

SECTION VI.

MINING LAW.

CHAPTER XXIII.

MINING AND MINING LAW AMONG THE ANCIENTS.

The main subject of the present discussion being the history of mining jurisprudence, and the consideration of that subject being limited as far as possible to its bearings on the immediate problems of legislation in the United States, I shall not attempt to collect, in this chapter, all that is known of the practice of ancient nations in regard to the arts of mining and metallurgy. The theme is an exceedingly attractive one, and on another occasion may be not inappropriate. I am aware that a more extended treatment of it would add greatly to the popular interest of this report, but I consider it more important to preserve the continuity of the argument which I am endeavoring to construct, and to introduce no threads which cannot be gathered into the conclusions which I hope to establish. Our knowledge of the legislation of earlier times has to be, however, in great part inferred from circumstantial evidence, or from the records which remain of ancient practice. A frequent reference to the history of mining, as distinguished from that of mining law, is unavoidable; yet this chapter must not be considered as even a complete outline, much less a comprehensive summary of all that is known to antiquarians on this interesting subject.

In comparison with the literature concerning the dress, language, mythology, and poetry of the ancients, we have very few books about the much more important questions connected with their proficiency in the mechanical arts, and especially the arts of mining and metallurgy.

Authorities.—Two books published during the last century are the only ones which have come to my knowledge in which the indications and fragmentary facts contained in ancient literature or existing ruins, observed by travellers, have been collected and systematically arranged. One is the work of Caryophilus, *De Auri et Argenti Fodinis Veterum*, of which I have not yet been able to find a copy in this country, though it is accessible in several libraries abroad; the other is a dissertation in the German language, by Dr. J. F. Reitemeier, published in Göttingen, 1785, and entitled *Geschichte des Bergbaues und Hüttenwesens bei den alten Völkern*. This admirable essay received the prize of the Royal Society of Sciences at Göttingen. There is a copy in the city library of Boston, to the superintendent of which I am indebted for the courtesy with which he placed the book at my disposal. Ancient authorities are more numerous, but not so satisfactory, since they give us mostly mere allusions or accidental revelations. Among them we may mention the Bible, Herodotus, Strabo, Pliny, Diodorus, Agatharcides, Clement of Alexandria, Aristotle, (*de mirabilibus, de cura rei familiaris, etc.*) Dioscorides, Livy, and Polybius, not to mention a multitude of classic writers from whose works intimations of importance can be gleaned, such as Xenophon, Cæsar, Plutarch, and even the legendary poems of Homer and Hesiod. To these sources of information must be added the works of various

mediæval and modern travellers, and the researches of antiquarian scholars in special fields of inquiry, too numerous to be catalogued here.

The origin of mining.—The art of mining is linked with so many others, which are the fruit of civilization only, and must be practiced under so many natural difficulties, which only advanced science has been able to overcome, that we may naturally believe it to have had neither a very early nor a very rapid development. No doubt the first races were led to the discovery of one metal after another by accident rather than systematic study of nature. Probably the first metals used by men were those occurring in a native state—such as gold, silver, and copper. The discovery of bronze, or the secret of hardening copper by rude metallurgical processes and mixture with other metals, was a step in the progress of the human race so important that it marks an epoch of pre-historic time, known as the age of bronze. The peculiar properties of gold and silver—their beauty, malleability, and above all their resistance to oxidation, which rendered their preservation possible through long periods, were undoubtedly the ground of that high esteem in which they have always been held, and which is at the present day enhanced by their relative scarcity, and the difficulty of obtaining them. The knowledge of these metals seems to have been indigenous in all countries where they occur, whether among the tribes of Asia, of Siberia, or of North America. Gold and silver are the A and B of the alphabet of metallurgy; and, although the mastery of the whole alphabet and its combinations in the literature of civilization has been the laborious work of ages, and is not yet complete, these first letters of it were beneficently made easy for man to discover. The rudiments of mining are first found in those countries where the human race itself probably had its origin. The Bible informs us that even before the Noachian deluge, some of the peoples of Asia understood the use of iron—but this knowledge does not appear to have been propagated among other nations. The Siberians and the Peruvians most certainly did not possess it, and other nations have made the discovery at a comparatively late period; but this only corroborates what we have already said, that the knowledge of metals was not, in the beginning, transmitted from one nation to another, but was the child of circumstances and accidental discovery in different parts of the world. At any given epoch of the first historic eras, before commerce and literature had produced an interchange of commodities and ideas, it is to be supposed that some nations would be more advanced than others in these respects. If the use of iron was confined to the race destroyed by the flood, then it perished with them.

At a much later period we learn that the Chaldeans and Assyrians possessed gold, silver, and “brass.” The Phœnicians had also an abundance of metals; and it is more certain, in their case, that they obtained their supply from some sort of systematic mining. Their country itself was not rich in mineral wealth. Possibly they worked the copper mines at Sarepta, but these were their only mines at home. But their extended commerce brought them into connection with other countries abounding in the treasure they sought; and they went to islands of the Mediterranean for gold and other metals, including iron, of which they understood the use, ascribing its discovery to two of their mythical heroes. They are known also to have mined in Spain, (probably for “Tyrian lead” and silver,) and they even touched the distant shores of Britain in their bold explorations, and gathered the tin ore of Cornwall and Devon.

But at least an equal antiquity, and a much greater elaboration and system, must be recognized in the mining of the Egyptians. Under the reign of Osiris, the Egyptian mines of copper, silver, and gold were in

productive operation. Both on the Ethiopian and the Arabian border, and near Saba, (which may or may not be Sheba of the Bible,) they worked the ores of their country. The Sinaitic desert, through which the Israelites travelled, contains to this day the ruins of mining works, the origin of which is shrouded in mystery, but may well be ascribed to that wonderful people the Egyptians, the extent of whose achievements in many directions the world is just beginning to estimate aright. They did not learn the use of iron so early as that of some other metals. Abraham found gold and silver used for instruments, ornaments, and currency among them, but no mention is made of iron. In the time of Moses, however, as is evident from two passages in Deuteronomy, the Egyptians smelted iron.

Mines of the Persians and Egyptians.—In the early times, as in all subsequent periods, conquest was one of the foes of mining. The Egyptians were twice conquered by the Ethiopians, and had several Assyrian wars, which must not only have produced such a disturbed condition of affairs as prevented the prosecution of mining, but also have drawn into the military service the classes of laborers employed in that business. The final establishment of the Persian dominion removed the disturbances from without, but the tyranny of the provincial governors produced numerous revolts, which doubtless had a disastrous effect upon mining. The Persians, however, amassed much treasure from their conquests, and obtained from the Egyptian mines, in particular, the finest silver. The strength which wealth imparted to this dynasty was painfully felt by the Greeks, in the vast armies which invaded their territory and the bribes with which their leaders were corrupted. The first period in the history of mining closes with the overthrow of the Persian empire by Alexander, and the transfer of the treasure and resources of the Orient into European hands. Meagre as are our data for this period, we are nevertheless led to a reasonably certain conclusion with regard to the tenure and authority under which mining was carried on. We hear of kings, like Croesus, enriching themselves from the product of the mines; but there is no indication that these sources of wealth were open to private citizens. The immense quantities of gold and silver employed by governments, and their use in constant wars, also confirm our conjecture that the mines of Asia and Africa were the property of the rulers, and that they were worked by slaves. This was certainly the case in Egypt, in the following period. It is probable, therefore, that the doctrine of ownership by the crown of the metals in the earth was originally established by tyranny, and that before its establishment mining, like agriculture, was carried on by the citizens. The story of Joseph, in the Bible, shows by what means the despot of Egypt was able to destroy the individual industry of agriculture, and to turn the whole kingdom into his own farm. Doubtless the process of "consolidation" in mining followed a similar course.

In the second period there was apparently still greater activity and extent of mining operations; at least our information on the subject is more satisfactory. Gold, silver, copper, and iron were obtained in Ethiopia, and iron at least in Libya. Possibly the recent discoveries of gold in Africa, which are now attracting considerable attention from the English, are but rediscoveries of the fields worked centuries before Christ. India and Caramania produced gold, and the latter country also silver, copper, and cinnabar. The people, however, are said by Strabo to have been very ignorant of the art of working metals. The Derbæ did not know how to melt their gold dust into lumps, and the Indians sold crude specimens of rich ore to foreigners. The Chalybeans,

on the other hand, became famous as workers in iron, and derived their principal revenue from this source. In Asia Minor the gold mines formerly owned by Croesus were worked down to the times of Xenophon, but Strabo says that in his day they were exhausted, and only traces of them remained. There were iron mines and skilled workmen in Palestine. Arabia Felix is celebrated by many ancient writers as possessing very rich gold and silver mines, but no traces of them now remain, nor have modern travellers observed auriferous sands in any of the streams of that country. Historical testimony on the subject is, however, quite positive and unanimous, and the matter may be considered as still in doubt. It is not impossible that the ancient writers, who were not always exact in such statements, mistook the treasure obtained by the Arabians through their Indian commerce for a product of their own soil.

We may well believe that this wide-spread development of mining, accompanied as it was with a diffusion of government, brought about some change in the mining law. The loosely-strung empire of Alexander fell to pieces after his death, and no doubt the mines became the property of governors, generals, nobles, and wealthy citizens. We have, however, in Egypt a type of the general systems which obtained, on a greater or smaller scale, throughout the petty despotisms which divided the world. Diodorus gives us a picture of Egyptian mining, partly taken from the earlier work of Agatharchides. According to this account the mines of Egypt were the property of its kings, who obtained immense sums from them.

Those were in one sense the palmy days of mining; for the king got his mining ground gratis, worked only the richest deposits, captured or reduced to slavery the necessary laborers, and levied contributions on his kingdom for the necessary food and other mining supplies. Rich mines, worked at no expense, naturally paid handsome dividends. Machines were not employed to any extent, since human power was cheaper. The Egyptian monuments which remain to us represent the most stupendous works of engineering, as accomplished by the labor of countless multitudes of men. The labor of the mines was performed by prisoners of war, convicts, and purchased slaves. As the Egyptians were not a warlike people, and seldom returned from battle victorious, it is not likely that their prisoners were numerous. Neither could the convicts have supplied their extensive mines. It is probable that the greater portion of their miners were purchased slaves. We are, in fact, informed that the workmen in the Egyptian mines spoke different languages. To prevent conspiracies and escapes, the different gangs were placed under overseers who were not their countrymen, and all hope of flight was finally extinguished by fetters, by constant confinement in contracted caverns, and by the nature of the region itself, which offered no opportunity for successful escape. The lot of these unhappy creatures in the mines and furnaces was indeed a hard one. They were forced to labor day and night, without rest or hope, and under the most dreadful hardships and cruelties. They were entirely naked, and neither age nor sex, sickness nor wounds, excused them from the severity of discipline. The stronger ones hewed the rock in the mines, the half-grown youths carried the ore to the surface, persons over thirty years (so soon was their vigor destroyed) were set at the easier task of crushing it in mortars, and the women and old men ground it fine in hand-mills. The historian adds, with laconic pathos, that they continued to labor until they dropped dead beneath their burdens.

Ancient mining in Siberia and Europe.—The far northern country of the

Massagetes is said by ancient writers to have produced gold and copper, but no silver nor iron. This is the nearest approach to a mention of mining operations in Siberia which history presents. But the observations of travellers, especially those recorded by Pallas, Lepechin, Gmelin, and Rytchkow,* afford convincing evidence of the existence of extensive workings for gold and copper in Siberia. The tradition of the Russians, that these early miners were Scythians, is groundless. Tartars they were not, since they were unacquainted with iron, which the former knew how to use. A nomadic race they are believed to have been, since no traces of buildings or masonry remain in those regions. All that we can conclude with probability is that, before the irruption of the Tartars into Siberia, very extensive but rude mining operations were carried on in that country by tribes not far removed in culture from the aborigines of North America. The tools which they employed were either of stone or copper—never, so far as has yet been discovered, of iron.

The smelting of copper appears to have been successfully carried on, even with somewhat refractory ores. Traces of mining accidents, of the voluntary abandonment of very hard rocks, of great economy of labor in "dead work," &c., taken together with the indications above mentioned of the social condition of this unknown people, prove to us that they carried on their mining operations by individual enterprise, as freemen, and probably without reference to particular ownership of the soil. Although this system (if system it may be called) stands in favorable contrast, on grounds of humanity, with the cruel and tyrannical practices connected with mining in the southern Orient, and especially in Egypt, yet it is evident that its result was superficial exhaustion, abandonment, and finally burial in oblivion of the mines. From the very dawn of history, therefore, these two representative voices of Egypt and Siberia warn us that neither mining by the crown, nor nomadic, superficial mining by the individual, is the true method of utilizing with economy the mineral resources of any country. The first is inconsistent with liberty, and the second with stable industry.

Concerning the earliest beginnings of mining in Europe little can be said. The civilization of the East, as is well known, communicated itself first to the Mediterranean nations. As mining is an essential condition to the progress of civilization, so we may reasonably conjecture the progress of mining at any given period from the culture of the people. We are justified, therefore, in assuming that mining in Europe takes its rise with the emergence from barbarism of the Mediterranean tribes. Strabo, Pliny, and Herodotus declare that Cadmus, a Phœnician, opened the first gold and copper mines in Thrace—a statement which is philosophically, if not historically, true. The Phœnicians certainly carried on mining in the islands of the Mediterranean, and even along the coast of distant Spain. But it is not probable that their operations contributed much to the spread of the art among the barbarians; since they not only, with characteristic selfishness, carried away all the products of their industry to enrich their own land, but kept to themselves whatever knowledge they acquired. They cannot be regarded as the teachers of European nations in this art—a credit which belongs rather to fugitives and exiles from other parts of Asia, who opened mines, or communicated the knowledge of mining, in the regions where they took refuge. The nature of the laws or customs regulating mining differed, therefore, according to the source of the art. The labors of the Phœnicians seem to have derived extent and comparative permanence from the conservative influence of commerce rather than tyranny.

* The treatise of Pallas is found in *Actis Soc. Imp.* 1780, published at St. Petersburg, 1784; and that of Rytchkow in Busching's Magazine, part 8.

Mining in Greece.—The mining works of ancient Greece are remarkable for extent, antiquity, and improved arrangement. The Greeks mined in the mother country and in their eastern and western colonies, and maintained through many centuries this industry, improving it by their own experience, and even studying it by scientific methods. The works of Theophrastus and Philo on metals are unfortunately lost, as is that of Strabo on machines and methods of parting metals. The remains of Greek mines are too nearly obliterated to afford us any evidence. We must learn what we can from incidental passages in Greek literature, and these refer almost entirely to the mines of Attica.

The history of Greek mining may be divided into three periods. The first includes the activity of the mines upon the islands, the oldest of which belonged to the Phœnicians; the second period comprises the operations of the Greeks themselves, on the main land; and the third is characterized by the working of new and productive mines in the provinces of the Macedonian Philip, which finally, with the rest of the Greek mines, fell into the hands of the Romans. The operations of the first period must be mainly inferred from passages in the Iliad and Odyssey; and these are of course to be interpreted with due allowance for their poetic form. When it is said that Helios, or the sun, invented gold, and the mythical, not to say allegorical, Erythoniuss discovered silver, while copper was brought to light by the investigations of workmen directed by the gods, we may infer that the order in which these metals became known to the Greeks was similar to that which, as we have already seen, obtains in the history of other peoples. Iron is said by an old Greek inscription to have been discovered at a period corresponding to 1431 B. C. of our calendar. These gleams of early history help us to understand how gold and silver, more than any other metals, have come to be considered the property of sovereigns. They were the earliest known, and that at a time when sovereigns took all they could get and could get almost anything they wanted. Homer's descriptions of the magnificence of Greek princes, if we may interpret them as historical, indicate no small surplus of gold and silver in Greece. It is to be remembered, however, that in the absence of that diffusive action which commerce maintains, and of that great demand for the precious metals to which their use as currency gives rise, the accumulation in a few hands of a comparatively small amount of gold and silver might well justify the glowing descriptions of Homer; and also that if the rich men of the present day were to spend their wealth, not on the means of comfort and enjoyment, not on books and works of art, not on public improvements, but only on plate, armor, jewelry, and chariots, they could far outshine the splendor of Homeric heroes.

The islands in which the Greeks carried on mining operations included Crete, (iron,) Thasos, (gold,) Eubœa, (iron and copper,) Cyprus, (gold, silver, copper, and iron,) Delos, (copper,) Rhodes, (copper, iron, and lead,) Milo, (alum and sulphur,) Seriphos, (iron,) and Siphnos, (now Siphanto, very rich gold and silver mines.) From the mines of the latter island one-tenth of the product was sent every year to the shrine of Delphi. In later times, this payment having been discontinued, the mines were drowned by the rising of the neighboring sea; and this disaster was ascribed to the wrath of Apollo at being deprived of his divine royalty!

In addition to these mines upon the eastern islands, there were others, probably of later origin, upon the islands near Italy. Pithecusa, opposite Cuma, was rich in gold; Sicily and the Liparian Islands were also famous for various ores.

The petty rulers of the islands were the only or principal owners of

the mines, and the labor was doubtless performed by slaves, according to rude and simple methods.

The second period of Greek mining, comprising the operations on the mainland, in Greece proper, is better known and more important. The Spartans, under the influence of their political system, established no important industry of this, or, indeed, of any kind; but the Athenians became distinguished in the administration of the rich silver mines of Attica, and the productive colonial gold mines in Thrace and Thasos. Thessaly had also rich gold ores, Bœotia produced iron, and Epirus possessed mines of silver. These resources seem to have been developed about the time of the Persian war. The public revenue from the Attic mines at the beginning of that war was equivalent to about \$30,000, and afterwards increased to much larger sums, which, together with the product of the colonial mines, had a great deal to do with the splendor and power of Athens. The unhappy Peloponnesian war put an end to Athenian mining. In vain Xenophon exhorted his countrymen to reopen the sources of their former prosperity, and prophesied the continuance in depth of the rich ores they had once so successfully worked. The poverty of the citizens, and the exhaustion (in spite of Xenophon) of the mines, were obstacles which could not be overcome. Neither, as we shall see, was the system of the Athenians favorable to the persistent working of mines under discouragement. We may take leave to doubt, at the present day, whether the mineral deposits of Attica are really exhausted; but at that time a temporary barrenness was equivalent to a complete failure. For nothing can carry forward such an industry over its periodical seasons of depression except despotic power on the one hand, or on the other hand that faith in the future which is the result of accumulated experience, called science; and the Athenians had neither of these. Their failure in mining was due to the same cause as their failure in political science; there was no education of the people to take the place of centralized power.

The administration of the Athenian and that of the Egyptian mines differed as widely as did the political systems of the two countries. The State indeed appears to have held a certain title to the minerals, but its rights did not extend to absolute possession, or at least were not strictly insisted upon. Before the Persian war the income of the mines was annually distributed among the citizens, from which we may conclude that the republic either mined for itself or leased its mineral lands. After that war, however, this distribution of profits was discontinued on the advice of Themistocles, although the State still received payments from the mines. It is not improbable that certain mines, especially ancient ones, were rented on special terms, as the property of the republic; but the general practice was adopted of encouraging the development of mineral resources by a liberal and universal code. Taxes on gross production were remitted; citizens and friendly aliens alike were encouraged to mine under the light royalty of one twenty-fourth part of the net profits. The number of private adventurers thus encouraged to mining enterprise must have been very great. Even Demosthenes, in whose day Athenian mining was already on the wane, speaks of them as a class, like farmers and merchants.* The labor was performed by slaves, hired from their owners. The overseers were also slaves skilled in mining. It is probable that in many cases the lessees themselves were slaves, as it was not uncommon in Athens for masters to lease to their slaves factories, workshops, and farms. In such leases the slave-superintendent usually paid a daily net sum *per capita* for the number of

*Demosth. adv. Aristocratem.

laborers employed. The owner of slaves employed in mining received daily one obolus for each. The lessee was responsible for the food and clothing, and, in case of flight, for the value of the slaves—possibly also for their lives. No doubt this was a much milder slavery than that of the Egyptians, yet, as the slaves were strictly watched and always kept in fetters, it was oppressive enough. Slave-labor must always be lacking in individual skill and zeal, and make up for this deficiency by increased numbers. Accordingly we find that the slave-miners of Athens amounted to many thousands, or, as Athencus says, to myriads. History speaks of a miners' revolt, in which the insurgent slaves took possession of Mount Sunium, and from that point made many destructive raids upon the Attic realm. The extent to which the republic attempted to prevent such perils by laws, regulating the number of laborers in each mine, or to control in general the operations of lessees, is unknown. That a certain governmental supervision was exercised appears from the fact that a director of mines was appointed, who indicated to adventurers, upon application, where they might prospect for ore, and that there were laws to determine the methods of mining, and the location, direction, and extent of veins, as well as the proper distance between different claims upon this same field.

Ancient mining in western Europe.—Before the time of the Roman dominion, mining was carried on in many parts of western Europe; and although there are little or no traces left of the laws which regulated the industry of the barbarians, I shall briefly mention the localities referred to, partly to complete this historical outline, and partly because the mining jurisprudence of the Romans, like their mining science, was affected by their conquest of those countries where the natives already practiced this art.

The Etruscans and the Sabines, in Italy, were acquainted with the use of copper, and the former made early discovery of iron on the neighboring island of Elba, the specular ores of which are famous to this day. The Salassians, in Lombardy, turned the Po into canals, and established extensive washings for gold. The region of the Taurisci and Norici was rich in gold, and at one time the natives invited laborers from the south to assist them in its production; but the result was an overstocked market, and a fall of one-third in the value of gold, which caused them to send home their laborers and reduce production to maintain the price. The tribes of Gaul obtained gold, silver, copper, and iron. But Spain exceeded in its treasures of gold, silver, copper, tin, lead, and iron all the countries of the ancient world. The barbarian natives obtained these metals from superficial deposits or outcrops, and the Phœnicians and Carthagenians, and afterwards the Romans, extracted them by deep mining. In fact, the art itself was planted in Spain by these foreign nations. The mere use of surface deposits can no more be called mining than the gathering of bunch-grass and pine nuts by our Nevada Indians can be called agriculture. Probably the Phœnicians themselves, in their distant operations in Spain and Britain, engaged rather in commerce than mining, buying the metals of the barbarians. But the Carthagenians, we know, established in Spain and Sardinia most extensive and productive mines, the revenue of which enabled them to support a numerous army of mercenaries and to wage long and costly wars with Rome. No doubt these mines were in some form the property of the state. The British islands were the scene of a considerable native industry, comprising gold, silver, iron, copper, lead, and tin. Strange to say, the Britons seem to have lacked or despised the art of manufacturing copper, though they practiced the more diffi-

cult metallurgy of iron. The Phœnicians traded with them secretly for tin, and the Romans, by following the Phœnician ships, finally discovered the mystery of the Cassiterides. But the Britons continued, until their conquest by Cæsar, to work their own mines of lead and tin. The tin of Cornwall was shipped first to the Isle of Wight, and thence to the coast of Gaul, where it was loaded upon horses and transported to Marseilles—a journey of 30 days.

