuable work "On the Liquefaction of the Gases," lead us to hope that the time is not far distant when we shall be able to as easily examine liquid oxygen in a glass tube as it is at present to look at a tube filled with carbonic acid in the liquid state. The one condition which must of necessity be arrived at is a sufficiently low temperature. In a paper published by Cailletet a year ago he directs attention to fluid ethylene as a means of reaching an exceedingly low temperature. This gas, in a fluid state, boils under the atmospheric pressure at -105° , as measured by a thermometer of carbon disulphide. Cailletet himself compressed oxygen in a very narrow tube, and cooled it down to -105° in this fluid. In the moment of expansion he saw a tumultuous ebullition; it boiled during an appreciable time, and resembled the projection of a liquid in the cooled part of the tube. This ebullition was formed at a certain distance from the bottom of the tube. "I was not able to recognize," he goes on, "whether the liquid pre-existed or whether it formed at the moment, because I was not able to see the separation of the liquid and the gas." S. Von Wroblewski has recently constructed a new apparatus for higher pressures, in which considerably large quantities of gas can be subjected to a pressure of 200 atmospheres, and with this apparatus it is proposed to study the temperatures at the moment of expansion. The experiments soon led them to the discovery of a temperature at which carbon disulphide and alcohol became solid, and oxygen is rendered completely liquid with the greatest ease. This temperature is reached by letting liquid ethylene boil in a vacuum. The boiling point depends, of course, in such a case, on the goodness of the vacuum of the pump. By the vacuum which, up to the present, it has been found possible for us to attain, the temperature falls to -136° . This low point—in fact, all the temperatures which we place on record—are measured with the hydrogen thermometer. The critical temperature of oxygen is lower than that at which the liquefied ethylene boils under the pressure of one atmosphere. The latter is not -105° , as at first it was assumed to be, but lies between -102° and -103° , as is shown by our thermometric observation. From a number of determinations which we have made we quote the following, which will serve to show where the point lies:

Temperature.	Pressures in atmospheres under which the oxygen begins to liquefy.
-131.6°	26.5
-133.4°	24.8
-135.8°	22.5

Liquid oxygen is colorless and as transparent as fluid car-

bonic acid; it is very mobile and exhibits a very beautiful meniscus. Carbon disulphide freezes at about -116° , and again becomes liquid at about -110° . Absolute alcohol at about -129° is thick and viscous like oil, and at about -130.5° solidifies to a firm mass. The more accurate numbers will be given in another paper. In the same way as referred to above, the author endeavored to liquefy nitrogen and carbonic oxide. The liquefaction of these two gases is brought about with more considerable difficulty than in the case of oxygen, and under such similar conditions that at the moment it is difficult to say which of the two gases is the easier. At a temperature of about -136° , and under the pressure of about 150 atmospheres, neither nitrogen nor carbonic oxide appears to liquefy. The glass tube with the gases appears to be quite transparent, and no traces of liquid can be observed. If the gas is suddenly freed from the pressure, there is remarked in the tube containing the nitrogen a powerful boiling up of the liquid, which is best compared with the boiling of liquefied carbonic acid in a Natterer's tube when it is placed in hot water. In the case of carbonic oxide the boiling does not take place in so strong a degree. If, however, the expansion be not allowed to take place so suddenly, and it be allowed to sink to 50 atmospheres, both the liquefied gases, nitrogen and carbonic oxide, evaporate completely, the liquids show a perfect meniscus, and rapidly evaporate. The two gases can only be retained for a few seconds in the form of liquid in the static condition. To retain them longer in that state a somewhat lower temperature must be reached than we have at present succeeded in attaining. Nitrogen and carbonic oxide in the condition of liquids are, both of them, colorless and transparent.

LEAD.

LEAD is a bluish white metal of considerable brilliancy, which soon disappears on exposure to the air, owing to the formation of a thin film of oxide. It is so soft that it may be readily cut with a knife, or may be made to take impressions, and it leaves a streak upon paper. It may be cut or beaten into thin sheets, but in ductility and tenacity it is low in the scale of metals. It is readily fusible at a temperature of about 625° , and at a higher temperature it absorbs oxygen rapidly from the air, and the oxide thus formed volatilizes in the form of white fumes.

The combined action of air and water on lead is a subject of great practical importance, in consequence of the metal being so frequently employed in the construction of cisterns and water pipes. The lead becomes oxidized at the surface, and the water dissolves the oxide; this solution absorbs the carbonic acid of the atmosphere, a film of hydrated oxycarbonate of lead is deposited in silky scales and a fresh portion of oxide of lead is formed and dissolved, and in this way a rapid corrosion of the metal ensues. This action is materially increased by the presence of some salts, and diminished by the presence of other salts in the water. It is much increased by the occurrence of chlorides (which, as chloride of sodium, is often present in spring water), and of nitrates and nitrites (which are often present in spring and river waters, from the decomposition of organic matter); while it is diminished by the sulphates, phosphates, and carbonates, and especially by carbonate of lime, which is an extremely common impurity in spring water. In the latter case, a film of insoluble carbonate of lead is rapidly formed on the surface, and the metal beneath is thus protected from the action of the water. If, however, the water contains much carbonic acid, the carbonate of lead may be dissolved; and considering the dangers that arise from the use of water impregnated with lead, cisterns constructed of slate are far preferable to leaden ones.

