souri iron ores, the hematite and the limonite (sometimes called brown hematite), the former occurring in two distinct varieties, namely, specular ore and red hematite. The first variety is found in the midst of broken and partially disintegrated porphyry, and in the (geologically) overlaying lower silurian sandstone. The red hematite forms strata in the carboniferous system. The limonites occur chiefly as deposits on the second and third magnesian limestones, except in the Osage River district, where they lie on subcarboniferous limestone. Besides these four classes of original deposits, Dr. Schmidt recognizes with each a secondary class of disturbed or drifted ores, making in all eight distinct classes of deposits.

The region of workable iron ore reaches north of the Missouri River at one point only, in Callaway county, where red hematite occurs in the subcarboniferous. South of the river, deposits are frequent throughout the whole southern part of the State. That portion richest in iron ores, however, is comprised in a broad belt crossing the State in a direction about parallel to the course of the Missouri river, between the 30th and 40th township lines. This belt is divided into three distinct regions. The first and more easterly embraces the deposits of limonite in the counties of Ballinger, Wayne, and Madison, and the small but immensely productive Iron Mountain district, with its two enormous deposits of specular ore in porphyry, Iron Mountain and Pilot Knob, besides numerous smaller deposits. The second or central region comprises the deposits of specular ore in sandstone, chiefly in the counties of Crawford, Phelps, and Dent. The third region contains the limonite and red hematite deposits of the Middle and Upper Osage, a district too remote from present markets to add very much to the immediate wealth of the State.

The oldest as well as richest deposits are in the iron-bearing porphyries of the eastern district, a formation regarded as a near equivalent, in point of age, to the iron-bearing rocks of Lake Superior, New Jersey, and Sweden. The deposits occur in the most variable shapes, and of every variety of size. There are regular veins as in Shepherd Mountain and Iron Mountain; regular beds as in Pilot Knob and in some localities east of it; irregular deposits, some of which approach veins by their shape, as in Lewis Mountain; while others have proved to be but isolated pockets, as on Hogan Mountain. In all cases, however, the mode of their formation is thought by Dr. Schmidt to have been practically the same, that is, by precipitation from iron-bearing waters, as ore deposits are still forming in numerous localities from the waters of chalybeate springs. The geological history of Iron Mountain affords a fair illustration of the manner in which the formation of all these beds of specular ore may be interpreted.

Originally the mountain was composed of porphyries, which also filled the valley east and south. In process of time the porphyries became fissured, by contraction or otherwise, and during long periods these fissures were kept filled with constantly renewed chalybeate waters, which slowly deposited the oxides of iron which they contain. As the fissures were gradually filled, the flow of the iron solutions was lessened and finally stopped. Then the ore dried, undergoing thereby a small contraction, which cracked and broke most of the veins without displacing the parts. Subsequently the porphyry was acted on by atmospheric or other waters, probably containing carbonic acid, which decomposed the rock, removing the alkalies and leaving a silicious clay. By the after erosion of the softened masses by rain and flood waters, the cracked and disjointed ore veins lost their support and fell to the ground, thus forming the beds of surface ore which cover the slopes of the hill and fill a part of the valley.

In the main body of the hill, the ore masses remain undisturbed, with more or less decomposed porphyry between, the ore constituting but a small percentage of the entire volume of the hill. The surface layer of ore boulders, pebbles, and ore sand, with very little clay, was originally from four to twenty feet thick, and must have represented a vast amount of erosion. The Iron Mountain ore may be taken as a type of all the Missouri specular ores. It is nearly pure peroxide, containing about seventy per cent of metallic iron, and is nearly free from mechanical admixture of foreign matter. Color, bluish black to steel gray. The surface ore is a little richer than the vein ore and has less phosphorus; both are nearly free from sulphur. Dispersed through all the Iron Mountain ores are magnetic particles, which can be separated from the mass with a magnet when the ore is reduced to powder. No ore with active magnetism, constituting a natural magnet and attracting iron filings, is found on the mountain. The Pilot Knob ore is slightly peculiar; color, steel gray to pearl gray, with a marked tint of sky blue. Its structure is crystaline to granular, with a very fine grain None of these ores affect the compass needle, though all are slightly attracted by a magnet when ground fine. The quality is less uniform than that of the Iron Mountain ores, the principal impurity being silica. The proportions of sulphur are very small.

The ore from Shepherd Mountain is a little more like a magnetite than any other ore in Missouri, but in the main is a specular ore, very similar to that of Iron Mountain. Its magnetic qualities are much more pronounced than those of either of the ores above described, many specimens being strong natural magnets. The ore is very uniform in chemical composition, very rich in metallic iron, and almost entirely free from phosphorus and sulphur. It is nearly as rich as the Iron Mountain ores, and much purer than either those or the ores of Pilot Knob.

At Buford Mountain the ore is rich in both iron and manganese, and is likely to prove a very valuable material for the manufacture of spiegeleisen, now so extensively used in the Bessemer process.