Mining of the Romans.—Almost all the nations celebrated for their mines in ancient times became at last the prey of the Romans; and Roman mining was therefore a very wide-spread industry. Our knowledge concerning it is, however, mainly confined to Europe; since neither the hints of classical writers nor the observations of modern travellers have thrown much light on the Roman mines in Asia and Africa.

The poverty of the early Romans indicates that they did not work the mines of their native land. They struck the first silver coins shortly before the first Punic war, when, by rapid conquests in middle and lower Italy, they acquired mines which furnished them the means to greater undertakings. The wars against Carthage made Rome mighty among nations, and eminent in the history of mining. The first two Punic wars delivered into her power the important mines of Sardinia, Sicily, and Spain. Oriental conquests added mines in Asia Minor, Greece, and Macedonia, and at a subsequent period the remaining mines of the east, in Asia and in Egypt, were acquired by the victorious arms of Pompey and Augustus, and those of northern Spain and Gaul yielded to the legions of the Cæsars. The tin mines of Britain were their latest conquest of this sort; and after these had been gained Rome was mistress of all the important mines of the ancient world, and gathered into her coffers the wealth which had before been the strength and glory of many different nations.

As the mines had been acquired by conquest, they became the property, not of private citizens, but of the republic, and afterwards of the empire. In the period after the first Punic war the revenues of the republic were collected, indirectly, through contractors; and the censor, to whom belonged the duty of farming out the finances, awarded at certain times the leases of the mines. Ordinarily, as for instance in upper Italy and Spain, the lessees worked their ground with purchased slaves. In a few districts, however, the native inhabitants were held to a certain amount of labor in mines and furnaces, as a sort of vassalage, like that of the crown-serfs of Russia a few years ago, and this crown-right over their services was granted to the lessees of the mines. The treatment of the slaves was not less inhuman than that practiced by the Egyptians. Diodorus describes both in nearly the same language. The increased money value of a slave among the Romans might indeed have caused some amelioration of his condition for the sake of prolonging his life; but probably this was lost sight of in view of the immediate profit derived from the rapid and reckless robbery of the mines. It was the swift exhaustion and waste of their mineral resources, and not any considerations of humanity towards barbarians, which led the Romans to change their policy of leasing the mines. From an economical point of view no system of mining could have been more injurious to the state. The lessees cared nothing for the future; they took no pains to utilize all the treasure in the earth; they were absorbed in the endeavor to realize as much profit as possible during their limited term of possession, and to this end they employed vast armies of slaves and ruthlessly laid waste the mining lands. Polybius says that the lessees of a single district in Spain employed in their mines no less than 40,000 purchased

slaves; and this evil grew to such a size in the gold mines of upper Italy that the censor, in order to delay the exhaustion of the mines and prevent the sudden depreciation of the precious metals, made it a condition of lease that the number of laborers in those mines should not exceed a certain limit. Of course under these circumstances the art of mining made no progress. The Romans took it as they found it among the conquered nations, and rather fell behind their teachers than surpassed them. The system of Egypt, bad as it was, was better than this. The selfishness of despotism was at least more provident than the indifference of democracy. The period from the first Punic war to the empire was characterized by an immense production of metals, and ended with the exhaustion of many of the mines. The despotic emperors took the matter in hand, and, though the past could not be repaired, they reformed the causes of the evil. They began to work the mines through regularly appointed officials, instead of leasing them to unscrupulous speculators; and as it was not feasible for the government to obtain so many slaves as had previously been employed by private parties, the system of feudal service from the inhabitants was gradually extended, and the oppression of the former irresponsible administrations was lightened. The crown-serfs, so to speak, were allowed to own and to sell land, but the purchaser acquired, together with the property, the obligations of service resting upon the former owner. Slaves were also employed, but these were rather condemned convicts than purchased barbarians or captives of war. The emperors seem to have preferred to apply this system to the maintenance of mines already open, and to have willingly allowed private adventurers to discover and explore new ones. Thus Trajan allowed the Dacian gold mines to be worked by a sort of stock company, (*collegium aurariorum*,) and Valentinian I. gave free permission to prospect for metals on payment of a portion of the subsequent products. Instances are mentioned of private persons owning large and profitable mines, probably by special grant. A new impulse was thus given to mining, and gold mines were opened during the first hundred years of the empire in Dalmatia, Illyria, and Dacia. The supervision of this vast industry required numerous officials, of whom the names only are left to us, such as *Comes metallorum*, the *Comes sacrarum largitionum*, the *Comes Orientis*, the *Vicarii*, and *Rationales*. Probably their duties were chiefly of a financial or magisterial nature, although the *Comes metallorum* may have been a sort of mining engineer.

But agencies came into play which overpowered the good influence of the new system. The errors of the past were, to a great extent, irremediable; the impoverished mines could not compete with others more favorably situated; and finally the irruptions of the barbarians on the borders disturbed or destroyed the industry of many districts. The serf-laborers were quite as likely to join the invaders as to defend the mines against them. From the silence of the later historians we may infer that mining in the Roman empire declined rapidly after the third century; and after the fifth century, when the barbarian hordes overwhelmed with successive invasions the tottering empire of the west, it ceased entirely. The Byzantines maintained it a little longer, but after the seventh century they gradually surrendered their mines to the conquering Arabs. The mines of Asia Minor, Thrace, and Greece were the last which the empire retained. The victorious barbarians no doubt gleaned what they could from the abandoned works of their predecessors. This was done, we know, by the Arabs in Spain, the Franks in Gaul, and the Goths under Theodoric in Italy. But we have no record of their manner of operation, nor can we say in what way the mining of mediæval

times grew out of this ruin of ancient mining. There is a chasm of centuries not bridged by historic records.

It is scarcely necessary for me to trace the evident parallel between the histories of Roman and American mining. The Romans, by an injudicious system of administration, plundered and wasted the then available resources of the known world; and when they awoke to the extent of the mischief it was too late to repair it. The system of indiscriminate free mining, permitted in this country for the last few years, though outwardly unlike the farming out of the Roman mines, possesses the same fatal evil. The mines are worked by those who have but a temporary interest in them, and do not hesitate to rob them for present gain, thus wasting the resources of the State. In ancient times, only despotism could cure such evils; but I am one of those who believe that freedom has means not less effective for reform, and I hope to establish on a firm historical, as well as philosophical basis, the propositions which I shall, in the present report, recommend as the true foundation for a democratic jurisprudence of mines.

CHAPTER XXIV.

MINING LAW IN THE MIDDLE AGES.

Mining is the only industry which extends its activity into the earth's interior.* The accidental boundaries which topography or commerce may give to landed estates can scarcely be the limits for the extent of underground work, which is rather controlled by the dimensions of subterranean mineral deposits. Mining was therefore even in pre-historic times already separated, as an independent industry, from other exploitations of the soil. It is carried on neither within the same boundaries nor by the same persons as agriculture. Under the influence of this distinction peculiar legal relations were established in Germany at a very early day, probably at the commencement of systematic mining, which have for their subject the subterranean deposits, and are not dependent upon the ordinary laws of property. In the form of a local custom, obtaining with remarkable uniformity in all the original centres of German mining, the principle of mining freedom (*Bergbaufreiheit*) established itself, permitting all persons to search for useful minerals, and granting to the discoverer of such a deposit the rights of property within certain limits. This principle of free mining emigrated with the German miners to all places whither their enterprise extended itself, and the original local custom became the general law. In this existence of an estate in minerals, entirely independent of the estate in soil, lies the distinctive character of German mining law. It is eminently a special law, not subordinate to the civil law, but co-ordinate with it. Its rules and maxims are self-created, and based upon its own peculiar experience. Where the mining freedom of which we have spoken does not exist, where the owner of the soil possesses, as in England, the exclusive right to the minerals contained in it, there can be no such thing as a distinct mining law.

The Roman law gave, as a rule, the mineral right to the land owner; but the opposite principle seems to have sprung up spontaneously in

* For a more elaborate discussion, see, among other works, the admirable commentary on the new mining law of Prussia, by Councillor R. Klostermann, from whose introduction the first paragraphs of this section are substantially borrowed.

Germany. The earliest record of the German custom is the mining treaty between Bishop Albrecht, of Trent, and the miners immigrating from Germany to that locality, bearing date, March 24, 1185. In 1208 the mining customs were officially announced in Trent. The formation of the Iglau code in Moravia took place about 1250, and this system was rapidly extended through Bohemia also. The Schemnitz law in Hungary was formed somewhat later, but coincides exactly with that of Iglau. The code of Freiberg, in Saxony, was probably brought from the Harz, since Freiberg was first settled by Goslar miners. Its publication took place in the 14th century. The mining regulations of Massa, in Tuscany, date from the middle of the 13th century. The uniformity of these laws is striking, and extends not only to the common principle of free mining, but to special provisions thereunder, and even to certain formulated maxims, which lead us irresistibly to the conclusion that they have in the transmitted habits and traditions of wandering miners their common origin.

This origin was much earlier than the records above cited. Mining is known to have been carried on by the Germans at Andreasberg, in the Harz, since anno Domini 968. The famous Rammelsberg mines at Goslar were discovered anno Domini 972 by the pawing of a steed, named Rammel, tied to a tree in the forest. Before the return of the master the horse had "developed" a promising vein of ore, and the mountain was baptized in his honor. The Freiberg district was discovered about 1165, by a teamster of Goslar, who picked up a rich specimen of ore while passing through the then unpopulated region. A stampede of miners from Goslar, and the opening of many valuable mines, was the result. Since 1547 the mines of Freiberg have been steadily producing. The mines of St. Annaberg were discovered by one Daniel, said to have been guided by a celestial flame. The mines of Schneeberg were found about 1470 by a spice pedlar from Zwickau, who, travelling by this mountain, noticed a discoloration of the soil, and set some laborers at work. In 1477 the great mass of native silver was found at Schneeberg, and honored by the elector Ernest, who used it on a memorable occasion as a dining table. It was a slab nearly a foot thick, and about 12 feet long by 6 broad. When it was melted, it yielded some 20 tons of silver. The mines of Marienberg date from 1521, and those of Mansfeld, which are still prosperous, from 1199. But older than any of these is Hungarian mining, which can be traced as far back as A. D. 750. Reitemaier* says the German mines were undeniably opened by miners from Gaul; but I think it fair to conjecture from the great antiquity of Hungarian mining, that there was also a direct current of progress from the east, perhaps not unconnected with those operations of the tribes of the Danube to which allusion was made in a previous chapter. Whatever mining the Gauls did was done under Roman law, and certainly there is no trace of that law in the history of German mining. In this case, as in many others, the tide of Latin ideas broke in vain upon the rocky Saxon character, and retreating left no marks but such as time speedily erased.

The earliest records of mining law in the middle ages do not create, they only recognize and establish, the customs which were even then already old. If the source of these customs is lost in obscurity, so also is their gradual development; for, as I have said, the earliest publication of them was made in Trent—in other words, in a foreign land, where they came into collision with existing systems. Of their peaceful growth at home we have no trace. They suddenly appear in history, adult and strong. But they soon met with opposition and modification at home,

* *Geschichte des Bergbaues, etc. bei den Alten Völkern, p. 150.*

where the emperor and the territorial sovereigns laid claim, at the end of the 12th century, to the mining royalty. The German mining law is a product of this antagonism—a compound of mining freedom with mining royalty—(*Bergfreiheit und Bergregal*.) The contest between the two principles occupied part of the 13th and 14th centuries. It was the south against the north, Egypt against Siberia.* The proud dynasty of Hohenstaufen began the war. Frederick I claimed the mines of Trent as imperial royalties, (*regalia*), and forced the bishop to accept a lease of them. The mines themselves were not interfered with. All that the emperor desired was a recognition of his prerogative, as a support to future claims; and, in general, the struggle of the German emperors for the royalty of mines was prompted, not by their desire to appropriate and work them, but by their claim of the right to levy on mining imperial taxes, independently of the different legislatures and sovereigns of the empire. Meanwhile, the territorial rulers saw their advantage in promptly adopting and employing for their own interest the theory of royalty, and finally the owners of the soil made themselves heard, and obtained a certain recognition of their claims to some non-precious metals.

During this conflict of ideas contradictory principles were proclaimed by different parties; and the thirteenth century presents a scene of confusion and uncertainty as to the relations of emperor, prince, landlord, and miner. The famous "Golden Bull" of Emperor Charles IV, dated January 9, 1356, simplified the contest by excluding from it two of the conflicting parties. That emperor was more inclined to augment his hereditary power as a Bohemian prince than to increase the prerogatives of his imperial authority, which would pass to some other German sovereign after his death. He therefore, in the imperial law referred to, surrendered the claims of the emperor in favor of the electors; and in fact the result of this partial surrender was the actual exercise of mining royalty by all the other sovereigns, as well as the electors. But the Golden Bull excluded also the land owner, putting all metals, precious and base, together with salines, under one rule, namely, the right of the territorial sovereign. Two forces were now left face to face, the royalty of the princes, recognized by the emperor, and the principle of free mining, already repeatedly recognized to a greater or less extent by the princes themselves. The relations of these two forces were not determined by the Golden Bull, which left the princes free to enforce their claims as far as they had already done so, or might be able to do so in future. The issue of the conflict, thus left to time, was different in different states; but the essential victory remained with the miners. The princes recognized the right of free prospecting and the right of the discoverer to the mineral deposit discovered, reserving to themselves only the usual tribute (finally the tithe) and the rights of police and magisterial jurisdiction. But although mining freedom thus obtained practical recognition, the rights of the sovereigns were exercised in exceptional cases in opposition to this principle. Mines and whole mining districts were granted without reference to the discovery; and the occasional feature of special grants was accepted as a part of the jurisprudence of mines. The procedure necessary to obtain property in minerals also suffered a change. Mere occupation by the discoverer was no longer sufficient; he must "denounce" his claim, and obtain his lease from the prince or his delegate—generally a regularly constituted office or court of mines, (*Bergamt, Bergbehörde*.) The maxim was still preserved, "The first finder is

* See remarks on Egyptian and Siberian mining in a previous chapter.

the first claimant;" but the greater weight was laid upon the "denunciation," (*Muthung*,) and the right of the discoverer was forfeited if he failed within a brief period to make his discovery known in the appointed manner. The princes of different states made use of their power to extend and modify existing regulations, so that mining codes proper took the place of the mass of traditional usages which had accumulated through four centuries, and which might have been called by partial analogy the common law of mines.

German mining codes of the sixteenth and seventeenth centuries.—One of the first steps taken by sovereigns to confirm by exercise their rights of royalty, was the endowment of certain cities and districts with peculiar privileges, on account of their mines. Turin and Vallensasco, in Italy; Mont Saut, in Languedoc; Truro and Pensance, in Cornwall; the Isle of Wight; Grünberg, Engelberg, and Melchthal, in the canton of Unterwalden; several iron mines in the canton of Berne; the Black Erzberg, in the valley of Filisur; Mount Guntzen, in the Alps; Goldberg, Reichstein, Zuckmantel, Kupferberg, and Gieren, in Silesia; Cremnitz, Schemnitz, Altsol, Neusol, Königsberg, Puggany, Tyller, and Eperies, in Hungary; Smaland in Sweden; and Casan in Tartary, are examples of this practice outside of Germany. The mining cities of Germany were very numerous. The Harz alone contained seven, which exist to this day, St. Andreasberg, Altenau, Clausthal, Zellerfeld, Grund, Lautenthal, and Goslar. In Saxony, and particularly in the realm of the Counts of Meissen, was the "ancient and honorable free mining city" of Freiberg, originally called Freistein, the origin of which is interesting as an illustration of the history of the period. The Freiberg district, as I have said, was discovered about 1165 by a teamster of Goslar, (the locality of the famous Rammelsberg mines in the Brunswickian Harz,) and first settled by miners from that place. A few years after, Duke Otto of Brunswick quarrelled with his director of mines, (*Bergvogt*,) and the latter, to revenge himself, marched to Saxony with all his workmen. They were joyfully welcomed by the Margrave, who not only granted them extraordinary privileges, but also, for the protection of the Freiberg mines in those uncertain times, surrounded them in 1176 with walls, and built the castle of Freistein in the midst of them. Saxony has many other mining cities, among which may be named St. Annaberg, Schneeberg, St. Georgenstadt, Schwarzenberg, Marienberg, localities of silver mining, and Altenberg, Eibenstock, Scheibenberg, Wolkenstein, and Ehrenfriedersdorf, localities of iron and tin mining. Arensburg at Cologne, and the copper mines of Riegelsdorf in Hesse, are also mentioned among the privileged mining districts. Watering-places were generally favored also, as appears from the following passage in an old essay on mining royalty :

Regarding mineral springs, hot and metallic baths, it is not considered that a great prince should make a royalty of them, or demand of the guests at such places any payment for their use. For Almighty God did not cause these springs to flow for the sake of princes and rich people only, but also, and perhaps chiefly, for the healing of the poor. And it is to be feared that they may dry up, if this gift is abused, as indeed was the case with the Griesbach, not far from Strasburg, the water of which disappeared when a certain duty was imposed upon the spring, but reappeared again as soon as the duty was removed. For this reason the Emperor, Charles IV, granted a privilege to the Wildbad of the Canton Berne. If a prince, however, should tax lightly the guests at any spa and use the money for their benefit, as, for instance, in the erection of a church in that place, he may not be reproved.

The principal German mining codes (*Bergordnungen*) of this period are those of Electoral Saxony, Cremnitz and Schemnitz in Hungary, Treves, Joachimsthal, Brunswick-Lüneberg, Zohnstein, &c. There is also a Danish mining code, and a good statement of general principles in the celebrated work of Agricola, *De Re Metallica*. It would be scarcely profitable at this time to review these different systems in detail,

or to burden the general description which I propose to give with constant references to particular sources of information. It will be quite sufficient for my purpose to present a picture of those features in which the codes of this period substantially agree, in order to show the general nature of the system which obtained throughout middle Europe during the period of "paternal government"—a period when political economy was imperfectly understood, and the doctrine that sovereigns might interfere for their own private ends with individual industry was replaced by the notion that governments ought to regulate for the general good all the affairs of the people.

It was principally the flow of precious metals, and afterwards of other products, from America to Europe which brought the industrial problem of the sixteenth and seventeenth century, and placed commerce in antagonism with the hitherto accepted maxims of government. At the end of the fifteenth century the value of the precious metals in Europe reached its maximum. The price of grain in 1494 was only half as much as in 1399; but it rose in the sixteenth century (or in other words gold fell) to three times, and in the seventeenth century to five times, the price of 1494. The effect of this change on mining was disastrous; and the arbitrary measures taken, in accordance with the spirit of the age, to abate the evil, of course failed of their intended effect. It must be remembered that at this time the laws regulating the guilds prescribed precisely how many masters, journeymen and apprentices there should be in every trade and what wares they might or might not produce; workmen were not allowed to labor outside of their proper city; heavy penalties attended the importation of any article which, in the opinion of the guilds, could as well be manufactured at home. It is not surprising that mining also was administered by the state under a bureaucratic system, and on false notions of political economy. It is amusing to read that in one instance the increase of the number of coal mines was forbidden, *lest the expense of so many deep workings should raise the price of coal*, while at the same time the owners of mines nearest the market were prevented from working, because it would not be fair to those whose mines lay further away! In spite of such follies as these, however, there grew up an elaborate and in many respects very wise system of administration, much of which has remained to the present day, and is well worthy to be studied.

A scheme of the organization of this industry would be something like the following:

1. The sovereign.
2. The director of mines, (*Berghauptmann.*) This officer represents the government, and is the highest authority. There may be more than one in the same state if it is a large one. Prussia recently had five, besides one chief director of mines, who was at the same time a sort of minister without a vote (*Vortragender Rath*) in the royal cabinet.
3. Mining councillor (*Bergrath.*) These are inspecting and consulting officers, who make periodical tours through the districts under their charge, and report to their superior. The director of mines and the councillors include within their duties also the administration of smelting works; but all ranks below them are restricted to one or the other department.
4. Master of mines, master of furnaces, (*Bergmeister, Hüttenmeister.*) This officer has charge of a single district, and inspects weekly.
5. Sworn inspectors of mines or of furnaces, (*Berggeschworene, Pochgeschworene.*) These officers inspect daily.
6. Surveyor, (*Markscheider.*)

These six grades must be filled by men of thorough education as well as experience.

7. Captains and foremen, (*Bergsteiger, Pochsteiger, Untersteiger.*) These officers may or may not be graduates of schools. They are chosen for their faithfulness and practical ability, and are constantly under the supervision of the various inspecting engineers.

8. At the smelting works there are assayers, counter-assayers, &c., and there is a paymaster (*Schichtmeister*) elected by the miners and confirmed by the mining court, who takes charge of the accounts of several mines at once.

This is an outline of the system which still prevails substantially in Germany. I am far from recommending, as the sequel will show, the adoption of such a plan by the American government; but mining companies in different districts would be greatly benefited if by free and voluntary association they could effect a similar cheap and effective administration. Under such a system the whole mining enterprise of the Comstock lode could have been superintended by the ablest men in the country at one-quarter the expense which has been incurred under the multiplied administrations of different companies.*

As I have said, great weight is laid, in the ancient codes, upon the denunciation of claims. Prospecting seems to have been in most cases unhindered. Says a German writer:

Here occurs the question whether a private person has any right to dig for and mine metals on the ground of another. A doubtful question *a priori*, since "no one may go a-hunting on another's land." It is also forbidden for any one to seek treasure on the land of another, and we might naturally suppose gold and silver mines to be meant; nevertheless the contrary is declared, in view of the general benefit from the production of metals, and the particular advantage of the royalty to the coffers of the state.