Pure lead is of very rare occurrence. Almost all the lead of commerce is obtained from galena, the native sulphide of lead, by a process to be explained afterward. The lead thus obtained is often nearly pure, and to obtain it perfectly pure it should be reduced with black flux from the oxide left by igniting the pure nitrate or carbonate.

The compounds of lead with oxygen are four in number—viz., a sub-oxide which is a black powder of no importance; a protoxide, which is the base of the ordinary salts of the metal; a binoxide; and red lead, which is a compound of the two last named oxides. The protoxide is commonly known as litharge. It is obtained on a large scale by the oxidation of lead in a current of air, when it forms a scaly mass of a yellow or reddish tint. If the oxidation be effected at a temperature below that required for the fusion of oxide, a yellow powder, termed massicot, is obtained. Litharge is much used by the assayer as a flux; it enters largely into the composition of the glaze of common earthenware and into the manufacture of glass; and it is employed in pharmacy in the preparation of plasters. A mixture of one part of massicot with ten of brick dust, made into a paste with linseed oil, forms the compound known as dill mastic, which, from the hardness with which it sets, is frequently employed to repair defects in stone facings.

The most important of the salts of the protoxide of lead are: 1. The carbonate, which occurs native as a beautiful mineral in transparent needles or fibrous masses, and which is prepared under the name of white lead on a large scale as a pigment by a process which we shall subsequently describe. The carbonate is insoluble in water, unless it is largely charged with carbonic acid. It is generally blackened by exposure to hydrosulphuric acid (sulphureted hydrogen), either in the form of gas or in solution, and this is a serious drawback to the use of lead salts as pigments. 2. The sulphate, which occurs native in white prismatic crystals, and is formed as a heavy white precipitate on adding sulphuric acid or a soluble sulphate to a soluble lead salt. 3. The nitrate, which is formed by dissolving lead or its protoxide in dilute nitric acid. 4. The chromates, of which the principal are the neutral chromate, or chrome yellow, and the dichromate, or orange chrome. They are much used as pigments, and in calico-dyeing. 5. The acetates. The ordinary or neutral acetate is prepared on a large scale by the solution of litharge in distilled vinegar, and evaporation, when the salt is obtained in four sided prisms, or more commonly in a mass of confused minute white crystals, which at 212° lose their water of crystallization. From its appearance and from its sweetish taste, it derives its common name of sugar of lead. It is used both in medicine and the arts. Basic acetate of lead, regarded by some chemists as a diacetate, and by others as a triacetate, and commonly known as Goulard's extract, is prepared by boiling a solution of sugar of lead with litharge, and adding alcohol, when the salts separate in minute transparent needles.

The best test for solutions of the salts of lead are the formation of a black sulphide with hydrosulphuric acid or hydrosulphate of ammonia, insoluble in an excess of the reagent; of a white insoluble sulphate with sulphuric acid, or a soluble sulphate; of a yellow chromate with chromate of potash; and a yellow iodide with iodide of

potassium. All the salts of lead, insoluble in water, are soluble in a solution of potash. Before the blow-pipe on charcoal, the salts of lead yield a soft white bead of the metal, surrounded by a yellow ring of the oxide.

Lead is an important metal in the arts. Rolled out into sheets, it is largely used for roofing houses, for water cisterns, and for water pipes. It is also of great service in the construction of large chambers for the manufacture of sulphuric acid. Its value in the manufacture of shot is well known. Alloyed with antimony, etc., it is largely consumed for type metal, and with tin for solder. Much lead is also required for the manufacture of pewter, Britannia metal, etc.

The most important compound of lead in the materia medica is the acetate of lead, which is administered internally as an astringent and as a sedative. It is of service as an astringent, especially in combination with opium, in cases of mild domestic cholera, and even of Asiatic cholera, and in various forms of diarrhoea. It will frequently check the purulent expectoration in phthisis, and the profuse secretion in bronchitis. In the various forms of hemorrhage—from the lungs, stomach, bowels, or womb—it is employed partly with the view of diminishing the diameter of the bleeding vessels, and partly with the object of lowering the heart's action, and by these means to stop bleeding. The ordinary dose is two or three grains, with half a grain of opium, in the form of a pill, repeated twice or thrice daily. If given for too long a time, symptoms of lead poisoning will arise.—*Glasgow Reporter.*

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