The specular ores in sandstone differ from those in porphyry chiefly in their tendency to change, on exposure to atmospheric influences, into brown and yellow limonites and red hematites: rarely into spathic ore. Generally these deposits are of a lenticular shape, with circular or elliptical outlines, and may have been formed either by deposition from chalybeate waters in depressions in the sandstone, or by a gradual replacement of lenticular limestone deposits. When inclined, the beds dip with the slope of the hill.

The disturbed deposits of specular ore are of two kinds: Masses of ore which have been removed from their original position by underwashing or otherwise and deposited elsewhere in a more or less irregular manner; and the remaining portions of original deposits, from which other portions have been removed. Ore banks having the appearance of drifted deposits are numerous in the central ore district, but they have not been sufficiently opened to be satisfactorily studied.

The red hematites of the carboniferous formation differ from all the other ores of the State in that they do not occur as deposits with definite limits, lying as independent and foreign developments between and across other rocks, but form and compose in themselves regular geological strata. These iron-bearing sandstones frequently extend over large areas, with varying richness. None, however, have been sufficiently opened to make it possible to decide whether the ore was formed directly after and on the surface of the underlying sandstone, or whether it was infiltrated afterwards, gradually replacing beds of limestone or the sandstone itself as it happened to be more or less readily soluble.

The deposits of limonite occur neither in veins, nor in beds, nor as strata, nor in pockets of regular shape, but in irregular cracks and crevices on or near the surface of the various limestones. These cavities sometimes have very large dimensions both in depth and width, and are generally near the present surface of the ground. So far as opened these deposits afford a denser, harder, and richer ore in the upper part than in the lower, where it is more inclined to be light, porous, ochery and clayish. This fact and the invariably stalactic structure of the ore are proofs that the solutions from which the ore was deposited was infiltrated from above. One of the largest and most coherent of these banks is the Ford Bank in the eastern district. It extends some 1,500 by 500 feet along a low flat hill; the thickness is irregular, ranging from 10 to 30 feet.

The disturbed and drifted deposits of limonite have not been sufficiently opened to enable a judgment to be formed in regard to their character. The more important deposits in the entire list are as follows, the most of them being described at length in the report:

1. Containing more than 2,000,000 tuns of workable ore: Iron Mountain, in St. Francis county (specular ore).

2. With less than 2,000,000 tuns and more than 500,000 tuns: Pilot Knob (quartzose specular), in Iron county; Benton creek (specular in sandstone), Crawford county; and Simmons Mountain (specular in sandstone), Dent county.

3. Estimated to contain between 100,000 and 500,000 tuns: Shepherd Mountain (specular and magnetic), Iron county. Scotia No. 1, (specular and red hematite in sandstone), Iron county. Cherry Valley No. 1 (specular in sandstone), Crawford county. Laub Bank (specular in sandstone), Phelps county. Pomeroy Bank (specular in sandstone and limonite), Dent county. Iron Ridge No. 1 (specular and red hematite in sandstone), Crawford county. And the Meramee bank, (specular and red hematite in sandstone), Phelps county.

MODERN PROGRESS OF CHEMICAL INDUSTRIES IN EUROPE.

In the course of a recent lecture before the French Association for the Advancement of Science, M. Aimé Gérard gave a very interesting and instructive sketch of the rise and progress of many of the principal chemical industries of Europe. Beginning with sulphuric acid, which he regarded as a common pivot about which turn all the industries which call in chemical reactions to their aid, it was pointed out that, heated with rock or marine salt, the product gives us on one hand sulphate of soda, and on the other hydrochloric acid, in other words, the primary agents for the manufacture of soap, of glass wares, of paper stuff, of bleaching matters, of dye, etc. Heated with saltpeter, it gives nitric acid, the creative agent of the beautiful coloring matters used for dyeing silks. Again, by the aid of sulphuric acid we clean metals, purify oils, manufacture candles, and plate and gild by galvanic action. It is quite clear that it would be impossible to obtain the enormous amounts of the product now required from the limited sources of supply of forty years ago. Then native sulphur, obtained from the volcanic ground of Sicily, was burned at the top of large leaden chambers, and about 20,000 tuns sufficed for the manufacture of the sulphuric acid consumed in Europe. Now 275,000 tuns would barely meet the demand. This vast drain could not be met by the Sicilian sulphur grounds, and hence were engendered the attempts to utilize iron pyrites obtained in the French mines of Chessy, near Villefranche. These successful, the industry spread to England and Germany, and now the estimated production of Europe, of concentrated sulphuric acid from iron pyrites, is 880,000 tuns, enough to fill a canal 64 feet deep, 32 feet wide, and from 15 to 18 miles long.