This freedom of prospecting was, however, limited so far that the foundations of buildings must not be injured, and all damages done to the surface or to agriculture must be paid. The discovery of a vein must be immediately made known to the master of mines by a denunciation, either written, or, if oral, then followed within three hours with a written one. The master of mines must see that the first discoverer is not cheated of his rights. He also exercises a general authority over all the prospecting work, and when the vein is actually exposed, he issues upon the denunciation aforesaid a permit to work it, (*Muthzettel, Muthschein.*) No such permit can be issued unless the denunciation contains an accurate description of the locality of the vein; until such a definite statement is possible the work proceeds merely as prospecting. After the permit is issued, the miner may go on until he has developed the true dip and course of the vein and opened it to a sufficient depth to require "bucket and rope" for his operations. At this point the master of mines orders a survey and location of the field, which is then regularly leased to the holder of the preliminary permit. Denunciations of placers (*seifen*) may also be received, but the master must then visit the place in company with the royal gamekeeper and forester, and satisfy himself that the proposed operations will not be hurtful to timber, game, irrigating or draining canals, etc., when he may give a license for placer mining. This license, however, he may revoke at any time; and if wilful damage is done in these respects by the placer miners, he may not only eject them, but hold them for the repair of the said damage, and even proceed, if required, to punish them for the wrong committed. The erection of stamp-mills, etc., he may authorize, if not to the injury of others already erected. All mining leases require the work to be continuously prosecuted. Parties engaged in making preparatory shafts and tunnels are

* See chapter on Comstock mines, in this report.

allowed no interval, unless they are miners at work part of the time elsewhere. This provision was evidently intended to encourage prospecting by the workmen in their leisure hours, and to give them a chance to become mine owners on their own account; but at the same time to prevent capitalists from commencing work and then dropping it, while continuing to claim such rights as would exclude other adventurers. After the mines are open and ore is struck, the making of the survey and application for a lease is peremptory, and when the lease is once issued, certain delays, caused by natural necessity, are to be permitted; foul air or much water are good excuses. The longest interval of idleness, however, must not exceed one quarter for silver and two quarters for base metals. Other claimants offering at any time during such an interval, "time is called" upon the idle lessees, and they must presently resume operations or lose the lease, which may then be issued, upon new denunciation, to others. Parties receiving permits to reopen abandoned mines are not obliged to specify the vein or veins they will work, but must report them and take leases upon them as soon as they are discovered.

Leases were generally subject to the royalty, usually 1-10 or 1-20 of gross product, paid to the sovereign. Where the mines were upon private lands, the landlord received a second tithe in lieu of damages. It was common also to give the Elector, "by ancient usage," one-eighth of the stock in every leased mine. This he retained, liable to the same assessments as any other stockholder, and if he at any time declined to pay his share of assessments his stock was forfeit. Poor mines, and in many cases iron mines, were freed from the oppressive tithe. Yet the coal mines were frequently held subject to the metallic royalty. The Counts of Schaumburg are said to have derived as much revenue from coal as other princes from silver. In Holland and Lower Saxony, even peat was laid under royalty, and it was not uncommon to include the manufacture of saltpetre in the same category.

Mining leases covered a certain area of the surface and a space below the surface, either bounded by vertical planes or by surfaces parallel with the dip of the vein. The first was called a square location, (*gevierdtfeld*), and the second an inclined location, (*gestrecktfeld*.) The practice of following to any distance outside of the vein leased the "dips, spurs, and angles," was unknown; and I am unable to discover any traces of it in ancient or modern times except in the mining customs of this country. The possessor of an inclined location was generally allowed to work about 30 feet in the hanging wall, and the same distance below the foot wall, (*Vierung, viertelhalb Lachter ins Hangende, und viertelhalb Lachter ins Liegende*.) Within these limits all the ore discovered might be extracted by the lessee. In case of veins crossing the elder location took precedence, but could only maintain the right to a zone of 30 feet on each side of its vein. In cases of doubtful controversy the matter was compromised by a union of the two mines. The simple square location was applied to beds, masses, and even to true veins, when they possessed a dip of not more than 15° below the horizontal plane. The size of this kind of location varied with the locality and the circumstances, such as the number of associates or stockholders, etc. A frequent size seems to have been about 200 feet square, with the discovery shaft in the centre. The length of a claim upon a vein was also variable. In Freiberg, I believe, 400 feet were allowed; in Hungary 200, and elsewhere, ordinarily, 300. According to the general rule, the discovery shaft stood in the middle of the claim. A mine was generally divided into 128 shares, (*Kuxe*), which might be held by one man, if he could afford it; but such was scarcely ever the case. An old

authority says "a silver mine needs 32 stockholders, a copper mine 16, and a tin mine 8."

Wood for timbering was furnished, when possible, by the royal forester. Where there were no crown lands and forests, the companies must agree with the owners of timber, and it was the duty of the master to preserve harmony and fair play between the two interests. The mines were mostly worked under contracts with the laborers, and the price per foot or fathom (*Lachter*) was fixed by the master and sworn inspector, according to the varying hardness of rock and difficulty and danger of the work.

The driving of adits or deep tunnels was the privilege of the prince, but it was almost universally permitted, under certain regulations, to private parties. There were peculiar rights connected with such a work. One was the tunnel-right, (*Stollenhieb*), entitling the lessee to all ores found within about eight feet (5 *Viertellachter*) above the water level of the tunnel, and for a distance of two feet on either side. The second right was the tunnel-royalty, (*Stollengerechtigkeit*), entitling the tunneller to one-ninth of the profits of any mine drained and ventilated by his tunnel. To gain this, however, the tunnel must really and effectively drain and ventilate; and this royalty might be taken away by the opening of a deeper tunnel, which thus acquired the right to one-ninth the mining profits. In order to gain either of these privileges a tunnel must be a certain distance "under grass"—in Saxony 70 feet, and in some states as much as 120. A new tunnel, in order to be entitled to the royalty already enjoyed by an older one, must strike the mine at least 30 feet deeper. Special contracts were frequently made between tunnels and mines, by virtue of which, when the ninth was too onerous and the mine was in danger of failure, a lower royalty was accepted.

CHAPTER XXV.

THE SPANISH MINING LAW.

The essential features of this law were given in the first report of Hon. J. Ross Browne, (page 257,) and I shall only recapitulate a few important facts in regard to it, referring to that report and to the full compilation of Mr. Rockwell.* The royal ordinance of the King of Spain, published in 1783, has been ever since substantially in force in Mexico. It asserts the right of sovereignty over all species of metal, and authorizes the concession of mineral rights only while the mine is worked. It is also very full in its directions as to the manner of mining, experience having shown that a mere temporary ownership of mines tends to a reckless and insecure method of exploitation. This law is remarkable for an attempt to reconcile the two systems of square and inclined locations by an elaborate graduation of the size and shape of the surface claim according to the dip of the vein. Chapter VIII of the ordinance, containing this plan, deserves to be quoted. It runs as follows:

SECTION 1. Experience having shown that the equality of the mine measures established on the surface cannot be maintained under ground, where, in fact, the mines are chiefly valuable, it being certain that the greater or less inclination of the vein upon the plane of the horizon must render the respective properties in the mine greater or smaller, so that the true and effective impartiality which it has been desired to show towards all subjects of equal

* A Compilation of Spanish and Mexican Law in Relation to Mines, &c., by J. A. Rockwell, New York, 1851.

merit has not been preserved; but, on the contrary, it has often happened that when a miner, after much expense and labor, begins at last to reach an abundant and rich ore he is obliged to turn back, as having entered on the property of another, which latter may have denounced the neighboring mine, and thus stationed himself with more art than industry—this being one of the greatest and most frequent causes of litigation and dissension among the miners—and considering that the limits established in the mines of these kingdoms, and by which those of New Spain have been hitherto regulated, are very confined in proportion to the abundance, multitude, and richness of the metallic veins which it has pleased the Creator of his great bounty to bestow on these regions, I order and command that in the mines where new veins, or veins unconnected with each other, shall be discovered, the following measures shall in future be observed:

SEC. 2. On the course and direction of the vein, whether gold, silver, or other metal, I grant to every miner, without any distinction in favor of the discoverer, whose reward has been specified,* 200 yards, taken on a level, as hitherto understood.

SEC. 3. To make it what they call a square, that is, making a right angle with the preceding measure, supposing the descent or inclination of the vein to be sufficiently shown by the opening or shaft of 10 yards, the portion shall be measured by the following rule:

SEC. 4. Where the vein is perpendicular to the horizon, (a case which seldom occurs,) 100 level yards shall be measured on either side of the vein, or divided on both sides, as the miner may prefer.

SEC. 5. But when the vein is inclined, (which is the most usual case,) its greater or less degree of inclination shall be attended to in the following manner:

SEC. 6. If to one yard perpendicular the inclination be from three fingers to two palms,† the same hundred yards shall be allowed for the square, as in the case of a vertical vein.

SEC. 7. If to the said vertical yard there shall be a departure of—

Amount of departure.	Side of square allowed.	Dip, in degrees.	Depth.
Two palms, three fingers.....	112½ yards.....	60° 39'	200 yards.
Two palms, six fingers.....	125 yards.....	58°	do.
Two palms, nine fingers.....	137½ yards.....	55° 30'	do.
Three palms.....	150 yards.....	53° 08'	do.
Three palms, three fingers.....	162½ yards.....	50° 55'	do.
Three palms, six fingers.....	175 yards.....	48° 50'	do.
Three palms, nine fingers.....	187½ yards.....	46° 50'	do.
Four palms.....	200 yards.....	45°	do.

So that if to one vertical yard there correspond a departure of four palms, which are equal to a yard, the miner shall be allowed 200 yards on the square of the declivity of the vein, and so on with the rest.

SEC. 8. And supposing that in the prescribed manner any miner should reach the perpendicular depth of 200 yards, by which he may commonly have much exhausted the vein, and that those veins which have greater inclination † than yard for yard, that is to say of 45 degrees, are either barren or of little extent, it is my sovereign will that although the declivity may be greater § than the above-mentioned measures, no one shall exceed the square of 200 level yards, so that the same shall always be the breadth of [claim upon] the said veins by the length of 200 yards, as declared above.

SEC. 9. However, if any mine-owner, suspecting a vein to be run in a contrary direction to his own, (which rarely happens,) should choose to have some part of his square [laid off] in a direction opposite to that of his principal vein, it may be granted to him provided there shall be no injury or prejudice to a third person thereby.

SEC. 10. [Provides that banks, beds, or other accidental depositories of gold or silver shall be apportioned into claims by the miners themselves, attention being paid to the richness of the place and to the number of applicants, and preference given only to the discoverer. The government reserves the right to revise such local mining regulations so as to prevent unfair dealing.]

* The reward of the discoverer (chap. iv, secs. 1 and 2) consists in three "portions" of the vein when in a mountain where no shaft nor mine has ever been opened before, and two portions when in a mountain known and worked in other parts. This grant is conditioned upon denunciation within 10 days, and, like all others, becomes void by four months' neglect to work the mines.

† This corresponds to a "dip," as now estimated by mining engineers, measured by the angle between the plane of the lode and that of the horizon, of 85° 25' to 63° 20'. In the following section I have added to each specification the dip in degrees, and also the depth in yards at which, according to this law, the vein, if it held a regular dip, would pass out of the mining field into the neighboring one.

‡ The word "inclination" is the same as I have previously translated "departure," and a greater inclination than 45 degrees would be, in modern phrase, a smaller one, that is, "he vein would dip less than 45 degrees below the horizon. See remarks on this section, below.

§ Less.

SEC. 11. The portions being regulated in the manner described above, the denouncer [that is, each claimant] shall have his share measured at the time of taking possession of the mine, and he shall erect around his boundaries stakes or landmarks, such as shall be secure and easy to be distinguished, and enter into an obligation to keep and observe them forever, without being able to change them; though he may allege that his vein varied in course or direction, (which is an unlikely circumstance;) but he must content himself with the lot which Providence decreed him, and enjoy it without disturbing his neighbors. If, however, he should have no neighbors, or if he can, without injury to his neighbors, make an improvement by altering the stakes and boundaries, it may be permitted him in such case, with previous intervention, cognizance, and authority of the deputy of the district, who shall cite and hear the parties, and determine whether the causes for such encroachment are legitimate.

It is frequently said that the Spanish mining law is the best that was ever devised. It certainly is one of the most elaborate, and perhaps was well fitted to the knowledge and social conditions of the era when it was formed. But a careful study of it is sufficient to show that it is now antiquated. The chapter above quoted, for instance, is evidently based on two assumptions: first, that mineral veins very seldom change their course and dip, and that an opening ten yards deep is enough to show what these characters are; and second, that no mine can be profitably worked to a greater depth than 200 yards. The first of these assumptions is not justified by experience; and the second has long since been rendered obsolete by the steam-engine, deep tunnels, and other appliances of modern engineering. The Spanish system in Mexico has certainly stimulated mining, after a fashion, in that country. The mines of Mexico have produced vast quantities of bullion, but a closer examination reveals that the art of mining itself has made little progress; the lack of permanent proprietorship has led to reckless robbery of mineral deposits; very valuable veins have been so unskillfully opened as to render deep workings impossible; the profits of mining have not been expended in permanent improvements, but either carried out of the country or wasted in civil wars; in short, Mexico has been plundered, not developed. She is just so much poorer to-day by the millions she has yielded to man; and those millions are proof only of the magnificent endowment which nature bestowed upon the land, not of any extraordinary wisdom in its administration. At the present time the policy of the Mexican government is to tax mining just as much as it will bear. A recent reduction in the exorbitant charges upon the extraction and exportation of bullion was the result merely of the determination of the mining companies to stop work if these tyrannical exactions were continued; and I do not yet see the signs of an intelligent and liberal policy towards this industry. The spirit of old Spain, which regarded the treasures of the earth as a prize to be avariciously grasped and selfishly appropriated, is still dominant in republican Mexico. An indolent people desires mining to prosper, not that agriculture, manufactures, and all other forms of industry may also prosper, but that all these industries may be unnecessary. The cure for this evil is to alienate the mines from the government, make them private property, put them on a level with other property, relieve them from unjust taxation, and make them a part of a wise general system of internal administration. Whether such a change could be effected as would extend the miner's title along the dip of the vein in depth, I do not pretend to decide. In Prussia the inclined location has been abolished; but that country has been so long the scene of mining operations that almost every group of mineral veins has been sufficiently explored to determine its peculiarities. Hence, by a proper selection of ground on the surface, a mining lessee may secure all the advantages of an inclined location. Whatever be the case in Mexico in this respect, it is, I think, quite necessary at present in our comparatively unexplored mining regions to give the miner what in early days the German law gave him, the right to follow his vein.

CHAPTER XXVI.

MODERN GERMAN CODES.

The elaborate administration of the mining interest on the part of the state which characterized Germany in the middle ages is giving way to a more democratic policy. Even so late as a century ago, the mining code of Frederick the Great made it the duty of the authorities to superintend all mining operations, to inaugurate them in one district, regulate them according to scientific principles in another, or sustain and protect them where they were already properly established. This policy is no longer necessary. The spread of knowledge and the activity of commerce renders it safe to leave to the mining communities in the main the management of their own affairs. The new Prussian mining law, which took effect October 1, 1866, replacing the former systems of Prussia, Nassau, Hanover, Electoral Hesse, Frankfort, and other provinces, presents the best example of the modern idea, in which education takes the place of government; and I shall content myself with a brief review of its characteristic features, omitting any detailed description of the present codes of Austria, Saxony, and other German states, as prolonging too far this already extended historical sketch.

1. According to the general mining law of Prussia,* the following minerals are excluded from the proprietary rights of the land-owner: Gold, silver, quicksilver, iron, (with the exception of bog-iron ores,) lead, copper, tin, zinc, cobalt, nickel, arsenic, manganese, antimony, sulphur, ores of alum and vitriol, pit coal, brown coal, graphite, rock salt and other salts occurring with it, and salt springs. These minerals are objects of mining, and the law prescribes the manner in which a title to them can be obtained. The state surrenders entirely its claim to mineral rights, and stands henceforward on the same footing as private citizens, retaining only the rights of police, justice, and finance, which it exercises over every other form of property and labor. Special grants, made under the ancient system, are not interfered with. To be properly objects of mining, the minerals enumerated must be (1) in their natural deposits, and (2) in such forms as can be utilized. Alluvial deposits, such as gold or tin placers, are included; the rare metals, precious stones, amber, petroleum, &c., are either left to the land-owner or made subject to special regulations. Marble and building stone generally are not held as objects of mining. In provinces once Saxon, as in the present kingdom of Saxony, coal belongs to the owner of the surface.

2. Prospecting, (*Schürfen*), whether by open cuts, pits, shafts, tunnels, or bore-holes, is allowed to all under the following limitations: It must not be carried on upon any public square, street, or railway, nor in graveyards, nor in places where the authorities forbid it on grounds of public interest, nor, without express consent of the owner, within 200 feet of any building on grounds belonging to the same, nor in gardens or yards. Whoever wishes to prospect on the grounds of another must seek his permission, but every land-owner must give such permission to all applicants, unless some one of the objections above enumerated can be shown to exist. Probable injury to wells, mineral springs, ponds, or neighboring mines is sufficient ground for prevention of prospecting by the mining authorities. The prospector is bound to pay the land-owner annually

* Perhaps the best manuals on this subject are those of Mining Councillor R. Klostermann, Berlin, and Director A. Huyssen, of Halle, both of which I have freely used, in various portions of this report.

in advance for the use of his land, if it be necessarily withdrawn by the prospecting operations from other uses, and to return it to him at the close of such occupancy, with damages for any depreciation of its value. All disputes arising are settled by the proper court. The prospector must make formal application in every case to the authorities, and receive the necessary license, before commencing to work. The proprietor of mines in operation cannot forbid prospecting in his field for metals to which he has not acquired the right; but, like the land-owner, he may demand security in advance for possible damages to his own property; and, when the new prospecting work actually threatens the safety or the undisturbed operation of the older mines, the authorities may refuse to allow it. But the owner of a mine has the preferred right to apply for permission to work for other metals than those already granted to him if the authorities decide that the former had better be mined in common with the latter. If the prospector, therefore, discovers them, the previous miner in the same field may claim them.

3. The discovery of a vein must be followed by its regular denunciation, (*Muthung*.) This act, like the recording of a claim in American mining districts, gives the miner at once the right of property in the mineral. The denunciation, which is also an application for license to mine, is made in writing, and in duplicate. Each copy is endorsed with the day and hour of presentation to the authorities, and one is then returned to the applicant. It must contain the name and residence of the applicant, the name of the metal or metals to be mined, a description of the locality in which the vein or deposit has been discovered, and the title by which the mine is to be known. A title already applied to a mine in the same district is not allowable. As I have said, the mere presentation of this document gives the applicant a *prima facie* ownership; but this right is still conditioned upon the investigation of the mining authorities, as to the validity of the alleged discovery. The metal or metals mentioned must be found, by official examination, to exist at the point described, in natural deposit, *i. e.*, not brought there by human agency, and in such quantity as to justify mining. The latter question is a delicate one, and the facts are generally construed with great liberality towards the applicant, who, after all, assumes the greatest risk of loss, if the deposit be poor. But certainly the rights of a land-owner are not to be disturbed to favor some crack-brained adventurer who has found a seam of coal an inch thick, or a lump of galena as large as a walnut. Under this rule the mining authorities of Bonn refused to grant a license on the strength of a few particles of pyrites in the rock. It should be also borne in mind that such a refusal is no real hardship to the prospector, unless he desires to deceive some one, or the public, as to the value of his claim. He is still free to continue prospecting as before. Finally, the authorities have to be satisfied that the proposed concession of a mining field does not conflict with the rights of other parties, whether earlier discoverers or neighboring mine-owners. For this purpose due notice must be given, and a certain time allowed. Meanwhile, the applicant must have the field surveyed by the official surveyor, and file duplicate maps, upon which the discovery-point and boundaries are laid down. This must be done within six weeks after the denunciation, otherwise the latter fails of validity—a very important provision, calculated to secure the *bona-fide* prosecution of a claim by the discoverer. The actual discoverer of a vein has, for one week after his discovery, the prior claim, even though another make earlier denunciation; but after the lapse of that period the date of denunciation determines priority of right.

4. Mining rights are granted, as far as possible, in fields bounded on the surface by straight lines, and in depth by vertical planes. The ancient custom of granting "inclined locations" on the dip of the vein is thus entirely abolished, and modern authorities in Europe do not hesitate to condemn it as productive of great uncertainty and litigation.* The size of the field on the surface may be a little over five acres in most parts of Prussia, but is restricted to quarter of an acre in a few districts, for special reasons. These areas give only the maximum; of course smaller fields may be granted. The shape of the field may vary, straight lines being the boundaries, and the greatest length not exceeding for a five-acre field about 13,600 feet (2,000 Prussian *Lachter* or fathoms,) and for a quarter-acre field one-fourth that distance. The discovery-point must lie within the field, though not necessarily in the centre.

5. All preliminaries being complete, the deed (*Verleihungsurkunde*) is made out in the name of the king, and published in the official newspaper of the district. It contains the name, business, and residence of the grantee, the name of the mine, the area and boundaries of the field, with a description of its location as to parish, county, civil and mining districts, the names of the metals to be mined, the date, and the seal and signature of the authorities. Three months are allowed for the assertion of conflicting claims, after which the rights of such claimants, in ordinary cases, expire.

Under certain conditions, which I will not pause to enumerate, the consolidation of adjacent mines is permitted. The division of one field into several, or the exchange between neighboring mines of portions of their respective fields, is generally permitted by the authorities; but such divisions or exchanges are not permitted as would leave segregated mining fields too small to be worked independently.

6. The nature of the property thus conveyed to the grantee is defined as "the right to obtain and utilize the minerals excluded for reasons of political economy from the title of the land-owner, and to construct, above and under ground, all necessary buildings and apparatus for this purpose." This right may be sold, mortgaged, and levied upon, like real estate. It must be exercised, however, under certain regulations, justified by the general good, and fixed by the state, and, when these conditions are not complied with, the right itself may be impaired or forfeited. A few of the more important conditions will be enumerated. The mine-owner is bound to keep the mine in operation, if so required by the authorities. It is no longer, as formerly, forbidden to let a mine lie idle for more than a certain period. On the contrary, work may be suspended at any time, without the formal permission of the authorities; and they can only demand its resumption when clearly required by public interests. A great lack of the metals produced, and an impossibility of obtaining a supply from other quarters, would be a satisfactory reason for such a demand. The owner has six months' time in which to comply with this demand, and, even before it is issued, is entitled to a hearing of his protest. He may also appeal to the minister of commerce. If he intends to resume work, he gives the authorities four weeks' notice of the fact. But if he fails to comply with their demand, they may proceed to deprive him of his grant, unless the circumstances which made the demand proper have in the mean time changed. Every mine must be worked according to a plan, which must previously be submitted to the government officials, and approved by them. If no objection is made, the mine-owner may proceed with his plan. If the plan is

* This question will be found elsewhere discussed, with reference to the particular condition of this country.

objected to, which can only be on grounds of safety to the mine, the miners, and the public, the mine-owner must either convince the authorities that their objections are unfounded, or change his plan to obviate them. Violation of this rule is punished with fine, and if necessary the authorities may suspend operations at the mine. Every mine must have an exact map of the underground workings, and this must be periodically perfected as the work advances. The responsible managers and superintendents of mines must be reported to the authorities, and if necessary examined as to their capacity for their several positions. If a person not recognized as competent by the mining authorities is put in charge of a mine, they may demand his removal, or suspend the operations of the mine until a competent person is appointed. Superintendents are responsible for the proper working of the mines according to the plans agreed upon, and bound to afford the proper officials free opportunity for inspecting the works, and all desired information. The mine-owner is bound to furnish, at stated periods, the statistical information called for by the minister of commerce. He must also permit persons bearing the permission of the authorities to enter his works. (This provision is most beneficial to students at a German school of mines, since they enjoy by virtue of it an opportunity of studying practical operations, such as they could not otherwise obtain.)

7. The mining authorities are: 1. The district officials (*Revierbeamten*;) 2. The supreme mining bureaux (*Oberbergämter*;) and 3. The minister of commerce. The district officials are inspecting and reporting officers or surveyors. The names given in a previous chapter, on the codes of the middle ages, are mostly retained, but the superintendents and mining captains are no longer government officials. The mining bureaux are presided over by the directors, as formerly. They issue licenses and grants, and have the general administration of the law in their hands. The minister is appealed to in the last instance.

8. In addition to these authorities there are the courts, the jurisdiction of which is determined by statutes, and is not at present important for us to consider. It is, however, a fact not without significance that all the German states have various courts, in which cases arising in mining operations may be adjudicated, often without the tedious forms attendant upon ordinary suits. The English court of the stannaries is an institution of this kind, and the English "cost-book" system of stock companies is also the counterpart of the immemorial *Gewerkschaften* of Germany. Our American mining districts contain many examples of mining partnerships or associations of a similar character; and no doubt it will be found advisable in the course of time to establish courts and rules of procedure adapted especially to this state of things, as has been done in all older states. Further remarks on this subject will be found in the chapter on English mining law.

9. The Prussian law in respect to the taxation of mines has been greatly simplified, but there still remain many complicated provisions which must be regarded as legacies of the past. In view of the history of that kingdom under the most remarkable dynasty of modern times, its gradual increase from the original limits of the little duchy of Brandenburg, by constant territorial acquisitions, to its present imperial proportions, and the respect which it has always shown towards existing laws and privileges, and towards its own past contracts and grants, it is not wonderful that those differences in legislation which I have mentioned in a previous chapter as growing up in the petty states of Germany should still be to some extent perpetuated in the provinces of Prussia. The present Prussian mining law is based upon nearly a score of ancient codes, and

recognizes many local exceptions to its general provisions. There has been, however, a steady progress towards unity and simplicity, and the general outline of this progress is instructive.

According to former laws all mines were bound to pay the sovereign a royalty of one-tenth of their gross product free of mining cost to him. This was reduced by the law of 1851 to one-twentieth; by the law of 1861 a gradual decrease was established amounting to one-fifth of the royalty per annum, until the royalty should be reduced to two per cent.; by the law of 1862 iron mines were declared entirely free of royalty, and a new decree established with regard to all mines, by virtue of which, after January 1, 1865, the royalty was to be but one per cent.; and this is the present amount paid to the state under that head. The state pays its share of the expenses of reducing ores, but receives its percentage of gross product free of mining cost.

But in addition to the royalty there were formerly innumerable taxes and commissions paid by the mines to cover the expenses of the scientific and financial administration carried on by the state. In some provinces (as I have said in a previous chapter) the sovereign had a certain share of the stock of every company as a complimentary gift; and on this he could draw his dividends like any other stockholder, being bound at the same time to pay assessments or forfeit his interest. There were quarterly dues, additional quarterly dues, dues for measurements, for specimens, for inspections, for auditing accounts, for supervision and direction, for affidavits, for weighing, for assaying, for surveying, in short for every act which the government officials performed; and these were not fees but fixed sums assessed upon the mines, as a hotel-keeper on the Rhine charges for candles, attendance, etc., the same amount in every guest's account. All these petty payments are now abolished, and in place of them a regular "tax of supervision," amounting to one per cent. of the value of the product, is levied on mines in actual operation. When surveys or other special services are performed for any mine, the official is merely paid a proper fee for his labor. Many of the services formerly performed by the officials may now be done by others, the authorities reserving only the right to insist upon the employment of competent persons. The tax of supervision of one per cent. is therefore nothing more than a contribution from the mines to secure thorough scientific inspection and direction of their works at a far cheaper rate than would be possible under any other arrangement. What American mining company, even among the wealthiest, could obtain the service of a whole board of able engineers and metallurgists, such as the directors and inspectors of every German mining district, by the payment of one per cent. of its product? Certainly in that vast number of our mines which are just beginning to produce, and need more than any others wise counsel and direction, much time, labor, and money are wasted, because competent direction is too expensive. I think it possible to devise a plan, not inconsistent with American ideas of individual liberty, by which the opportunity to acquire such assistance may be afforded to our mining districts. But a national school must first give us the material in the shape of thoroughly trained engineers, before we can expect either legislation or association to secure so great a reform.

To recapitulate: the Prussian law, apart from local exceptions, imposes a royalty of one per cent., which is net revenue to the state, and a tax of one per cent., which the state expends for the good of the mines themselves. I shall urge, in the sequel, that the United States ought to repudiate the whole doctrine of a royalty, as such, and leave the mines free from taxation under that head. The late bullion tax was something of that nature, and

has properly been abolished. But that the mines, thus relieved of all burdens, may rightfully be required to contribute something toward the expense of such necessary provisions for their own benefit as they cannot make, in their isolated condition, for themselves, is a far more reasonable proposition, and one which deserves serious consideration. A tax far lighter than the late bullion tax might be so expended as to save to the mines themselves millions of dollars every year. Prussia received from her mines, in 1865, a little over \$9,000,000 gold (American.) This was partly the product of mines actually worked by the state, and partly the royalty from others. The expense incurred by Prussia on account of the mines in the same year was more than \$7,000,000, leaving a net profit of only \$2,000,000. The steady reduction of taxes under such circumstances shows that the government has adopted the wise and liberal policy of administering the mining law so as to secure, not an immediate revenue to itself, but an energetic and skilful development of the resources of the country, rightly deeming the increased production and use of the metals to be worth more to the nation than a few thousands of dollars, obtained by stifling this most beneficent industry.

CHAPTER XXVII.

THE CODE OF FRANCE.

It was the law of April 21, 1810, in the formation of which the Emperor Napoleon I took so large a part, which gave its present constitution to the mining industry of France. Under the ancient monarchy the mines were regarded as a dependency of the royal domain, and only the sovereign could grant permission for their exploitation. Such grants had only a temporary character, and were most frequently encumbered with onerous conditions of payments into the royal treasury, besides those which in the majority of cases must be made to the owner of the soil.

After the abolition of feudal rights, the mines and mineral deposits of France were placed, by the law of July 28, 1791, at the disposal of the nation, and the government was authorized to make "concession" of them; but this concession was at the same time forbidden to be otherwise than temporary; and, moreover, all that part of every mineral deposit lying within a hundred feet of the surface was expressly reserved to the landed proprietor, who also had a right of preference in obtaining the concession. These provisions nearly amounted to a prohibition of general mining. It was made easy to mine in the case of those persons only who, being farmers, would probably not care, or know how to mine; and it is no wonder that, under these restrictions, little progress was made in the exploitation of mineral deposits.

The law of 1810 declared, in accordance with the Code Napoleon, that the property in minerals goes with the property in land; but stipulated that the government might separate the two, granting the mineral right, even in perpetuity, to another than the land-owner, on the single condition of a tribute paid to the latter. It made this property in minerals negotiable and taxable like any other, putting it on a basis as secure as that of real estate. In this way protection was given to capitalists desiring to engage in mining, and an era of prosperity, previously im-

* This summary of the subject will be found, substantially, in the splendid official publication, *Resumé des Travaux des Statistique de l'Administration des Mines*, 1853-9, page 6.

possible, was inaugurated for the mines of France. The law, in making this distinction between surface and subterranean proprietorship, has included in the class of mines only those substances which by reason of their nature or the manner of their occurrence must be exploited in a certain way, according to special rules. All other minerals are left to the proprietor of the soil, and may be worked under a simple permission, or without such permission, subject to the police regulations established by government. *Minières*, or surface works, such as beds of iron-ore, workable by open excavation, pyritous earths, suitable for the manufacture of copperas, or deposits of peat, require the permission referred to; quarries (*carrières*) of building-stone, marble, granite, sandstone, &c., require only observance of the police regulations. Mines, in the sense of the law, capable of becoming the objects of a concession, include therefore mineral fuels, bitumens, sulphur, alum, and metalliferous deposits of every kind except the beds of iron specially classed as *minières*. Among the substances thus legally subject to segregation from the surface proprietorship, only two, mineral fuel and iron, are worked to any large extent in France. Aside from these, there were in that country in 1860, only 247 mines of all kinds, classified as follows:

Graphite and bitumen.....	50
Pyritic and aluminiferous ores.....	15
Rock salt and salt springs.....	29
Antimony.....	24
Manganese.....	20
Lead and galena.....	18
Lead and silver.....	27
Copper.....	9
Copper, lead and silver.....	17
Lead, silver, zinc, copper, and other metals.....	30
Gold and silver, separate or together.....	3
Arsenic, separate or with gold and silver.....	2
Tin.....	2
Sulphur.....	1
<hr/>	
Total.....	247
	<hr/>

At the time when the law of 1810 was passed, however, the mines of France were not so limited in number. The productive provinces west of the Rhine, which now belong to Prussia, were then included in the empire of Napoleon; and the principles of mining law, as well as the rates of taxation established by the French law of 1810 and the imperial decree of 1811, remained in force under the Prussian supremacy until the end of 1864. The only change made by the Prussian law in regard to royalty is the subjection of salt mines and springs in those provinces to the state. This was necessary on account of the monopoly of salt maintained by the Prussian government. In all other respects the law of Napoleon virtually continued in west Prussia.

The provisions with regard to taxes were these: Each mine paid a certain fixed sum per annum, according to the size of its field, and also a tax of 5 per cent. on its *net* profits. To this amount one-tenth was added to cover incidentals. The net profit was ascertained by subtracting the current expenses only, not the cost of permanent improvements, from the total production. These taxes amounted in the aggregate to about 2 per cent. of the gross product; and since the 1st of January, 1865, they have been replaced by a single tax of that amount. It is, of

course, much easier to collect a tax on gross receipts than on net profits, and the result is the same to the mines. Prussia has also declared the iron mines free of tax. Thanks to the law of Napoleon, which swept away with vigorous hand the accumulated privileges and forms of the past, or, perhaps, we might rather say, thanks to the revolution which burned off the forest-growths of centuries and left him an open field, and finally, thanks to the judicious legislation of Prussia, less hampered here than in her eastern provinces, the districts west of the Rhine enjoy one of the simplest and most efficient mining codes in the world.

CHAPTER XXVIII.

MINING LAWS OF SWITZERLAND.

On this subject Hon. John Hitz, consul general of Switzerland, writes as follows:

I can only state that, after a careful perusal of the federal laws of Switzerland, I find nothing having reference to mining privileges. As you are aware, the federal government of Switzerland owns no territory in the cantons, and therefore exercises no authority whatever over the mineral or other deposits contained in such cantons. If any laws exist relative to mining, they must be cantonal regulations; and among these which now lie before me I find no other mention than in the laws of Glarus, which provide (Art. 42) that "within the jurisdiction of the *Landesgemeinde* (cantonal government) fall * * * * * the regulation of salines and forests, water rights, game, and fisheries, wine tax, market, and mines, as well as the purchase and sale of real estate;" and in the laws of Valais a passage which declares, (Art. 29,) "The following are the powers of the Grand Council: * * * 9. It shall issue concessions of mines, and may authorize their transfer to third parties." As you are aware, even cantonal authorities do not own territory as public domain. Every inch of ground belongs either to private individuals, corporations, or communes; and the two cantons above named are the only ones known to me who claim to be the dispensers of mining privileges, unless the extraction of salt is considered such a privilege, in which case the canton of Aargau owns, and either operates itself or leases, certain salt wells on its territory along the Rhine, near Rheinfelden.

It is evident from the foregoing statement of the consul general that the mining industry of Switzerland is not sufficiently important to call for general federal legislation, while the democratic policy of the Swiss has entirely destroyed the doctrine of any inherent right of royalty to minerals residing in the government.

CHAPTER XXIX.

MINING LAW OF ENGLAND.

The English law of mines is, like all English law, the growth of centuries, and complicated with many local regulations and "immemorial customs." The oft-quoted "case of mines," in the reign of Elizabeth, referred the crown right to the common law, and the decision of the judges was that all gold or silver ores belonged to the crown, whether in private or public lands; that any ores containing neither gold nor silver belonged to the proprietor of the soil; that the king* could grant

* Plowden, 31, 310, quoted in Hon. J. Ross Browne's first report, p. 217. The quaint reason given by Onslow in this case was that, "because gold and silver are the most excellent things which the soil contains, the law has appointed them, as in reason it ought, to the person most excellent, and that is the king." (See Pettus, *Fodinae Regales*.)

away mines of gold or silver, but not without express words in his patent, demonstrating his intention to sever the mines from his royal patrimony. It is indeed not improbable that the crown once laid claim to all mines, and it is well known that at a comparatively recent period it was attempted to comprise within the royal prerogative all those of copper and tin, on the ground that these ores necessarily contain some portion of gold or silver. In the reign of William and Mary, however, two enactments* secured to the subject the enjoyment of all mines in which tin, copper, iron, or lead are found, notwithstanding any quantity of the precious metals mixed. The property in minerals unsevered from the land, whether held together with the property in the land or separate from it, is what the law terms a corporeal hereditament, as distinguished from the mere right to work for them, which is an incorporeal hereditament. Apart from the claims of the crown, the property in minerals is *prima facie* in the owner of the fee of the land, whether in possession, remainder, or reversion, or subject to the tenancy of other persons. But the property in minerals is not necessarily accompanied by the right to work for them.† Indeed, when the owner of the fee is not in possession, nobody can work for the minerals; not the tenant, lest he commit waste;‡ not the lord of the manor, because he has not possession of the surface, nor even of the subsoil. The minerals are part of the demesnes of the manor, and naturally follow the fee in every case. Thus, for instance, minerals found on the sea-shore below ordinary high-water mark belong *prima facie* to the crown; between the ordinary and extreme high-water mark, to the owner of the adjoining freehold; in land suddenly left by the retirement of the sea, to the crown; in land formed by the casting up of alluvial matter, to the lord of the manor.

The property in minerals, and the right to search for them, may be vested in other persons than the owner of the fee, by alienation, prescription, or custom.

In the case of alienation there is an important distinction between such a conveyance as confers an estate and such as merely confers a right to dig, without property in the minerals until severed from the soil. A conveyance of the former class is binding forever, whether the owner of the minerals continues to work for them or not. This distinction of law between an estate in minerals and the right to mine is an important one; it describes exactly the step which the United States government takes, in the mining law of 1866, by which a perpetual estate is granted to those who had up to that time only been able to enjoy a possessory title, conferring the right to mine. According to the English statute of frauds no legal interest in minerals beyond that of a tenancy at will can be created or transferred otherwise than by writing. The effect of this and other statutes is to make an instrument under seal necessary for the conveyance of any interest beyond that of a tenant at will, or for less than three years, as also for the conveyance of a right to dig for minerals. The most general forms of conveyance for particular interests are either leases of the minerals or licenses to dig them for a term of years. A license is not exclusive in its nature unless expressly so drawn; the grantor may work himself for the minerals, or he may license other persons to do so. Conflicting claims, arising out of different licenses, would probably be decided in equity in favor of the party in possession and actually working.

* 1 Wm. and M., c. 30; 5 Wm. and M., c. 6.

† For these and other points, see authorities quoted in Collier's Law of Mines, p. 14, *et. seq.*, from which much of this sketch of the English law is taken.

‡ Tenants may dig *open* mines to get for their own use gravel, clay, marl, or manure, and, it has been held, coal and iron also.

A lease is necessarily exclusive of the rights of all other persons, vesting in the grantee the absolute possession of the whole of the subject-matter demised.* The legal estate in mines can only be alienated in the modes thus noticed; but an equitable interest, with a title to a share of produce, may be acquired by agreement, either written or spoken, express or implied, attended with equitable rights against coadventurers, and with legal liabilities to the public. A mining company, for instance, can only acquire title to mines by deed (*i. e.*, by an instrument under seal) or by prescription or custom, of which I shall speak presently; but each stockholder may acquire effective title to his share of profits by virtue of a mere certificate, or, rather, by a mere agreement, of which the certificate is the convenient expression or result. This kind of title in mines is subject to the statutes affecting partnerships, joint-stock companies, and cost-book mines. †

Prescription and custom, as has already been said, may also vest in other persons than the owner of the fee the property in minerals, or the right to search for them. According to Coke, ‡ prescription is a personal

* The granting clauses in the form of a lease of metals, with license to dig, use of water, &c., are as follows:

"In consideration of * * * he, the said A B, hath given, granted, and demised, and by these presents doth give, grant, and demise unto the said C D, his executors, administrators, and assigns, all copper, and all other ores, metals, or minerals (except coals) to be found in, under, and throughout the lands and premises comprised within the limits hereinafter described, * * * together with full and free liberty, license, and authority to dig, mine, work, and search for the same, and to raise and bring to grass all such copper and other metals and minerals, * * * to carry away and convert the same to his and their own use and uses, and at his and their wills and pleasure to pass and repass, carry and recarry, and to drive, dig, work, and make any new or other adit or adits, shaft or shafts, pits, drifts, leats, and watercourses in, over, upon, and through any part of the said premises, and to use those already made and driven, and to erect thereon any shed or sheds, mill or mills, engine or engines, or other buildings as he * * * shall from time to time think necessary and convenient for the more effectually working the premises aforesaid, and for working, washing, dressing, cleaning, manufacturing, bringing about, and making merchantable such copper and other ores, metals, and minerals, * * * to have and to hold, use, exercise, and enjoy all and singular the several powers, liberties, and authorities hereby granted and intended so to be, (excepting and reserving and subject as aforesaid,) * * * from the day of the date of these presents for and during the term and time of — years now next ensuing, and fully to be complete and ended."

The grant is qualified by various agreements between the parties. The use of water may be granted for the purpose of mining, subject to the rights and privileges of others already acquired, and to such other reservations as the circumstances require. The time, manner, and amount of payment of rent or royalty is specified, (*tribute* is not strictly rent,) and the lessee is bound to keep proper accounts, accessible to the landlord, to work the mine with all reasonable expedition "regularly and effectually, and in every respect according to the most approved modern practice of good miners," &c., &c., with greater or less fulness of detail, according to the whim of the parties. My experience in this country rather favors the drawing of a mining lease in general terms, leaving it for the courts to decide, in case of disagreement, what is fair dealing on either part. Detailed specifications in the lease do not obviate, but complicate, litigation.

† The cost-book system in use in Cornwall and Devonshire differs from ordinary partnerships on the one hand, and joint-stock companies on the other. The principal distinction from ordinary trading partnerships appears to be the absence of the *delectus persone*, and consequently a limited liability: while the organization differs from that of a stock-company in the fact that its powers are not delegated to an aristocracy of directors, but directly exercised by the whole body of shareholders.

The following is the form of transfer of share in a cost-book mine:

"I, _____, do hereby, for valuable consideration, sell, assign, and transfer unto _____ parts or shares of and in a certain mine or adventure, called _____, situate in the parish of _____, county of _____, together with the like share or proportion of and in all engines, tools, tackle, materials, ores, halvans, moneys, and all other appurtenances thereto belonging, together with all dividends and profits in respect of the said part _____ or share, and all interest, privileges, and advantages to be derived therefrom. As witness, &c.

"I _____ do hereby accept the said _____ shares, subject to the same terms and conditions, rules and regulations, as the said _____ held the same."

‡ 1 Inst., 113.

usage, as that such an one and his ancestors or those whose estate he hath, have used, time out of mind, to have such an advantage or privilege. Prescription can be claimed only by the owner for the time being of the freehold; an incorporeal hereditament only can be subject of it, and it must be of origin beyond the time of legal memory; in other words, the right to work for minerals, but not the legal estate in them, may be subject of prescription.

} Custom is defined to be a usage of the inhabitants of a certain district, and requires three things for its validity: It must have its origin beyond legal memory, ("from time whereof the memory of man runneth not to the contrary;") it must have been uninterrupted; and it must be reasonable. The law is very careful to guard against the abuse of this right. In fact, the whole institution of "immemorial custom" is based only upon the principle that it is better to allow certain deviations from the rules of abstract justice laid down for general practice, than to commit the greater injustice of invading the established usages of society, and disappointing the well-grounded confidence of honest citizens therein. The notion that a custom may be arbitrarily created or modified at any given time, "by popular sovereignty," so as to affect the vested rights of property, is foreign to English and to every other law worthy of the name. It really overthrows the whole foundation on which this humane maxim has been built.