In Marseilles, thousands of tuns of salt from the marshes are made into soap maker's alkali. Formerly the hydrochloric acid gas produced from the decomposition was lost and, escaping in white clouds from the chimney of the factory, brought destruction to crops and vegetation near. It was in England that the condensation of this gas was made obligatory on manufacturers, and laws were passed in Parliament to that effect, resulting in the transformation of the fumes into the yellow liquid from which decolorating chlorides, products which render valuable service in the bleaching, dyeing, and making of paper, are obtained. It is a strange fact that the importance of these secondary manufactures has greatly increased, and it is to the perfecting of the processes through which chemistry may manufacture these decolorating agents that the efforts of inventors are tending. In England, Weldon regenerates manganese, which generally serves for the transformation of hydrochloric acid into chlorine. Deacon seeks from the air itself the oxygen necessary to the transformation, and announces the production, now almost certain, of chloride of lime at $2 per 220 pounds: an immense progress, for, whenever we are able to extract readily from hydrochloric acid the chlorine it contains, we shall have furnished to textile industry a means of inexpensive bleaching, and to the paper manufacturer a mode of utilizing now waste products.

With the hydrochloric acid there is obtained sulphate of soda, and this is converted into soda and carbonate of soda. To effect this, it used to be heated to 2120° Fah., in a reverberatory furnace, mixed with zinc and charcoal. In front of the door stood two or three workmen, who, with huge iron pokers, kept up a continual agitation of the molten mass: brutal work, but now gradually disappearing. In England a rotating furnace is used, which consists of a horizontal cylinder, 16 feet long by 10 feet in diameter, on which a small steam engine impresses the movement of rotation about its axis. This is traversed from end to end by the flame from the hearth, and the matters, violently agitated, react upon each other without requiring the muscular force of man.

In the production of the potassic compounds, we probably meet with the most remarkable progress presented by the modern history of chemical industries. The ash left by wood, burnt in our fireplaces, is no other than a mixture of calcareous compounds, insoluble in water, and soluble salts of potash, among which the carbonate predominates. This mode of making potash from wood now only exists in America, Hungary, and Russia, and bids fair to become entirely extinct. The sources from which potash is now derived are, first, the sugar industry. A sugar beet of 4·4 pounds weight contains from 15 to 30 grains of potassic compounds. From the molasses, these in concentrated form are obtained. The molasses by fermentation is formed on the one hand into alcohol, which is obtained by distillation, and on the other into distiller's wash, which, evaporated and calcined, reproduces in the saline state the potash which the beet originally held fixed in its tissues; 6,000 tuns of potassic compounds, valued at $6,000,000, are thus annually obtained. But even this vast amount would not suffice for commerce, and hence we turn to a second source, sea water. In every quart there are 375 grains of marine salt (chloride of sodium) and 15 grains of chloride of potassium. Imagine, now, this sea water introduced into salt marshes, over immense areas, and left to evaporation. The salt is finally deposited in a crystaline state, and when some 3 inches thick it is gathered. Formerly the mother water, rich in potassic compounds, was drained off and wasted; but by M. Balard's refrigerating processes, the valuable potash is now extracted. The discovery of large mines of rock salt in Stassfurt, Prussian Saxony (where it was only necessary to hew out the potash mineral, the carnallite, with the pick axe, and boil it with a little water, to obtain chloride of potassium almost pure) dealt a powerful blow to the French industries; but after a ten years' contest, the latter, by the aid of improved processes, are again firmly established in commerce. From 10,000 to 12,000 tuns of potassic compound are now produced yearly at Camarque, France.

M. Gérard continues at some length regarding ammoniacal compounds, phosphates, sulphate of ammonia, etc. A few facts relative to the progress realized, by industries which make use of chemical products, will serve as a conclusion for our *resumé* of his discourse. As regards paper, it is stated that the production in 1873 was 143,000 tuns. Each Frenchman consumes annually in different forms more than 6·9 pounds of paper, and the entire amount yearly used in France would be sufficient to encircle the earth at the equator with a belt 192 feet wide.

The cultivation of wine in France covers 60,000,000 acres, Owing to the ravages of the *oidium* between 1850 and 1860. the production fell from 115 to 73 quarts per head per annum. Brief notice is made of the present trouble with the phylloxera. As regards the sugar beet industry, the yield for 1873 is stated at 495,000 tuns.

Operations of the Patent Office in 1873.

The annual report of the Commissioner of Patents, for the year ending December 31, 1873, shows the following:

Number of applications for patents during the year 1873	20,414
Number of patents issued, including reissues and designs	12,864
Number of applications for extensions of patents	278
Number of patents extended	233
Number of caveats filed during the year	8,248
Number of patents expired during the year	4,482
Number of patents allowed but not issued for want of final fee	2,783
Number of applications for registering of trademarks	534
Number of trademarks registered	492

Of the patents granted, there were to—

Citizens of the United States	12,371	
Subjects of Great Britain	341	
Subjects of France	64	
Subjects of other foreign governments	88	
		12,864

STATEMENT OF THE PATENT FUND.

Amount to the credit of the patent fund, January 1, 1873	$794,111 42
Amount of receipts during the year 1873	703,191 77
Total	1,497,303 19
From which deduct expenditures for the year 1873	691,178 98
Balance January 1, 1874	$806,124 21

A NEW Bunsen gas burner has been recently invented, which gives a heat of about 3,000° Fah. A furnace of thirty burners generates steam enough to run an engine of one and a half horse power.