A good illustration of an immemorial custom, affecting the right to mining property, is the "tin bounding" which formerly prevailed in Cornwall and Devonshire, and is still valid, though comparatively disused in those districts. A charter granted in the third year of King John to the tanners of Cornwall and Devon speaks of it as already ancient.* In the recent case of *Rogers vs. Brenton*, 10 Q. B., 26, the custom was stated and confirmed by the jury as follows: "That any person may enter on the waste land of another in Cornwall, and mark out by four corner boundaries a certain area; a written description of the land so marked with metes and bounds, and the name of the person for whose use the proceeding is taken, is recorded in an immemorial local court, called the stannary court, and proclaimed at three successive courts held at stated intervals; if no objection is successfully made by any other person the court awards a writ to the bailiff of the court to deliver possession of the said 'bounds or tin-work' to the bounder, who thereupon has the exclusive right to search for, dig, and take to his own use all tin and tin ore within the described limits, paying to the land-owner a certain customary proportion of the ore raised under the name of toll-tin. The right descends to executors, and may be preserved for an indefinite time, either by actually working and paying toll, or by annually renewing the four boundary marks on a certain day." Similar customs exist in Derbyshire, in the forest of Dean, and in various parts of Europe. In the case above alluded to, *Rogers*, the plaintiff, claimed his exclusive rights as a bounder, though he had neglected the mine for many years, pleading that the bounds had been regularly renewed. The defendant was agent of a company which had begun to work the mine and refused to recognize the alleged rights of the plaintiff. Much evidence was given concerning the nature and prevalence of the custom. The witnesses agreed that the bounds could be preserved by mere annual renewal without working, and some of them doubted whether even the ceremony of

* Quod possint (stammatores nostri) omni tempore libere et quiete absque alicujus hominis vexatione fodere stammum, et turbas ad stammum fundendum * * * sicut solebunt et consuenerunt, et emere buscam * * * et divertere aquas ad operationem eorum in stammariis sicut de antiqua consuetudine consuenerunt.

renewal was necessary, except as evidence of the right. They also differed as to the consequence of neglecting to renew on the exact day. None could assign any limit to the surface of land that might be included within the four corners, but it was said to be generally very small. One of the most experienced witnesses remembered a pair of tin-bounds "a quarter of a mile each way," but this was the largest he knew of. Only one instance was recollected by any witness of bounds recently proclaimed; all the wastes of tin-mining districts were supposed to be already under ancient bounds. The jury found, as to the question of fact, a verdict for the plaintiff, on the ground that working was not essential to the custom. The court, however, decided that the custom as found to exist by the jury was unreasonable in as far as it conferred a right to bounds on a person not actually working. The opinion pronounced on this occasion by Lord Denman is a most thorough and elaborate explanation of the principles underlying the case, and deserves to be studied by American legislators. I quote a few passages:*

Upon the ownership of the land, giving a *prima facie* title to minerals, the custom of bounding has been engrafted. * * * In substance it is this: the mine is parcel of the soil; the ownership is in the owner of the soil, but it is a parcel which, to discover and bring to the surface, may ordinarily require capital, skill, enterprise, and combination; which, while in the bowels of the earth, is wholly useless to the owner as well as to the public; and the bringing of which into the market is eminently for the benefit of the public. If, therefore, the owner of the soil cannot, or will not, do this for himself, he shall not be allowed to lock it up from the public; and, therefore, in such case (unless, by enclosure, he may seem to have devoted the land to other important purposes inconsistent with mining operations, such as agriculture or building) any tinner, i. e., any man employing himself in tin mining, may secure to himself the right to dig the mines under the lauds, rendering a certain portion of the produce to the owner of the soil.

It is right to observe, in passing, how every step, even in this strong invasion of the rights of ownership, still is made with reference to them. In the first place, the land to be bounded must be wastrel; if it be several and enclosed, it must have been anciently bounded while wastrel, and so, in the language of the country, assured for wastrel; the liability must have first attached on it, therefore, before enclosure and devotion to other useful purposes. Then after the tinner or boulder has commenced by cutting the turves, and so making out the limits within which he will work, proceedings are to be taken in the stannary courts, of which the owner has notice, and sufficient time is allowed before the boulder's title becomes complete, during which the owner may still intervene and preserve his rights entire, so as he will exercise them for the benefit of the public. If he abstain from any interference it may well be considered that he has consented to the boulder's proceedings: and the customary render of the portion called toll-tint may be a very sufficient consideration to him for what he gives up of his original exclusive rights. * * * This then brings us to the point which was more especially contested on the argument, whether this customary right can exist without continuing *bona fide* to search for tin, and to work the land for mining purposes with the enclosed limits; whether it is sufficient to renew the bounds annually by a new cutting of the turves as at the commencement. Assuming for the present the validity of the custom, if the *bona fide* working within the bounds be made a part of it, and assuming that it is a custom which is to be tried by the tests established by the common law for ascertaining whether a custom be good or not, it appears to us that without this qualification it cannot be sustained. Customs, especially where they derogate from the general rights of property, must be construed strictly; and above all things, they must be reasonable. Bounding is a direct interference with the common law rights of property; it takes from the owner of the land, who is unable or unwilling at a particular moment to dig for tin under his waste land, the right to do so, it may be forever, and vests it in a stranger, making only the customary render in return;

* The opinion may be found in 10 Q. B., 26, and the passages here quoted, with others, in Collier's Law of Mines, p. 33 *et seq.*

† "The custom in Devonshire, as declared in the convocation rolls of the stannary parliaments for that county differs from that in Cornwall, principally in being a freehold interest descending to the heir, and being unaccompanied by the obligation to pay any toll or compensation to the land-owner. The Cornish custom having been mainly supported on the ground of its being accompanied by this obligation, there seems little reason to doubt that the custom in Devonshire, if found by a jury to exist in fact, would be deemed void in law."—Collier's Law of Mines, American edition, page 41.

‡ According to Cudden *vs.* Estwick, 6 Mod., 124, and other cases, the conditions are, that the party bounding should have a benefit, the party claiming be at some charge, and that it should have a reasonable commencement.

it empowers the stranger not only to extract the mineral from beneath the surface, but to enter on the surface, and cumber it with machinery, buildings, and refuse stuff which the operations below occasion,* and all this without the least regard to the convenience or interests of the owner. The only things which make this reasonable are the render of the toll-tin to the owner, and the benefit to the public secured thereby in the extraction of the mineral from the bowels of the earth. Both these are not only lost, but the latter, it may be, positively prevented, if the boulder may decline to work and yet retain the right to exclude the owner. Instead of insuring that the minerals should be brought to the surface, the custom so construed may be made the means of keeping them locked up within it, and at the same time preventing any improvement in the surface. Many bounds may become the property of the same owners, who may think their interests best served by limiting the supply and diminishing competition, while the owner will decline to spend his capital in building or agricultural improvements, because at any moment the boulder may renew his operations, and entirely and without compensation defeat the purposes of his expenditure. If it be said that the public good is best served by that regulated supply which best serves the private interests of the boulder, that wherever it is for the interest of the public that the mine should be worked, the interest of the boulder will be to meet the demand by an adequate supply, and that when the mine is not worked, it is only because it is for the interest equally of both that it should not be; without admitting or denying the truth of these assertions, one answer is that, where such a state of things has existed so long and so decidedly as to amount to reasonable proof that the original purpose with which the bounds were enclosed has been abandoned, it is unreasonable to maintain the bounds themselves. It may have been that the owner did not enclose the land or work for the mineral himself, only on account of a temporary inability, or the temporary existence of the same causes which the boulder now alleges as the ground for his ceasing to work. Why then is he to lose his earlier and better right forever, and under the same circumstances the boulder to preserve his? Another answer is drawn from regarding the original purpose of the custom, which was not founded on the doctrine of demand and supply, but on the expediency simply of bringing the mineral to the surface for the use of men.

In view of these and other considerations, the court held that the provision in question was void, because unreasonable; and there are good grounds for supposing that the unqualified right claimed was also historically to be refuted, as but an abuse of the original limits of the custom.†

I have quoted this exposition of the law at some length, because the principles laid down are universally applicable and just. They apply with equal force to the case of mines in public lands; and the frequency with which they are violated by the whimsical "regulations" of mining districts in the United States is an evil which requires immediate attention, now that those regulations have been formally recognized as valid to some extent in law, and as furnishing a proper basis for the acquisition of the estate in minerals from the general government. I shall discuss this subject more fully in the sequel.

I do not find any traces in the law of England of a recognition of the right to follow mineral deposits in depth outside of the boundaries marked upon the surface.

Statutes regulating the manner of working mines, the employment of children, &c., have from time to time been made by Parliament. So, for instance, a bill passed February 14, 1860, provides for the regulation and inspection of mines, and prescribes general rules as to safety-lamps, ventilation, guide-rods, &c.‡

The laws and equities relating to mining in England are administered generally by the courts of chancery and common law. There is, however,

*According to the legal maxim, "Cuicumque ali quid conceditur, conceditur etiam id sine quo res ipsa non esse potuit." The right to obtain minerals comprises the right to do all that is necessary thereto.

†The ancient charters were granted to tanners "operantes in stannariis," and "dum operantur." In Carew's *Survey of Cornwall*, fol. 136, ed. 1769, it is said, "These bounds he is bound to renew once every yeere, as also in most places to bestow some time in working the myne, otherwise he loseth his privilege." Collier, quoting from Smirke, gives these and other instances.

‡Levi's *Annals of British Legislation*, ix. 1861.

a court of very ancient origin,* called the stannaries court (formerly several courts, called stannary courts, held before the stewards of the four stannaries) and now presided over by the vice-warden of the stannaries. This court has both common law and equitable jurisdiction, concurrent with that of the superior courts and the county court, and affords an easy and expeditious method of settling such disputes as arise out of mining transactions. The proceedings in equity concern chiefly the mines operated on the cost-book system, and contrast favorably with the prolonged, complicated, and expensive operations of the courts of chancery. The late Prince Albert was lord-warden of the stannaries.

CHAPTER XXX.

MINING REGULATIONS IN AUSTRALIA.†

Gold was discovered in Australia in 1851, by Hargraves, a miner from California. A considerable immigration of miners ensued, and laws were enacted in 1852 and 1853 by the legislative council of New South Wales, "for regulating the management of the gold fields, raising a revenue therefrom, and for the preservation of order thereon." The first of these laws authorized the governor general to grant to British subjects only leases and licenses for mining purposes, for terms not exceeding 20 years, and by the eighth section, aliens were to pay twice the license-fees and royalties payable by British subjects. The ordinary license-fee to mine and dig for gold in any waste lands of the Crown was 30 shillings per month. For a grant of permission to work a quartz vein, the fee was £25; and for each renewal, the same sum was paid. The act of 1853 removed the distinction between British citizens and aliens, admitting the latter to "the like privileges of working the gold mines and gold fields of the colony, and of employing themselves thereon, as now are or hereafter may be enjoyed by British subjects. The fees are reduced to 10 shillings for a license to dig or mine for gold upon Crown lands, and one-half of that rate for license to mine upon private lands, already leased from the Crown for pastoral purposes.

CHAPTER XXXI.

MINING LAWS OF CANADA.

The different provinces of the Dominion have, I believe, different local codes. The most instructive for my purpose are those of Nova Scotia and Ontario. The letter of Hon. P. S. Hamilton, commissioner of mines at Halifax, published in the last report of Mr. J. W. Taylor, United States commissioner, on the resources of States and Territories east of the Rocky mountains, contains an outline of the law of Nova Scotia, from which the following paragraphs are taken :‡

*Confirmed rather than created by charters, 3 John and 33 Edw. 1, often subsequently recognized and defined, and finally established in its present form during the reign of William IV.

†This account is taken substantially from Mr. Gregory Yale's Book on Mining Claims and Water Rights, San Francisco, 1867.

‡A still more full and complete account of the law of Nova Scotia may be found in the Guide to Nova Scotia, by Alexander Heatherington, editor of the Halifax Mining Gazette.

Whoever may be the owner of the land, gold mines in Nova Scotia belong in the first instance to the Crown. At least this is practically the case as yet. There are portions of land in the province which have been granted without reserving to the Crown any minerals, but upon such unlimited grants no gold has yet been discovered. As a rule, out of all land granted in Nova Scotia there are reserved to the crown all mines and deposits of gold, silver, lead, tin, iron, copper, and coal. All other mineral substances are conveyed with the soil. The regulations improvised by the governor and council on the first discovery of gold in Nova Scotia, as also the first "gold field act" passed by the provincial legislature, were framed, as might naturally enough be supposed, with but a very imperfect knowledge of what was requisite to a gold-mining community anywhere, still more of all that was peculiar in the Nova Scotian gold fields, and would most conduce to their development. Consequently they were hampered with many provisions which experience soon proved to be useless, but which bore heavily and vexatiously upon those who engaged in mining enterprises. There is little room to doubt that the check thus given to such enterprises at their very conception is, in its results, felt to some extent even yet. The law now in force, which with its subsequent amendments was framed by the writer of this paper, (Mr. Hamilton,) has been found to work satisfactorily to all parties concerned, although of course every year's additional experience suggests some further amendment.

According to the existing law, the intending miner having determined upon the site of his future operations, it not being preoccupied by another, may in the first instance apply at the department of mines for either a prospecting license or a lease. There is no limit to the extent of ground that he may apply for. To obtain a prospecting license he must pay at the rate of fifty cents per acre; and where the ground applied for is not Crown land, must enter into a bond to reimburse the proprietor thereof for any damage that may be done to his land. This license holds good for three months, but is renewable for a further term of three months upon the prepayment of 25 cents per acre. This gives him the exclusive right to explore on the whole tract applied for, and select any part, or the whole of it, upon which to carry on mining operations.

Before entering upon any such mining operations, he must, whether he has previously held a prospecting license or not, apply for a lease of such unoccupied ground as he may have selected for his purpose. On making such application he is required to pay at the rate of \$2 for each area of 250 feet in length by 150 feet in breadth, and also, when the ground applied for is private property, to make an arrangement with the owner of the soil for any damages the latter is likely to sustain. Thereupon he receives a lease for 21 years, reserving a royalty of 2½ per cent. upon all the gold mined. The law further requires him to have labor performed annually at the rate of 100 days' work for every 250 by 150 feet leased by him, and to furnish quarterly and swear to a return showing, among other things, the amount of work and when performed, the quantity of quartz mined, the mill to which it was sent, and the quantity of gold obtained from it. Any person is liable to a heavy fine who runs a quartz-mill without a license. Before obtaining this license, for which there is no charge, he must give bonds with ample sureties for the performance of his duties as required by law. The licensed mill-owner must every month make and swear to a return showing the quantity of quartz crushed, the mine whence it came, and the quantity of gold taken from it; and out of this gold he himself pays to the mines department the royalty reserved by law, receiving three per cent. out of that royalty as commission for his trouble.

Under the law thus described by its author, about \$3,000,000 have been extracted from the gold mines of Nova Scotia within the past six years. He says the law works satisfactorily; but the slow development of the mines under it leaves room for the suspicion that its burdens are too heavy for this industry to support.

Certainly the province of Ontario has found the taxation of mines a source of no revenue, but a cause of much ruin to mining. In February or March, 1868, the legislative assembly passed an act of extraordinary character, which, besides fixing in a very arbitrary manner the size and shape of mining claims, and providing that both alluvial and quartz mines should be bounded by vertical planes in depth, limited the period of lease to one year, made the lease liable to forfeiture by one week's intermission in the working, and imposed a royalty upon all gold and silver mines, whether on crown lands or private property, of not less than two nor more than 10 per cent. of the gross amount of gold and silver mined. Fortunately the lieutenant governor was empowered to fix the tax between these limits, and even to grant mineral lands by order in council, on any terms he might see fit to prescribe.

I presume the experience of a single summer has been sufficient to show the unwisdom of this law. At all events, it has been repealed, almost or quite unanimously, at the session of the assembly which closed a few days ago, (December, 1868;) and an act* has been passed abolishing all royalties, taxes, and duties imposed by any previous patents, and rescinding all reservations of gold and silver mines contained in previous grants. The fee simple of the minerals is made over to the owner of the soil, and no reservation or exception of gold, silver, iron, copper, or other mines or minerals may hereafter be inserted in any patent from the crown granting lands sold as mining lands. Exploration for minerals on crown lands is declared free to all persons, and actual mining may be carried on upon crown lands, either by the purchase of the ground as mining land or by the procurement of a miner's license. The license must be renewed annually, is not transferable, and authorizes the licensee personally, and not through another or others, to mine during one year from the date of said license on any unsold crown lands within the mining division therein mentioned, and not for the time being marked or staked out and occupied by any other licensee. Each mining claim on a vein shall be 200 feet along the vein, by 100 feet on each side thereof, measuring from the centre of the vein or lode. Companies of two or more persons, who each hold a miner's license, may stake out and work additional feet along a lode by the above width, in the proportion of 100 additional feet in length for every additional miner, not to exceed 1,000 feet in length altogether, and work the claim jointly. Mining claims shall be laid out as far as possible uniformly, and in quadrilateral and rectangular shapes; measurements of all mining claims shall be horizontal, and the ground included in every such claim shall be deemed to be bounded under the surface by lines vertical to the horizon.

These provisions indicate that deep mining is as yet unknown in the province. If mining claims are to be bounded beneath the surface by vertical planes, then 100 feet on each side of the vein is too little for the security of the miner. However, all this arrangement of mining under license is evidently intended for individuals without capital, and such

* This account is based upon a copy of the act as introduced by the ministry. I presume it is the same as that which passed the assembly. The newspapers have not to my knowledge mentioned any important amendments, and the introduction of the bill was received by all parties with cheers.

persons cannot be expected to carry on operations to a great depth. The tendency of the law will be to encourage the purchase of mineral lands from the crown, since that releases the owner from all necessity for license, or limitation of claim by a fixed standard of surface measurement. This is a beneficial tendency, unless it goes so far as to lock up the entire territory in the hands of surface-owners and prevent all independent mining. The laws of Canada, as will be seen from these examples, are fundamentally the same as those of England, modified by old grants of the crown, and by the legislation of the different provinces. The general character of that legislation hitherto has not been very favorable to a rapid development of mining, but the new and more liberal policy is gaining ground, and doubtless the example of Ontario will be followed by other provinces. The principal reform—a release of the miners from onerous taxation—once effected, other necessary or advisable improvements will follow as they are dictated by experience.

CHAPTER XXXII.

CONCLUSIONS.

History gives us a partial explanation of the causes which have made Germany, ever since the middle ages, the school of the world in the art of mining. In that country, and we might almost say in that country alone, has mining been pursued for centuries, comparatively undisturbed by wars and conquests, and continually fostered by the state, and assisted by the progressive science of each succeeding age. In laws, in histories, in her miners' dialect, and, above all, in the not yet obliterated traces of ancient operations, Germany presents to us a complete and instructive picture of the mining industry of the past, whilst her numerous and well-appointed schools, with their armies of accomplished graduates, her local populations of (so to speak) hereditary miners, her wise and elaborate system of legislation for mines, and her multifarious manufactures, based upon mining, keep her still the foremost nation of Christendom, if not in every branch of this industry, or in all the steps of invention and progress which attend it, yet at least in its general stability and settled economy, and in its harmonious relations to other forms of organized labor as a recognized element in the prosperity of the state.

Spain had once an excellent mining code; but it was based upon an incomplete science, and upon institutions of labor which have passed or are passing away; and the Spanish code (familiar to us as the present system of Mexico) has stood still while the world advanced. England has a vast and productive mining industry; and English statesmen are not slow to recognize its importance as the foundation of the commercial power of that country. But the intricacies and local complications of English law are proverbial, and the mining codes are no exception to the rule. We can probably copy little from England, save those principles of common law which we have already. France has the most modern system, (if we except our own, which is as yet scarcely worthy of the name,) for the clean sweep of the Code Napoleon did not spare the ancient regulations which fettered the mining industry of that nation. But France has unfortunately few metal mines, and her experience can afford us, therefore, but little light. It is to Germany that we must look for our best models of legislation, as of applied science. No popular notion is more erroneous than that which ascribes to the Germans, as a

people, learning without practical skill and tact; and nothing can more strikingly illustrate the error of this impression than the manner in which the Germans have brought to bear upon the art of mining the sciences of chemistry, mechanics, mathematics, law, and political economy.

It is not, however, by closely imitating the course of any nation that we can successfully establish an American system. The one thing to be studied in all nations is the degree of wisdom with which they have adapted their legislation to their circumstances; and it should always be borne in mind that we occupy a position widely different from that of a state bound by precedents and privileges, and, at the same time, possessed of greater central power than democratic governments can or should ever acquire. Our American system cannot be a delicately balanced and nicely administered one: the hoofs of each new party riding into power would trample such workmanship to pieces. It must be broad, simple, and, as far as possible, automatic. Our institutions are not like philosophical apparatus, closely watched and often adjusted; they are rather like the ocean, lashed by storms and swayed by mighty tides, yet keeping its own level after all, and asking no man to supply its deficiency or drain its surplus.

It is no small task to apply the teachings of history and the examples of successful states to these new conditions; yet it were folly to forget those teachings, and, blindly disdaining all examples, to blunder forward in a path where every false step wastes the energies and delays the progress of a great people.

I think the foregoing analysis and historical summary proves the truth of certain principles, which harmonize also with the democratic policy of this country. Among these I would name the following:

1. The assertion of any right of royalty in the precious metals is unfounded in nature, and unwise in practice. The most enlightened nations have abandoned the idea of anything more than a general supremacy of the state over mining in the interest of the people.

2. The benefits derived by government from the mines must be indirect. No tax for revenue should be laid on mining any more than on agriculture. Taxes sufficient to cover the cost of the necessary supervision of the mining interest are, properly enough, levied in all nations except the United States. We had a bullion tax, and spent none of it for the miners; now we have no tax, which is better, at least, than the former system.

3. The question, whether the government should sell the mines or only license their working, is to be answered, in this country, in favor of the first alternative, unless we are prepared to establish and administer a vast mining system over our scattered districts. I think the true course is to alienate the mines from the United States as soon as possible, and to do this upon a general and uniform policy, preventing the necessity of special legislation.

4. The manner of conveying titles to the mines should be so regulated as to avoid as far as possible all litigation in future, and at the same time encourage mining. For, it must be remembered, in surrendering the title to the mines wholly to the patentee, we remove that stimulus to their development which the conditions of the possessory title formerly maintained; and we can only rely on the natural laws of supply and demand to secure the continued working of the mines. According to those laws, profit limits production, and mining must be profitable to the individual, if it is to be continued for any length of time. Now, passing a title to the miner which is indefinite or ambiguous, and brings him into conflict with his neighbor, is laying a heavy burden on mining, and so, without gain to any one, diminishing the product of bullion.

5. The nature of the property conveyed is such that ordinary measurements cannot always define it. The Spanish and English laws, as I have shown, invariably bound mining claims by vertical planes, just as the property of land-owners is bounded. The modern Prussian law does the same thing. But according to the present codes of other German states, and the ancient codes of all, inclined locations may be granted, with the right to follow the vein in depth, without reference to the surface ownership. The American miners' law is unlike either, and, so far as I know, has no parallel in history. It comprehends the vein, its dips, spurs,* and angles, to any depth; and under this provision, when two veins are found to meet in depth, the oldest location is held to be the main lode, and the other is confiscated as a "spur." There is no justice in such a provision. On the other hand, there is no limit in American local regulations as to the distance between parallel locations, which, no matter how closely they lie together, are presumed to be on different veins until proved to be on the same. This state of things both invites and protracts a litigation which is seldom settled except by exhaustion and compromise.

There are not wanting those who urge the adoption of "square locations" exclusively, as the cure for these evils. But with such, after mature reflection, I cannot agree. The great aim of the government in disposing of its mines should be to secure their permanent and systematic working. To define the boundaries of mining ground by vertical planes does indeed lessen the danger of litigation, but it also lessens the value of the claim; and, in most cases, the value thus subtracted from one property is not added to any other. Thus a miner under the Spanish law loses the right to work his vein, because at the depth of 600 feet it passes out of his surface boundaries into the neighboring claim; but the neighbor is not much better off for knowing that 600 feet below the surface he may find a vein of ore. To the miner who has already reached that depth, it is valuable; to the miner who must dig and blast 600 feet to find it, it may be worth nothing. Meanwhile, it is undoubtedly for the interest of the country that the work should be continued in depth; and the proper person to carry it on is evidently the one who has commenced it and prosecuted it thus far. The Spanish precedent I have already discussed elsewhere, and shown that its effect has not been favorable to permanent mining. England and Prussia present more modern and plausible systems. Prussia is most deserving of attention, since in that country the inclined location has been abolished, and it is natural to suppose that experience has proved its inferiority. This cannot be accepted, however, without due consideration of the circumstances of the case. Mining has been carried on in Germany for centuries. We may safely assume that every mining district is thoroughly studied and known. The local peculiarities of the veins are understood; and it is not difficult to locate a surface claim so that it will cover the ground upon a vein to the greatest depth to which mining can be carried. Besides, most of the mines are already opened; many of them are worked under inclined locations of the old sort; and these are not interfered with.

In the United States, on the other hand, we are comparatively ignorant of the peculiarities of our mining districts, and our mineral veins have shown themselves in many, I might almost say in most, cases, to vary in dip to an extraordinary degree. The veins of Lander Hill may be cited as an example. Some of them dip at the outcrop 60° below the

* The word *spur* is omitted from the United States law of 1866, but the sweeping recognition in that law of "mining customs" virtually restores it.

horizon, and, at a depth of 300 feet, are found to run for a considerable distance almost horizontally. Only very large square locations, tracts of 40 acres at least, could cover such mining ground; and I consider it impracticable to grant the mineral lands containing gold and silver in such parcels, though, no doubt, capitalists would prefer such large areas.* For the present stage of mining in this country, as for the earlier stages of mining in Germany, the inclined location must be accepted as the best for lodes.

But it does not follow that the boundaries of an inclined location cannot be defined at all. They used to be so in Europe, and they may be so in this country. The location should give the right to a certain distance each side of the vein, so many feet in the hanging wall, and so many in the foot-wall. When two claims cross in depth, the elder location simply holds its course through the other, taking only so many feet away, and leaving to the second party the right of way to follow and find his vein again. If one claim joins another in depth, the two being branches of the same vein, the elder location takes the whole in depth, but does not take the "spur" above the junction, except so far as its right extends in the two walls. At the same time, the surface location of veins should be regulated by law, and the making of new parallel locations close to older ones should not be allowed. Of this I shall speak presently.

6. Although history abundantly shows that mining flourishes best when the property in minerals is distinguished from the ownership of the soil, it seems to me good policy for the United States, in selling the mines, to sell also the surface. In most cases the land will never be taken up for agricultural purposes, and if the miner does not buy it no one will. I do not mean that the ownership of minerals shall go invariably with the soil, but that, where the United States has both for sale, both should be sold to the same party, who may afterwards dispose of either as he likes. The present law partially recognizes this policy by selling inclined locations at so much per acre. Under one interpretation of this rule, the same acre may be sold over and over again, and, strictly speaking, not belong to any of the purchasers, since all they receive is the right to use it for mining purposes.

The foregoing conclusions will be better understood in their application to American mining after a brief analysis of the United States law. For an able commentary upon the law, and the earlier instructions under it, issued from the General Land Office, I would refer to the interesting work of Mr. Gregory Yale, of San Francisco, on mining titles and water rights in California. I shall not go minutely into the analysis on the present occasion, since it is rather my purpose to suggest amendments to the law than to discuss constructions of it.

The first and second sections of the law of 1866 provide for two classes of miners in this country. The first section *licenses* all miners upon the public domain. They are not trespassers, neither are they owners; they are simply licensed to mine, under such regulations as may be prescribed by law or agreed upon among themselves. The second section makes it possible for certain persons or associations to step out of the class of licensed miners into that of actual proprietors. This section *distinctly applies to veins or lodes only,*† and leaves all placer, gulch,

* Let any one attempt to calculate the value of a square location of 40 acres on the Comstock, or Lander Hill, or Treasure Hill, at White Pine!

† A recent decision of the Commissioner of the General Land Office includes placer, gravel, and cement mines under the operation of section 2. The words of the chairman of the Committee on Mines and Mining, in reporting the bill to the Senate, May 28, 1866, were: "By bill it is only proposed to dispose of the vein mines. * * * * It is not proposed to

hydraulic, and cement miners, together with all those who do not acquire patents to veins, on the broad ground established by the first section. Nor does the second section make it obligatory upon any person to acquire a title to the vein of gold, silver, cinnabar, or copper he may be working under the general license of the first section.

The second section declares that a diagram may be filed, conforming to the local laws, customs, and rules of miners, and a *tract* entered and patented, *together with* the right to follow the vein, &c. This, it seems to me, distinctly conveys the surface ownership to the patentee, together with the right of inclined location. But the mining customs do not recognize a surface ownership, vested in the miner, and hence much confusion has arisen, since the law leaves the size of the "tract" to be determined by local customs. Nor is confusion the worst result that may be expected. Miners will begin to make regulations expressly to influence the subsequent operation of the patent law. It is said that the only patent thus far issued is one conveying several hundred acres of land, the "custom" having been, no doubt, conveniently established for the occasion.

Section third provides, among other things, that no plat, survey, or description filed for patent shall cover more than one vein or lode. Under this provision what is the status of a vein existing, but not discovered until after the patent has issued, within the borders of a certain tract? If the vein was previously known, then the patent could not issue for the tract covering it, and the boundaries of each tract must be so drawn as to exclude all veins except the one on which the patent is applied for; but if the second vein is discovered within the tract patented, I think the legal position is this: the patentee owns a piece of land, and the mineral right to one vein, cropping out on the surface within his property. The United States, which formerly owned both surface and mineral, still owns all other veins within the tract, except the one patented, *and under the spirit of the first section* any one may mine upon the other veins, simply paying damages, not royalty, to the patentee.

Recommendations.—I have the honor to recommend, as necessary amendments of the present law, the following provisions:

The size of the *tract* decided by patent and the number of feet upon the lode should be fixed by law, in spite of all conflicting miners' customs. Vested rights must be adjusted by agreement among owners; but it should be at once announced that the United States will hereafter regard the locator of a vein as entitled to claim, say, 200 feet on each side of the vein; that no other locations subsequently made within that distance will be recognized as patentable; that subsequent locations made within less than 200 feet of the boundary of the first location will be shorn of so much of their width on that side, being limited by the elder locations; that the patentee shall pay to the United States, say, \$5 per acre for his land, and a fee of, say, \$10 for each separate vein discovered and worked within the tract, after the first vein, upon which the

interfere with, or impose any tax upon, *the miners engaged in working placer mines.*" The words of the law are, "*vein or lode of quartz, or other rock in place, bearing gold, silver, cinnabar, or copper*" There is no possible construction of these words which will include placer mines, or alluvial deposits, or beds. The Commissioner argues that there are different kinds of veins, and that it is difficult to decide how a vein was ormed—all of which does not touch the case. Amid all the discussions of geologists about vein-formation, the distinction between all veins and alluvial deposits has never been disturbed. It is found in the earliest laws, and is perfectly comprehended by the ordinary miner. The United States law of 1866 cannot be applied to mines of the latter class; it was an experiment, applied only to "quartz mining," and the attempt of the Land Office to extend it over placers, before a single quartz mine has received a patent under it, only tends to bring the whole law into contempt.

issuance of the patent is based. The right to follow the vein, its dips, variations and angles should remain unaltered, and all ores found within 30 feet of the vein in the hanging or foot wall should be considered as belonging to it. In a case where two veins cross in depth the elder location should keep its right to 30 feet in either wall; if the veins unite and become one the elder location would take the whole vein below the junction, but not the whole spur above, being restricted on that side to its right of 30 feet.

It is true that this system would not prevent all collision of interests. A and B might, for instance, locate side by side on parallel veins 400 feet apart, and each might subsequently discover a vein within his tract near the boundary line between them. In working these they might find themselves close together and liable to interfere. But in such a case it would at least be only a question between A and B, not between them and a score of piratical locators, only intent on mischief; and disputes arising between owners in this way would be much easier to settle by compromise than the present class of suits, where one party has nothing to lose and everything to gain. Besides, no patent should be granted until the vein first located is sufficiently developed to show its course and width. Until that has been done the miner should be content to work under the free license granted by the United States; and when that has been done the chances of subsequent discoveries of valuable and separate veins within 200 feet are in most districts not very great. In fact, the majority of the "float locations" made under present customs in the immediate neighborhood of developed veins are worthless, except for purposes of black-mail, robbery, and litigation; and if the privilege of working such subsidiary out-crops belonged only to the patentee of the vein in the centre of the tract they would never be worked. Again, the conditions on which the possessory title depends should be made uniform in all the mining districts; and I am of opinion that in no case should claims be held without being worked a reasonable period every year. The present chaotic state of the practice in this respect is described by a committee of the Nevada legislature as follows:

In one district the work required to be done to hold a claim is nominal; in another, exorbitant; in another, abolished; in another, adjourned from year to year. A stranger, seeking to ascertain the law, is surprised to learn that there is no satisfactory public record to which he can refer; no public officer to whom he may apply who is under any bond or obligation to furnish him information or guarantee its authenticity. Often in the newer districts he finds there is not the semblance of a code, but a simple resolution, adopting the code of some other district, which may be a hundred miles distant.*

My predecessor repeatedly urged this point; and in the absence of the necessary federal legislation the evil has certainly not diminished. I think the provisions of the "quartz laws" of Nevada county, California, might be adopted in this regard, with advantage, as the universal rule. They require work to the extent of \$100 in value, or twenty days' faithful labor, each year, and make the regularly elected and sworn county clerk or recorder the mining recorder also. The spirit of the law should be to prevent all parties from holding claims who do not mean to work them. This is a legitimate sequence of the position in which the United States law places such parties. They have free permission to mine, not to "squat," and prevent other people from mining. They should not treat the mines as their property until they have bought them from the United States. It is said, "sometimes the miner, having found a vein, is obliged to wait for capital or for better times to work it." But if he has a *bona fide* intention to work he can do as much as will hold his

* For a full statement of these evils see the report of the committee, quoted in J. Ross Browne's report for 1867, page 227.

claim. The secret of much opposition to such a wholesome provision is that those to whom the United States generously gives the free license *to mine* do not wish to mine, but to speculate. A few men organize a district, locate hundreds of thousands of feet, pass laws to protect their "rights," and then, by working one or two rich veins, try to attract a population and sell out their claims. The law is not intended to protect speculators of any class.

Nor should patents be granted on veins not opened and traced. When a man has chosen a vein, worked it to the extent of \$1,000 expenditure, and determined to buy it, he is entitled to the special protection of the second section of the law.

There need be no difficulty in executing these provisions. If miners do not desire to enter the class of owners, they can remain licensed to prospect and mine on the public domain; but the protection afforded by such provisions as I have recommended against piratical locations would make applications for patents very numerous, especially in new districts. Nor is there any hardship in excluding later locations within 200 feet of the original one. We grant a man the right to own and work a vein which he has discovered, because we assume that he expended skill and labor in the discovery, and that his working will benefit the public. But these considerations do not apply to the individual who makes haste to follow the discoverer, and "locates" the nearest piece of quartz, hoping either to find by chance the main lode, (the discoverer having found by skill and labor only a spur or branch of it,) or else to get down to the vein located by the discoverer, and extract a quantity of rich ore before, by the slow process of drifting along the vein into his stopes, it can be proved that he is a trespasser. I could adduce many instances in which men have sunk vertical shafts to cut a rich deposit which did not belong to them, and, while they were taking out large quantities of valuable ore and turning it into money, coolly said to the real claimant, "You tell us this is your vein: *prove it*, and we will give it up at once." The courts invariably demand that kind of proof which requires a connection to be made between the works of the claimants, either by surface cuts or by drifts under ground, and, so far as I know, never award any damages on account of the ore which the intruder, finally ejected, may have extracted and sold "in good faith." The present law gives no greater security to capitalists than the mining customs, for under the latter a company could at least locate all the outcrops in its neighborhood, and so prevent piratical locations; and that is the most that can be done under the law. The patent must cover but one vein, but the patent is kept from being made worthless by interference and litigation only through innumerable surrounding locations made by the patentee! Is this what we call securing the title of the miner?

What are these mining customs to which the law pays such sweeping respect? They are edicts passed at 24 hours' notice by mass meetings of from five to 500 men; it requires no more formalities to abolish or amend them than it did to make them—a notice pasted on a door, a "mass meeting" next day, and the thing is done. The records of titles are kept by an officer called the recorder, not known to the law nor answerable for malfeasance in office, except that if he were known to tamper with the books in his charge his life might be taken by the party wronged. The records are kept in a few districts in fire-proof offices and in suitable form, but more frequently in small blank-books, pocket-books, or scraps of paper, stowed away under the counter or behind the flour-barrel or the stove of a store or bar-room. These are not exaggerations. The title to millions of dollars' worth of property depends on records no

better cared for than this. The whole record book for the Philadelphia district, Nevada, was burnt up, and the district "jumped;" and the game would have succeeded but for the unusual circumstance that a second copy of the records was in existence. If I am correctly informed, this second copy was only a partial one, and there was a good deal of litigation and trouble, involving some bloodshed, as the result of attempts to enforce old claims on oral testimony. The Sheba mine, in Humboldt county, is another instance (see account of that mine) of the shifting and *unrecorded* nature of these mining laws. In regard to the size of claims and the tenure by which they are to be held, it is best to make one uniform federal law, overriding these regulations.

I have the honor to recommend also, as an advisable addition to the law, that the United States deputy surveyor under the act shall be required to examine whether a mineral deposit proposed to be patented is a vein or not. If not, the same area shall be deeded as before, but without the right to follow the vein out of the limits of vertical planes from the surface boundaries. And I recommend in general an extension of the law to cover placer claims, by providing that such claims may be sold by surface area, in "square locations." The question of size is not vital, since it regulates itself. After the United States has once sold two adjacent properties, it cannot prevent their being united. Hence, by combination and by different purchases, companies will be able to acquire as much land as they desire.

In carrying out any such measures, no conflict with the miners is to be feared. The law is not compulsory. It simply opens the door to admit members of the licensed class (which includes all citizens and those who have declared their intention to become such) to enter the class of patentees by purchase, (which may include also aliens.) The motive applied is an improvement of the title. The miners' or possessory title, in spite of its frequently vaunted validity, is not one upon which money can be safely lent. It is a curious fact that miners can hardly ever borrow money to develop their claims, while they frequently sell the claims, undeveloped, for much more than they failed to borrow. The insecurity of the mining title lies in this: that an absentee owner or mortgagor is at the mercy, 1st, of the laws which the miners may at any time enact; and, 2d, of the agent on whose compliance with those laws his whole title depends. A capitalist in San Francisco lent to a miner from the interior \$10,000 in gold, to help him develop a very promising gold mine, and took a mortgage on the mine as security. The miner returned to the district where the property was located, stopped work for a certain number of days, and allowed the mine to be "jumped" or re-located as abandoned by a friend of his own. The friend became, by miners' law, the owner; the two rascals divided \$10,000 between them; and the capitalist was left to muse upon the instability of the "possessory title."

The substitution of a perfect title for this shifting one is a benefit to every poor miner. It will enable him to borrow money on his mine, a much better course than to hurry a sale of it to some speculative company before its value is half determined. The miners will hasten to avail themselves of the provisions of the law if it is made easy for them to do so. But the expense, delay, perplexity, and contradictory decisions which have hitherto marked the administration of it have produced discouragement and indifference.

The present law is not operating at all; therefore the question of its benefits can hardly be answered. But I think that such amendments as I have suggested, together with one more practically important,

would remove most of the present difficulties in its way. The latter touches the question of expense. The compensation of deputy surveyors under the law is notoriously inadequate, especially in the new and sparsely settled districts. (See letters included in the chapter on Montana.) The result is that the miners are subjected to extra legal expense, or the work is not properly done. In view of the fact that new mines should be encouraged, and that producing mines should bear the expense (as they do everywhere else in the world) of the system devised for their own good, I recommend a bullion tax of one-quarter of one per cent. to be applied, one-half to the necessary expenses of mineral surveys over and above the present legal fees, and one-half to the maintenance of a national school of mines, on the plan set forth in another chapter.

SECTION VII.

MINING EDUCATION.

CHAPTER XXXIII.

MEANS OF DISSEMINATING INFORMATION WITH REGARD TO MINING METALLURGY.

The object of the government in taking measures for the spread of information concerning the mineral resources of the country and the proper methods for their exploitation is three-fold. The first end served is to increase the confidence of its own citizens in the natural wealth of the country, and to augment the credit of the country throughout the world. One reason why the credit of the United States is so much lower than that of other nations far less able to pay their debts, is the fact that this nation makes no such thorough periodical exhibits of its sources of strength as do European states. In other words, they advertise more than we do; and their immense statistical official publications have a fine effect upon their financial standing with the world. A second good result from the spread of the kind of information alluded to above, is the communication of valuable advice and knowledge to the mining populations, rendering the business of mining more profitable, and thereby encouraging an increased production of bullion. The third object to be attained is the protection of the country against reckless and wasteful mining, by the inculcation of sound principles, and the enlightenment of the miners as to their own best interests. This is not in the nature of a lesson, forced upon them, but of a boon which they desire and would gratefully welcome.

The means by which the government can act in this important matter are three: a commissioner, a bureau, and a national school. I shall briefly discuss the first two, and pass to a more detailed consideration of the third.

The provision of Congress, under which Mr. J. Ross Browne and myself have served, was certainly a measure of great benefit, so far as it went. No one can deny that the two reports of 1867 and 1868 throw a great deal of light upon the previously obscure and almost fabulous subject of the mineral resources of the country. The eagerness with which they have been sought for by the citizens of all the States, exhausting the official editions, and justifying the publication of editions by private houses besides, is a proof of the estimation in which they are held by the people. Both those reports, and the present one, were too much occupied with a presentation of the resources of the country west of the Rocky mountains, and of the general condition and prospects of the mining industry, to leave space for the discussion of topics more directly instructive to the miners themselves; but if the work is continued, future reports may deal with such topics, and no doubt considerable good would arise from the discussion. But while many things which the commissioner attempts to do are necessary to be done, I do not think that he can cover the whole ground. He cannot receive and reply to

letters from miners who desire advice; he cannot serve as a medium for exchanging information. To do that, he must have clerks and a bureau. Now there are many reasons which make a national bureau of mines desirable, and, in default of any better means, necessary; but I am decidedly of opinion that the duties of both commissioner and bureau, and a great many more beside, could be best and most economically performed by a national school.

To this subject I have given much attention, and I deem it one of the most important that can be brought before Congress for consideration. All attempts to enlighten our miners, and preserve from waste and ruin our mines, will be but partially successful, unless we can establish a living and progressive agency of intelligence in their midst. The advantages to be gained by the creation of such a school as the bill of Senator Stewart, introduced last year, proposes, may be enumerated as follows:

1. It would give us the right kind of scientific engineers and metallurgists. The excellence of many foreign schools is acknowledged, and numerous American students attend them to obtain that education in the arts of mining and metallurgy which they need to practice at home.

But, while the principles of theoretical science remain everywhere the same, all questions of the best modes of applying those principles vary with circumstances. The economy of different methods and processes is so intimately connected with the price of labor and fuel that the process which is the best in one country is cast aside in another. It is a severe requisition that we make upon a young graduate of a foreign school of mines, when we ask him to adapt his acquired science at once to our widely different circumstances. Every such graduate has to reconstruct, alone and for himself, the whole art which he has learned—a work requiring genius as well as intelligent perseverance, and one in which many men fail, who, *if they had been educated in the region where they were to practice*, would have been respectably and deservedly successful all their lives. A school of mines would speedily give us a settled and digested American science of mining and metallurgy, and the reproach that has been cast upon science would pass away.

It is undeniable that many of those now engaged in mining sneer at educated engineers, the graduates of foreign schools. This contempt is partly justified by the failure of foreign engineers and metallurgists to adapt their ideas to our conditions; but it is mainly unjustifiable. Many charlatans have imposed upon the credulity of the public by parading the names of foreign schools—like that Isenbeck, who professed to practice upon black rock ores the “Freiberg flux process;” but that is no reason for despising really well educated men. Another great cause of this feeling is the fault of the public. When American (or foreign) young men come here from the schools of Europe to take part in mining, the true wisdom is to give them subordinate positions at the mines, where they may gradually learn the new conditions of the problem, and fit themselves for higher positions. They are generally good surveyors, assayers, and draughtsmen. But the general rule has been to take such young and inexperienced men as superintendents, or, worse yet, send them as experts, to inspect totally undeveloped mining lands, and say whether they will “pay dividends on judicious investment of capital.” Now, of all the branches of knowledge in the world, this one of prophesying the future of a newly discovered mineral deposit in a newly opened territory is not and cannot be taught in a school. It requires the basis of a thorough education, coupled with years of field experience, and a familiar acquaintance with the locality examined. Besides, men fresh from countries where ores are worked much more cheaply than here,

would naturally be tempted to consider veins "highly promising," or "very rich," which were only so according to foreign standards. Their flattering reports once made, their services were no longer needed; and unskilled overseers proceeded to waste what little chance of profit there might be in the case. No wonder that when the mistakes of scientific, but not practical, and practical, but not scientific men are heaped together upon the head of science, they seem to cover her with shame. But all this arises from the notion that there is something recondite and approaching sorcery in the sciences of geology, mineralogy, and metallurgy. In fact, science is merely knowledge, and knowledge is power. Let every miner have a chance to hear lectures and witness experiments in the sciences which interest his calling, and he would conceive for science a true respect, equally removed from the vulgar superstition on the one hand, and the boorish contempt on the other, with which she is too often regarded. Then our thoroughly trained American engineers would be received with confidence by the people, and they would justify that confidence by inaugurating and maintaining reforms in mining and metallurgy, increasing both the gross product and the net profit of our mines, and securing the future by wise forethought. None of the objections urged against foreign schools hold good against a national school among our own mines.

2. It would serve all the purposes for which a commissioner is now appointed. The work of compiling statistics and other information for the use of Congress and the people is expressly turned over to the faculty of the school by the terms of the bill; and their annual reports would no doubt be more valuable than the opinions and statements of any single man. The professors are also enjoined to travel through the mining districts, and address popular and instructive lectures to the miners—both parties gaining by this acquaintanceship.

3. It would serve all the purposes of a bureau or department of mines. The delays and difficulties which have arisen in the administration of the mining law by the General Land Office show how hard it is to manage such matters at such a distance. For an industry so constantly progressive as that of mining, the best kind of bureau is a school; because that remains always in vital connection with the people, hears of the latest improvements, tries experiments, publishes results—is, in short, in sympathy with the work for which its pupils are trained.

4. It would tend to unite different sections of the country, the mining interests of which are now separate and isolated. The interests of miners are alike. The miners in Oregon and in New Mexico are wrestling with essentially the same problems as those of Colorado and Carolina. What they need is one central point to which all experience shall gather, and from which light may radiate to all. The scientific collections, apparatus and library of such an institution would be worth more to the country than a score of inferior ones, costing in the aggregate ten times as much. This is one reason why the work cannot be left to private enterprise, or State liberality. No one private or State school can command the support and collect the experience of all the mining communities. For that, a national school is required. It has been shown by experience in other countries that such a school, devoted to the mining sciences only, and maintained by the state, has a powerful influence on the productiveness and permanence of the mining industry, while a mere department in some institution of learning, or a school smothered in a capital, away from the mining regions, has never been found to affect so widely the actual work of mining, although, no doubt, such endowments do much good. Let us have as many private schools, State schools and college schools as can

be supported; they will all succeed the better for the existence of that of which none of them can take the place—a national school among the mining regions. I no not underrate the advantages of private schools. On the contrary, I highly esteem them and rejoice in their prosperity. The school of Columbia College, New York, the Sheffield School of New Haven, the Rensselaer Institute at Troy, the Massachusetts Institute of Technology, the Pardee scientific department of Lafayette College, Pennsylvania, have all given considerable space to mining and metallurgy; and the first is devoted entirely to the branches of theoretical and applied science which relate to the extraction and beneficiation of useful minerals. Now there is work enough in the United States for twenty local mining schools, one in every State or Territory where mining is carried on; but there is neither room nor need at present for more than one national school, to stand in the midst of all local institutions, to concentrate and utilize the efforts of all. Such a school would simply take the place of the foreign academies to which our young men are now obliged to go, after they have learned what can be taught them here; and *as soon as it shall thus become possible to complete a thorough course without the expense of a foreign residence, our mining schools, great and small, would have twenty students where they now have one.*

5. Such an institution is more and more urgently needed every year, because the difficulties of mining in the Pacific States and Territories are constantly increasing. The steady annual decline of bullion product is partly due, as I have elsewhere remarked, to this cause. An average uniform product is only to be attained by a system of mining which does more than merely extract the richest ores and then abandon the mines. It is a significant fact, that the largest part of the bullion from lode-mining this year comes from the same mines that furnished it last year, and the year before, and the year before that. Mines like the Eureka of Amador, and the Eureka, North Star, Empire, and others of Grass Valley, would be much more common if skill and wisdom were more common among miners. Individual enterprise might in time correct this evil; but it has not yet done so, and we cannot afford to wait for so slow a reform nor to pay its frightful cost. The very extent of our mining territory is a fatal inducement to avoid rather than to overcome the growing difficulties of the work. It is so much easier for ignorant men to try their luck on virgin ground than to continue the exploration of ground already open, that in the absence of an organized effort to enlighten the people on this subject, we may expect to see our vast mining fields overrun and pillaged before an earnest and systematic development is undertaken. The praiseworthy efforts of single men to stem the tide are almost insignificant in comparison with the general tendency. One might as well expect the Indian to commence stock-raising while the prairie swarms with buffalo. He cuts out the hump and the tongue, throws away carcass and hide, and laughs at all notions of economy and industry. A despotic government would stop this waste by arbitrary measures; but the democratic policy of moral suasion by education is at once more feasible and more effectual.

6. An objection has been advanced which is plausible enough to merit a brief reply. It is said that the government is not called upon to interfere, simply because individuals are not successful in mining, any more than in case of depression in any other business. This objection confounds the distinction between individual and national loss. In point of fact, I think that individuals or companies have lost less money in mining this year than last, and less last than the year before. Mining is regulating itself according to the laws of self-interest. Those who are

not making money for the time being stop; only the best mines will be worked, and those only in such parts and for such periods as will secure the quickest and largest dividends. It is safe to say that not more than one-quarter of this year's bullion product has been obtained at a profit over and above costs; while, balancing the whole yield against the whole outlay, there is no profit left. The tendency of individual enterprise is naturally to abandon all the unprofitable mines, thus reducing the yield to one-quarter of its present amount—a reduction which could not be wholly compensated by robbing newly explored districts of their surface ores. It is the country, not individuals, that loses by such a course; and any measure which promises to encourage individuals to persevere, and offers them the means of obtaining that exchange of experience and impartation of knowledge which will render their work (so important to the country) profitable to themselves, is worthy of serious attention. It is a measure of national policy, not a "governmental interference."

The value of a national school of mines being acknowledged, it becomes a question of importance where it shall be located. That it ought to be, as the bill of Senator Stewart provides, west of the Rocky mountains, is evident from the following, among other reasons: It is the gold and silver mining industry which needs support, is most closely connected with the national credit and welfare, and gets, at present, the least aid from any quarter. The government does not own the iron and copper lands in the east, and is not directly interested in their product. Yet they are protected while gold and silver are not, nor can be, except by such a measure as this. Besides, the older States are better provided already with educational facilities.

Again, the Pacific States and Territories have, and will continue to have, a large and growing population interested in mining; they will furnish numerous students to such a school, and the school in return will gain in efficiency by its location in the midst of the mining districts. This is indispensable, if the provision requiring the professors to travel every year among the mines is to be made effective. A miners' meeting, held at Nevada City, near Grass Valley, last summer, passed the following resolutions, which, I think, express very clearly the substance of this matter:

Resolved, That we cordially recognize the importance to our mining industry of a national school of mines on the Pacific slope, substantially upon the plan advocated by the Secretary of the Treasury and J. Ross Browne, late United States commissioner of mining statistics, and embodied in the bill now before the United States Senate.

Resolved, That such a school, to exert its full measure of influence and achieve complete success, must be situated in the immediate vicinity of mining and metallurgical operations, so as to combine the benefits of actual practice with those of scientific instruction; and that we will not, so long as this fundamental condition is fulfilled, embarrass this important measure by the assertion of particular local interests; and we call upon the miners of the Pacific States and Territories to support the plan in a similar spirit of liberality.

The choice of location is wisely left to the directors of the institution. I venture to suggest that for the first year or two no permanent selection need be made. The erection of buildings would entail a considerable expense, which might better be avoided at the outset. Regarding the enterprise as an experiment, (however our hopes for its success are fortified by reason, analogy, and history,) I think that place should be chosen for a commencement which offers the best advantages *for the time being*, such as accessibility to students, neighborhood of well-managed mines and reduction-works, and cheapness of living.

The abolition of the bullion tax raises the question, how the school is to be supported. Before considering this, I would say a word or two concerning the probable expenses of the enterprise. The bill in its present form (see report of J. Ross Browne, 1868,) contemplates a large

expenditure at the outset. This might, no doubt, insure an earlier maturity, but it is not absolutely necessary. As I have already suggested, the cost of permanent buildings may be avoided for the present, by a temporary location and employment of cheap or hired buildings. It is not necessary to make instruction absolutely free. The national mining school of Saxony is managed upon a compromise system. The students do not pay all the expense, but they do bear a part of it, and the government supplies the deficit. In the present instance, an equitable and acceptable arrangement is not difficult. There are certain expenses, such as the salaries of the principal instructors, procurement of collections, library, &c., which are necessary and constant, whatever be the number of students. There are other expenses, which vary with the number of students, such as the cost of laboratory accommodations, the salaries of assistants, etc. It seems fair that moderate fees should be received from the students, to cover expenses of the latter class; and as the number of students increased, these fees might amount to such a sum as materially to reduce the proportion paid by the government. The directors should fix these charges with care, low enough to offer no hindrance to any who desired the benefits of instruction, and high enough to cover the variable expenses alluded to, and to insure appreciation of the privileges offered. Even aside from the saving to the government, I think this plan would increase the efficiency of the school. The sum of \$100,000 currency, judiciously expended, would be sufficient, in my opinion, to put the school in operation with the most necessary collections, apparatus, &c.; and the annual cost of maintaining it (apart from the erection of buildings) need not exceed that amount, the expenses incident to the increase of students being covered by fees. I recommend that \$100,000 be appropriated for this purpose for the first year. Subsequently, perhaps some acceptable plan could be adopted, by means of which the mining industry itself might bear a portion of the expense. A bullion tax of one-eighth of one per cent. would cover the whole, and be an insignificant burden, besides affording, what is now lacking, a ready indication of the prosperity and productiveness of the mines every year. If the Sutro tunnel is constructed by government aid, a portion of its revenues might be annually set aside by law for this purpose; but for the present an appropriation is the most direct means. I believe the nature of the object would justify this in any event; but it is especially reasonable in view of the fact that considerably more than a million dollars has been paid by the miners within the last four years, in the shape of a special tax on bullion. In view of the whole relation of government to mining, discussed in a former chapter, I claim that such a tax is only justified when its proceeds are applied for the benefit of the mining industry; and hence the appropriation asked, for the establishment of a national school of mines, is but a slight return for the extra burden which has been imposed upon mining.

In conclusion, I would urge the importance of immediate action upon this subject. It will be at least a year before the school, on the most moderate scale, can be put in operation, and the necessity for it grows stronger every day. If we delay until threatened evils are actually upon us, if we allow our country to recede from her foremost position among mining nations, we cannot excuse ourselves. On the other hand, a timely support to this industry will strengthen the hands of others, stimulate the settlement of our vast territory and the organization of stable communities upon it, and secure the future material progress of the country.

The history of the world proves that all nations eminent for profitable and permanent mining have employed two agencies for success—a

national mining code and a national mining school. These the United States must have.

I append accounts of several European schools, which will serve to show the nature and compass of their activity. The schools of London, Schemnitz, Leoben, Fahlun, and other places also deserve attention; and, in fact, a thorough study of the organizations of foreign schools should precede the adoption in detail of a plan for our own. Such an examination is provided for by the bill of Senator Stewart, establishing a national school of mines.

CHAPTER XXXIV.

THE FREIBERG SCHOOL OF MINES.

BY BENJAMIN SMITH LYMAN, OF PHILADELPHIA.

In view of the probable establishment before long of a national school of mines in America, it is worth while to look at similar schools in other countries. The following account of the Freiberg mining school was published five years ago, in a newspaper not specially devoted to mining interests, and has long been out of print. Few important changes there have taken place since then. The younger Weissbach has become professor of mineralogy in place of Breithaupt, and has from illness been compelled for some months past to interrupt his teaching. The number of Americans at the school has greatly increased, and was 35 a year ago, and is perhaps even greater now.

It would be well if former students of the Berlin and London mining schools, or of those at Clausthal, Liege, St. Etienne, Prizibram, Schemnitz, Leoben, and elsewhere, would likewise give the American public some account of these institutions.

The Royal Saxon Mining School, or academy (Bergakademie.) now 97 years old, is situated at Freiberg, 25 miles southwest of Dresden. It is surrounded for miles by mines, chiefly of lead and silver, that have been worked for 600 years, and is within two or three miles of two large smelting works. Freiberg is a town of 17,000 inhabitants, and has recently been connected with Dresden by railroad. The smelting works near Freiberg and some of the mines belong, as well as the school, to the government, and the rest of the mines and furnaces throughout Saxony are thoroughly under government control, so that not only are very good opportunities given the students of visiting the mines and furnaces and of working practically at them for their instruction, but the oversight of all these works, in the interest of their proprietors or of the government, gives permanent employment of many grades and kinds to Saxon graduates of the school.

There are about 140 students at the academy; less than half of them are native Saxons.

State students.—About five-sixths of the native students receive aid from the government; that is, they pay only \$37 (American money) yearly for tuition. In return, they are required to pass examinations and are carefully watched over in their studies; and they bind themselves not to settle outside of Saxony after graduation without paying all that

has been remitted to them by the government on the score of instruction or otherwise.

Admission to the school.—Free State students, as they may be called, must apply for admission to the school as early as the end of February; they must show by their birth certificate that they are between the ages of 16 and 23; they must bring a physician's testimonial of health, strength, and soundness, and a certificate of vaccination; they must bring written testimonials of their good character up to the date of their application; if under age, they must bring a certificate from parents or guardian of approval of the application; their previous education must fit them for the profitable pursuit of the studies they desire to pursue, and in the absence of satisfactory certificates to that effect from certain public institutions they must pass an examination. This examination is about equivalent to that required for admission to Harvard College, and includes algebra and geometry, equations of the first and second degree, stereometry, plane trigonometry, and the use of logarithms. Some facility in drawing, and a good, neat, legible handwriting, are also required; and some knowledge of French and English is considered an advantage. If the applicant comes from a school where Latin is not taught, the examination in this is omitted, but that in the mathematical and practical branches is made the more strict.

Preparatory mining course.—After a satisfactory examination of this kind, the student has to spend four months in following a preparatory practical course at the mines. For the first four weeks he must spend at the mines four six-hour shifts each week, and for the rest of the course five a week. The first eight weeks are spent on the mechanical preparation of the ores; the next six in practical work of different kinds in the mine, such as drilling and hammering stone; one week in seeing how the ore is raised from the mine; and from one to two weeks in observation of the various timbering and masonry work in the mines. During the course the student is helped to information in every detail by the overseer of the mine or his subordinates, and a report is made out monthly to an appointed academical instructor of the student's regularity, industry, zeal, and behavior. The student must also hand in, every month, to the same instructor, a complete journal of his daily work, its object, and what he has been taught about it, as well as his own observations. At the same time he has to pursue at the school certain preparatory studies in mathematics and drawing. Neglect of the duties during this course, or a betrayal of physical unfitness for the fatigues of a miner's life, may yet prevent the student from entering the school. But if the course is satisfactorily finished, he has to spend the remaining time until the beginning of the academical lectures in getting generally oriented in regard to the mines by visiting them under the special direction of the aforementioned instructor, and from time to time in his company. Those students who have already worked a year practically in mines are excused from the practical preparatory course, but not from at least two months of this general orientation.

Preparatory metallurgical course.—There is also a preparatory metallurgical course that must be attended in the long vacation by those students who wish to hear the lectures on metallurgy the following year. This preparatory metallurgical course begins about the first of August and lasts four weeks. The students meet every morning at six or seven o'clock at one of the smelting works, and have to write down, at the dictation of an instructor, a detailed description of the different metallurgical processes and operations. The rest of the morning is spent in visiting in company with the instructor the different parts of the works.

Each student must hand in, weekly, to this instructor a journal, containing not only the dictations but original observations and explanatory drawings; and this journal is handed in at the end of the course to the professor of metallurgy.

Academical instruction.—The students are encouraged to continue their visits to the mines and furnaces near Freiberg throughout the year, especially on Mondays, when there are for that very purpose as few academical exercises as possible; and in the vacations they can make excursions to more distant works. The most deserving of the students receive state aid for the longer excursions, and so travel into distant countries in the long vacation. In the spring and summer the professors themselves occasionally conduct excursions of a half day or a whole one, or of two or three days, to furnaces and mines, and to points of geological interest, and they sometimes make a long vacation journey with a few students.

The academical lectures are given in yearly courses that begin on the first Tuesday of October and end with the last week of the following July, with vacations of about two weeks at Christmas, Easter, and Whitsuntide, and with pretty frequent single holidays. The number of years to be spent at the academy by a student is not prescribed, but is commonly three or four. The student is also free to choose the courses of lectures that he will attend; but he must make known in writing at the beginning of June his choice for the following year, and that choice must be in accordance with the final examination that he intends to pass, and with the progressive nature of the studies themselves.

The students are obliged to take notes of the lectures and their accompanying practical exercises, and to exhibit a journal of the same from time to time to the several professors. During each course of lectures there is now and then a recitation in order that the professor may know the success of his lessons and the diligence of his pupils. At the end of July a public yearly examination of the students all together is made, and at this their journals, exercises, drawings, and the like are all exhibited as proof of their industry. This is, however, a parade or exhibition rather than an examination. If a student wishes to leave the academy, he must announce his intention, and he may have a testimonial. At the end of the whole course of study the student who wishes to enter the service of the state must pass the state examination, as it is called.

State examination.—The state examination takes place in October, but notice of intending to pass it must be given before the end of June. Not more than three candidates are examined at once, and the examination is open only to the students and certain officials, and to the relatives of the candidates. The examination is of four kinds: for those who wish to become miners, surveyors, constructors, and metallurgists.

The miners are examined in mineralogy, geology (with ore deposits,) mining, elementary mechanics, bookkeeping, mining law, general surveying, physics, drawing. They must show, too, that they have diligently followed the courses on practical surveying, general chemistry, metallurgy, and civil architecture. In default of such showing they must be examined in these branches.

The surveyors are examined in general and special surveying, mineralogy, but only in the most important characters, geology, ore deposits, mining law, drawing, physics. They must bring, too, good testimonials of their attendance on the courses on mining.

The constructors are examined in mining, physics, civil architecture, bookkeeping, general surveying, drawing, higher mathematics, elementary mechanics, construction of machines. They must have heard, also, the courses on general chemistry, metallurgy, mineralogy, and geology.

The metallurgists are examined in theoretical and analytical chemistry, dry and wet assaying and blow-piping, metallurgy, physics, mineralogy, elementary mechanics, mechanical preparation of ores, bookkeeping, drawing. They must have heard the courses on geology, civil architecture, mining law, and mining.

The candidates of all kinds must bring to the examination large drawings already made. One day is spent in making the oral examination in the different branches. On the second day is made an examination in drawing, principally in sketching after the models or after oral descriptions; also in writing short original papers on given subjects, to be finished in a short time, in connection with the performances in drawing. The third day is given to an examination of the metallurgist in practical assaying. Moreover, the candidates of all kinds must have handed in before the end of September a paper on a subject that has been given them at the time of their announcing their intention to stand the examination. The examination in each branch is declared "excellent," "good," or "satisfactory;" and if "satisfactory" is not obtained in a single branch, the candidate cannot be admitted to the practical course, but may try the examination again the next year.

Practical courses.—After the State examination, those who wish to practice their profession in Saxony must spend a whole year in practical work at the mines, or, if they are metallurgists, at the Royal Smelting Works. During the year at the mines they must practice all the different kinds of work, from the lowest to the highest, including that of overseers, two, four, eight, or twelve weeks at a time. They must go daily to the work, and remain at it during a full shift; and are paid for their labor \$1 12½ a week. They are required to hand in monthly a brief journal of their daily work. They must not turn their attention to other branches of study or work than that they have selected; but they may be allowed, from time to time, to visit other mines when something special is to be learned of importance. Those who wish to enter the service of the Royal Smelting Works must work there half a year at the practical metallurgical operations, and another half year at the work of the different officials of the establishment. They must remain daily at the furnaces from six in the morning until four; they are paid at the rate of \$1 12½ a week. If their work does not prove satisfactory, they are dropped from the employment of the government, and sent away from the furnaces. Those metallurgists who do not wish to join the service of the Royal Smelting Works are not allowed to spend more than eight weeks in practical work at the furnaces, and receive no pay for their work.

Subsequent employment.—Three of the best metallurgists are selected at the end of the year's course, in case their services are required, to assist the officials, and to continue at the furnaces as before. The others may receive permanent employment elsewhere, and, while waiting, are paid \$1 12½ a week; or, if they must wait long, or are especially deserving, \$1 50 a week.

Those who wish to practice the profession of surveying must, after the state examination and the year's practical work in the mines, perform a given trial piece of surveying, lasting several months and testing thoroughly their professional capacity. The rest at the end of the year's practice are employed in various mining or geological matters, according to each one's special fitness, until some permanent position is found for them. Those who intend to study law at the university after their mining studies must announce this intention before entering the mining academy, and must pass, either before that, or after leaving the academy,

the ordinary examination for admission to the university. They are not obliged to go through with the year's practical work after the state examination.

Independent students.—The students who receive no aid from the government have to pay from \$7 50 to \$22 50 for each course of lectures, besides an annual fee of \$11 to the academy; so that an industrious student of this class has to pay commonly \$75 or \$100 a year for his instruction. In order to be admitted to the academy, these students must be more than 16 years old; they must bring testimonials of good character up to the time of their coming there, as well as testimonials of fitness to pursue the intended academical studies; and if they are Saxons, they must bring their birth certificate. They are allowed to take part, if they choose, in the practical preparatory mining and metallurgical courses, and in the recitations and other exercises of the course, as well as in the yearly and state examinations; but those preparatory courses and the state examination must be specially paid for. These students are also allowed—two at a time—to have a practical course of eight weeks at the smelting works. Before leaving the academy they must announce their intention to do so, and they may have a testimonial to take away with them.

The professors.—There are 13 academical instructors, and they give in all 33 courses. They receive themselves the money that is paid for their courses by the students. Most of the instructors hold also other positions under the government connected with the mining or metallurgical interests of the state.

Breithaupt gives the courses on mineralogy, on crystallography, and on the paragenesis of minerals.

Weissbach gives two courses on elementary mechanics, (one general, the other with reference to mining;) a theoretical course, and a practical one on the construction of machines, and a course on general surveying.

Gaetzschmann gives two courses on mining.

Von Cotta gives a course on geology, one on paleontology, and one on ore deposits.

Scheerer gives a course on theoretical chemistry; one on practical chemistry, (qualitative analysis, and preparations;) one on analytical chemistry, and one on the metallurgy of iron. The last two chemical courses are accompanied by practical exercises in the laboratory.

Junge gives two courses on mathematics, (one on cubic and undetermined equations with alligation, progressions with interest, plane and spherical trigonometry, analytical geometry; the other on the elements of the differential and integral calculus with their applications, and the principles of higher mechanics; one on descriptive geometry, and one on practical surveying. The last is accompanied by practical exercises in the mines and above ground, and in the plotting room.

Fritzsche gives a course on metallurgy, one on assaying by the dry way, and one on assaying by the wet way. The courses on assaying are accompanied by practical exercises in the metallurgical laboratory.

Henchler gives a course on civil architecture, and the instruction in drawing.

Kressner gives a course on mining law, and one on mining business style of writing.

Richter gives a course on the blow-pipe, accompanied by practical exercises.

Proelss gives instruction in French.

Albin Weissbach (the son) gives a course on physics, and one of practical exercises in mineralogy.

Gottschalk gives instructions in bookkeeping.

The buildings and collections.—There are three buildings occupied by the academy; the principal one, the metallurgical laboratory, close by, and the chemical laboratory, at a distance from the other two. The principal building contains three lecture-rooms, a large mineralogical collection, a geological collection, a collection of machine models and a shop for making them, a large library, a shop for the sale of minerals, the dwelling of the superintendent of the academy, that of the janitor, and a few other rooms, including the academical prison. The metallurgical laboratory building contains laboratories for dry and wet assays, and for the blow-pipe practical exercises, a large room for the office work of the surveying exercises, and a lecture-room. The chemical laboratory building contains, besides the laboratory, a lecture-room and the dwelling of the professor.

The mineralogical collection is open to the students two or three days in the week; and, as the minerals are mostly in drawers, these drawers are opened for the students by one of the mineralogical professors. A separate small collection of, say, a thousand specimens of minerals is used for the course of practical mineralogical exercises, and the students are allowed to handle them freely.

Admission to the geological collection can be obtained at almost any time, and also to that of machine models.

The library is open twice a week, and books can either be consulted there or taken out and kept several weeks.

The discipline.—The academy, under the finance department of the state, has now its own police and its own criminal court, and punishes violations of its own laws; and its discipline extends over all the students without exception.

Its laws forbid to the students immoral behavior in general; noise in the academical buildings during the lectures; gaming and drinking bouts; disturbance of the public quiet; large meetings, for pleasure, or fencing, or anything else, without special leave; extravagant living and accumulating debts; fighting; challenging; duelling; defamation; negligence of studies; encouraging others to negligence; neglect of the regulations about visiting the mines or furnaces; neglect of the special directions of mining or furnace officials; walking alone in the mines; firing off the holes drilled for blasting; selling minerals; injuring anything in the library, collections, or laboratories.

The punishments are reprimanding, either by an instructor in the name of the rest, or in the presence of the teachers' meeting, or in presence of the academical court; reporting to parents or guardian; setting tasks for whole or part of the vacations; imprisonment from one day to a week, or from one week to four, either during the daytime only, or day and night; withdrawal of state aid in whole or in part, temporarily or permanently; threatening of advice to leave the academy; advising to leave the academy, either for a time or forever; expulsion from the academy and town—either simple expulsion, or expulsion together with a public announcement of it. Moreover, a combination of several of these punishments may be inflicted. Behavior at the academy may also affect the future position of a student who enters the service of the state.

The students are allowed to have societies among themselves, provided they are not for political purposes; and the chief officer of each society must report to the academical authorities a list of its officers and members, and state its place and time of meeting. There are three such societies.

*American and English students at Freiberg.**—The following list, compiled from official records, includes all Americans and Englishmen who studied at the Freiberg academy from its foundation in 1766 to its centennial, 1866. It will serve not only to show to what extent these countries are indebted to Saxony for the education of their sons, but also to expose the swindlers who pretend to come from Freiberg. The absence from this list of the name of any American or Englishman who claims to have studied at the academy before the year 1866 will be conclusive proof of the falsity of his claim:

Name.	Country, as given at entrance.	Year of entrance.
J. Hawkins.....	England.....	1786
A. Champernowne.....	England.....	1789
Thomas Barcker.....	England.....	1790
Thomas Weaver.....	England.....	1790
John Hailstone.....	England.....	1792
John Coke.....	England.....	1793
George Mitchel.....	Ireland.....	1798
George Tuthill.....	England.....	1798
Thomas Holland.....	England.....	1798
Robert Jameson.....	Scotland.....	1800
John Henry Vivian.....	England.....	1803
Wm. H. Keating.....	United States, (Philadelphia).....	1819
Stephen de Mornay.....	England.....	1829
Richard G. Killaly.....	Ireland.....	1830
Aristides de Mornay.....	England.....	1832
Alex. de Mornay.....	England.....	1832
Edward Steut.....	England.....	1833
Lewis Gorden.....	Scotland.....	1838
Theodore F. Moss.....	United States, (Philadelphia).....	1838
Christian E. Cheeswright.....	England.....	1839
Frederick Bridgeman.....	England.....	1846
William L. Faber.....	United States.....	1846
Ricardo de Bayo.....	England.....	1846
Robert Pigott.....	England.....	1848
John W. Osborne.....	Ireland.....	1848
Henry Rohdewald.....	United States, (Baltimore).....	1849
Franz Lennig.....	United States, (Philadelphia).....	1849
Walter McClelland.....	Scotland.....	1850
John Betts.....	England.....	1850
Eugene Hilgard.....	United States, (Illinois).....	1850
John G. Ellery.....	United States, (New York State).....	1851
Arthur P. Vivian.....	England.....	1851
William Bradley.....	United States.....	1852
William Ketchell.....	United States, (New Jersey).....	1852
Hillary M. Bauermann.....	England.....	1853
John Blandy.....	United States, (New York).....	1853
John D. Eastor.....	United States, (Baltimore).....	1853
Henry F. Blanford.....	England.....	1853
Samuel Minton.....	England.....	1853
Stewart D. Birch.....	England.....	1854
George Brush.....	United States, (Brooklyn).....	1854
Herbert Reynolds.....	England.....	1854
John Sturz.....	England.....	1855
George P. Wall.....	England.....	1855
James Hague.....	United States, (Albany).....	1856

* The preceding account of the Freiburg school of mines, and the following chapter on the Paris school, both the work of Mr. Lyman, are extracted from the columns of the American Journal of Mining, published in New York city. The chapter on the Berlin academy, by Mr. Ward, is taken from the same source. This list of American and English students, however, and the regulations of the Berlin academy in a subsequent page, were not originally a part of the chapters in which they are placed, but have been added by myself.

List of names of Americans and Englishmen, &c.—Continued.

Name.	Country, as given at entrance.	Year of entrance.
John F. Powles	England	1856
William Powles	England	1856
Raphael Pumpelly	United States, (New York)	1856
Leopold Bierwirth	United States, (New York)	1857
Carl Froebel	United States, (New York)	1857
Louis Janin	United States, (New Orleans)	1857
Henry Janin	United States, (New Orleans)	1857
William A. Kobbe	United States, (New York)	1857
William Hustler	England	1857
James Latham	England	1857
Edwin Parkyn	England	1857
William V. Russel	England	1857
John Taylor	England	1857
Rudolph E. Werthemann	United States, (San Francisco)	1857
Frank T. Williams	England	1857
Lewis Falkenau	United States, (New York)	1858
Alfred P. Rockwell	United States	1858
William B. Richardson	Scotland	1858
John H. Boalt	United States, (Ohio)	1859
S. M. Crafts	United States, (Boston)	1859
Robert H. Lamborn	United States, (Philadelphia)	1859
Ernest Moss	United States, (New Orleans)	1859
Francis Washburn	United States, (Boston)	1859
Clement Foster	England	1859
William Galloway	Scotland	1859
Edmund B. Preston	Calcutta	1859
John F. Lewis	United States, (South Carolina)	1860
Rossiter W. Raymond	United States, (Cincinnati)	1860
Augustus Steitz	United States, (St. Louis)	1860
Louis Vogel	United States, (St. Louis)	1860
Harry Bowman	England	1861
Hugh Bowman	England	1861
Walter Crafts	United States	1861
Edward H. Jackson	United States	1861
Winfield S. Keyes	United States, (New York)	1861
Benjamin S. Lyman	United States, (Massachusetts)	1861
Eugene N. Riotte	United States	1861
James B. Smith	United States	1861
Eckley B. Cox	United States, (Philadelphia)	1862
William S. Lee	United States, (New Jersey)	1862
William N. Symington	United States	1862
Charles J. Duval	United States, (New Orleans)	1863
Fritz Gillmann	England	1863
Philip H. Lawrence	England	1863
Charles Madge	England	1863
Louis F. Reichert	United States, (California)	1863
Augustus J. Bowie	United States, (California)	1864
George L. Bradley	United States	1864
Howard Crittenden	United States, (California)	1864
Walter L. Kane	United States	1864
Samuel F. Emmons	United States, (Boston)	1864
Marshall Hastings	United States, (California)	1864
Maximilian Koester	United States, (California)	1864
Ethebert Watts	United States, (Philadelphia)	1864
John H. Caswell	United States, (New York)	1864
J. W. Cortlan	United States	1864
William M. Curtis	United States, (New York)	1864
Thomas M. Drown	United States, (Philadelphia)	1864
William B. Foster	United States, (Pennsylvania)	1865
Robert Hazen	United States, (San Francisco)	1865
Arnold Hague	United States, (Boston)	1865
Almon D. Hodges	United States	1865

List of names of Americans and Englishmen, &c.—Continued.

Name.	Country, as given at entrance.	Year of entrance.
Edward R. Howe.....	United States.....	1865
Alexis Janin.....	United States, (New Orleans).....	1865
Richard J. Inge.....	United States, (California).....	1865
George J. Johnson.....	United States.....	1865
Lebeus H. Mitchell.....	United States, (Massachusetts).....	1865
O. A. Moses.....	United States.....	1865
Lyman Nichols.....	United States, (Boston).....	1865
Philip Oettinger.....	United States, (New York).....	1865
John B. Pearse.....	United States, (Philadelphia).....	1865
Edward D. Peters.....	United States, (Boston).....	1865
William H. Pettee.....	United States.....	1865
Frederick Prime.....	United States, (New York).....	1865
Thomas C. Raymond.....	United States.....	1865
Charles C. Rueger.....	United States, (California).....	1865
Duncan D. Templeton.....	United States, (New Orleans).....	1865
Sydney W. Tyler.....	United States, (Connecticut).....	1865
Gardner F. Williams.....	United States.....	1865

Total, 124. Britons, 48; Americans, 76, of whom 33 entered in the years 1864 and 1865. The number in 1866 is said to have been still larger. Nearly or quite all the Americans in the above lists have graduated and returned to this country.

CHAPTER XXXV.

THE PARIS SCHOOL OF MINES.

The French imperial mining school (*École Impériale des Mines*) at Paris was first founded in 1783. The special object of its instruction is the mining and working of minerals; also, the study of steam machinery, the discovery and care of mineral springs, drainage and irrigation, building and running of railroads, and in general the arts and occupations connected with mineral manufactures. The instruction includes the branches of machinery, metallurgy, mineral chemistry, mineralogy, paleontology, geology, (both pure and applied to agriculture,) administrative law, mining and manufacturing laws, as well as the principles of construction needed in the practice of government mining engineers and of managers of mines and furnaces.

The students of the school, the instruction, the management and discipline, and the building and collections will be spoken of in turn.

The whole number of students is little more than a hundred, and is made up of government students, outside students; foreign students, and free students.

Government students, (élèves ingénieurs.)—The government students are taken only from the graduating class of the polytechnic school. These graduates are allowed, in the order of their school rank, to choose which branch of the government service they will go into; and it almost always happens that the full number of places in the mining school is filled by the very highest scholars. The number taken each year depends upon the demands of the service; half a dozen years ago the yearly number for several years was six, but of late it has been only three. Their age on entering the mining school averages more than twenty-one years.

After graduating at the mining school they become ordinary mining

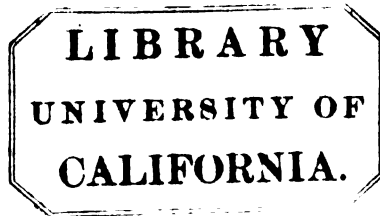
ERRATUM.

The following names were omitted by clerical error from the list of the enrolled students at the Freiberg Academy, commencing on page 236:

Name.	Country, as given at entrance.	Year of entrance.
James Watt.....	England.....	1787
Stephen D. Buchan.....	England.....	1836
Adolph Steinhauser.....	England.....	1836
Alfred Betts.....	England.....	1852
William T. Blanford.....	England.....	1854
Henry Bleidorn.....	England.....	1854
R. J. Kernick.....	Cornwall.....	1856
Thomas Macfarlane.....	Scotland.....	1856
Wadsworth Bush.....	England.....	1861

It should be added that the list does not include students under private tuition, nor those who may have visited Freiberg in the course of their professional education, without regularly enrolling themselves among the members of the academy and regular attendants upon the lectures.

R. W. R.



1911

1912

1913

engineers of the third class, and are assigned to duty in some part of France. The higher grades, to which they may rise in course of time, are: ordinary mining engineers of the second and first class, mining engineers-in-chief of the second and first class, and general mining inspectors of the second and first class. The ordinary engineers have charge of the mining and railroad interests of the government, and the inspection of steam boilers, in larger or smaller districts, according to their rank; the engineers-in-chief have, in like manner, the oversight of several such districts; and five of the general inspectors, who are in all only about a dozen in number, have charge of the five great divisions of the whole of France. Moreover, the care of the Paris mining school, and of the two other lower mining schools of France, and other special duties, give occupation to a few of the mining engineers of almost every grade. The whole number of mining engineers in the service of the government is about 130, and there are about 20 more on unlimited leave of absence, or in the service of companies, making about 150 in all.

The government students have a salary of 100 francs a month, and, during journeys, 150 francs a month, besides an outfit of 100 francs, and eight francs for every day of travelling.

Outside students, (élèves externes.)—The outside students are intended to become managers of mines and furnaces in the owners' interest. They are admitted to the school on a competitive examination, and have the same instruction and practical exercises as the government students. A preparatory year of instruction is also provided for those who wish to become outside students, but are not fitted for admission to the studies of the first year.

A candidate for admission to the preparatory year, with the view of becoming an outside student, must be French by birth or by naturalization, and at least 16 years old, and at most 22 on the foregoing 1st of January. His application must be sent to the minister of agriculture, commerce, and public works by the 1st of September, and be accompanied by a birth certificate, and, if need be, his naturalization papers; by a certificate of good character from the authorities of his dwelling-place; by a physician's certificate of having been vaccinated, or having had the small-pox, and, if need be, by an official certificate that the preliminary examination is unnecessary. This preliminary examination is made before the middle of October by government mining engineers designated for the purpose, and must be passed by all candidates, except those who have passed the examination at the end of the first year of the polytechnic school. The final examination is made at Paris, in the first half of November, by the council of the mining school. The candidate must write and spell well, and must know arithmetic, algebra, geometry, plane trigonometry, analytical geometry, descriptive geometry, and physics, and must be able to draw from copies. There are commonly perhaps 15 French students following the studies of the preparatory year.

Candidates for admission as outside students to the studies of the first year must be French, in like manner, and a year older than the candidates for the preparatory year—that is, about 18 at least on the opening of the school term in November. They must also hand in their application in the same way together with similar certificates; and all must likewise pass a preliminary examination, except those who are graduates of the polytechnic school, or are licentiates of the mathematical sciences, or have passed the examination at the end of the preparatory year. The final examination is made by the council of the school in the first half of November. The requirements are good handwriting and good spelling, a knowledge of the differential and integral calculus, of

mechanics, of descriptive geometry and its applications, of those parts of physics that treat more especially of gases and of optical instruments, of general chemistry, and geometrical drawing, and water-color washing. Before the examination each candidate must hand in at the school a page of French written from dictation, five drawings of descriptive geometry, (exercises on the straight line and the plane, solution of three principal cases of trihedral angles, tangent plane to a surface of revolution, section of an oblique cone by a plane, development of a truncated cone, intersection of two cylinders,) three drawings of stone cutting, (an oblique door in a battering wall, a straight descending vault, an unclosed winding staircase,) a drawing of carpentry, (a roof of truss with all the pieces in detail,) a washed drawing of a screw and nut shaded.

About 20 outside students are admitted every year to the studies of the first year, and about 12 every year receive diplomas at the end of their studies.

Foreign students, (élèves étrangers.)—Foreigners are permitted to share in the instruction of the school in all its branches, including the preparatory year; and are admitted, without examination, on the simple recommendation of the ambassador at Paris of each applicant's government. Of course it is desirable for all students to have the same fitting and age as the French students have, in order to profit by the studies of the school. Foreign students can have places in the laboratory and in the drawing-room, only in case places happen to be vacant there. They may pass the same examinations as the government students, and are expected to pass one of them each year; and at the end of their studies they may have a certificate of the manner in which they have studied, and of their examination marks; but no diploma is given them, and they have no right to practice the profession in France, except as assistants of French engineers. The foreign students are subject to the same discipline as the French, but are less cared about and less closely watched over, so that they do pretty much as they like. Half a dozen years ago, the number of foreign students in the preparatory year was perhaps a dozen; in the first and second year of the regular course, about half a dozen, and in the third year, three or four. There are commonly two or three Americans among the foreign students of the school.

Free students, (élèves libres.)—Besides the above-mentioned students, others, called free students, are allowed to take such portions of the school instructions as they may choose, but are required to pass at least one examination each year. They have much the same privileges as the foreign students, and, like them, receive no diploma at the end of their studies. The free students are few, perhaps a dozen in the whole school.

The instruction.—The instruction is three years long, (besides the preparatory year,) and is given in lectures, (without recitations,) practical exercises in chemistry, drawing, mineralogy and paleontology, and in occasional excursions. With French generosity, it is made quite free of cost to all the students, French and foreign alike; and the lectures on mineralogy, geology and paleontology are open to the public. The students of the second and third years have to travel in mining regions in their long summer vacations.

The students are not left to grope in their ignorance for a fitting arrangement of their studies, but a well-planned regular course of study is prescribed, and things are learned in their proper connection, a matter of great importance.

Preparatory year.—The instruction of the preparatory year begins at the middle of November and lasts until the end of summer.

Professor Haton de la Goupilliere (ordinary engineer of the first class) lectures on the differential and integral calculus and in mathematics.

Professor Fuchs (ordinary engineer, second class) lectures on descriptive geometry and the parts of physics that treat specifically of dynamical electricity and optics.

Professor Moissenet (ordinary engineer, first class) lectures on general chemistry.

The students of the preparatory year also practice geometrical drawing and water-color washing under Mr. Amoroux, the drawing-master of the school.

First and second years.—The lecture courses of the first and second years are given together; that is, some of them are two years long, and the students who enter the school one year begin with the second part of the course of those who entered the previous year; but the lecture courses are so arranged that some begin one year and some the next. The courses that are only one year long alternate with each other, so as to be equal in number each year. It is necessary, therefore, to be at the school at least two years in order to get the most important part of the instruction. Ten lectures of about 16 hours in all are given each week, and the courses last from the middle of November until the middle of April.

Gruner, (general inspector, second class,) professor of metallurgy, gives a two-year lecture course, that begins the even years, (1860, for example,) with general metallurgy, furnaces, fuels, and the like, and iron; and the next year takes up copper, lead, silver, gold, quicksilver, tin, antimony, bismuth, and zinc.

Rivot, (engineer-in-chief, second class,) professor of mineral chemistry, gives a two-year lecture course, that begins in the odd years, with the metalloids, alcalis, and earths, together with cements, mortars, mineral waters, soils, and manures; and the next year treats of the metals. He has also charge of the laboratory, where each student works in periods of three weeks at a time, alternating with the drawing exercises. In the laboratory the students begin with making preparations of different bodies, and then make analyses and dry assays. A written account of the laboratory work is required from the student.

Daubrée (engineer-in-chief, first class) is professor of mineralogy, in the place held half a dozen years ago by the much lamented De Sénarmont. The lecture course is only one year long, but it is repeated every year, and it is expected that the students generally will follow it two years running before getting the needful practical familiarity with the minerals. A few, however, are able to pass the examination satisfactorily at the end of the first year. Besides the lectures, there are, for some weeks before the examination, practical exercises in the presence of the professor.

Callon (engineer-in-chief, first class) is professor of mining and machinery, and gives a one-year course on each of these subjects in alternate years, beginning the one in mining on the odd years, and the one on machinery the even years.

Elie de Beaumont (general inspector, first class) is professor of geology, but he gives only four or five of the lectures himself, and the rest are given by his colleague, Mr. De Chancourtois (engineer-in-chief, first class.) The lecture course is but one year long, but it is repeated every year, and the examination comes at the end of the second year, and hearing the lectures is only required that year. Besides these lectures, there are, in the spring, weekly excursions of a whole day in the neighborhood with both these professors. After the spring examinations are

over, there is every year, in the beginning of June, a geological excursion of a whole week to some distant part of France, as, for example, to the Ardennes, or to the Jura. On this yearly excursion, Elie de Beaumont himself takes the lead, and does it most admirably; long may he be spared the strength for such fatiguing labors! The party numbers some forty, counting the professors and two or three of their assistants and friends and the students, to all of whom transportation is furnished free.

Bayle (engineer-in-chief, second class) is professor of paleontology. He began with paleozoic fossils in 1859; and in 1860 took up secondary fossils; and in 1861, probably, went on with tertiary fossils, making really a three-year course of it. The student, however, is required to follow this course only through the first year; but as the examination does not come until the end of the second year, together with the geological examination, he finds it to his interest, if only for that reason, to hear the lectures of both years.

Professor Fuchs (ordinary engineer, second class) teaches surveying, with practical exercises above ground and in the catacombs underground, in the summer between the first and second years lectures.

The drawing exercises of the first and second year under Mr. Amoureux, consist of machine drawing from copies and from real machines, plotting, mapping; and later, in the second year, in making original drawings in solution of given problems in mining, machinery or metallurgy.

Third year.—The lectures of the third year are comparatively few in number, and mostly on subjects of less interest and importance to foreign mining engineers than the lectures of the other two years.

Couche (engineer-in-chief, first class) is professor of construction, and lectures on railroads and machine construction.

Professor Lamé-Fleurs (engineer-in-chief, second class) lectures on mining laws.

Professor Delesse (engineer-in-chief, second class) lectures on agriculture, drainage and irrigation. Excursions are sometimes made to large farms in the country.

The drawing exercises of the third year are original designs connected with the solution of problems in mining, machinery or metallurgy.

Mr. Schlessinger teaches German to the students of every year; but the study of it is optional, and few study it after the first few days.

Mr. Elwell teaches English, in like manner, to those of any year who choose to study it.

Examinations.—The examinations at the ends of the lecture courses are both written and oral, and a week is given to the examination in each course. The written examination takes place in the library, and two or three questions are given to all the students together for each to answer. Each student may make use of his lecture notes or of any books he may bring with him or find in the library; and, if he wishes, he may work upon the answers all through the day until four o'clock; but the time required for his work is noted. The questions in metallurgy, one year, to give an example, were how to adjust the charges of two iron furnaces in order to produce good foundry iron in one and forge iron in the other, at less than certain given prices, with three ores, and forge cinders of certain given composition and cost, and with labor of a certain given cost. The geological questions, one year, required a description of the coal measures proper, their characteristic structure, composition and fossils, and their difference from other coal formations; also an account of the principal conditions in which limestone occurs on the globe, and

the origin of different limerocks; also an account of the different tin ore deposits in the world, and the conjectures as to their probable mode of formation. The written examination in mineralogy consisted, under De Sénarmont, of crystallographic computation. In the oral examinations the students are examined one at a time by the professor of each branch and a couple of other gentlemen, and the questioning lasts from ten minutes to half an hour. In mineralogy the student is asked the names of six or eight materials placed before him. In geology and paleontology, he is tried in the same way with a few fossils as well as questioned on geological points, and required to explain a specimen or two of ore veins. The examinations of the second year include, also, the subject of the first year's lectures.

Journeys.—Besides the geological and agricultural excursions already mentioned, the students of the second and third years have to travel for at least 100 days in the second half, that is, the summer of those years; commonly two or three students together. They have to make known their plans beforehand, and have them approved of; and after their return, have to hand in a journal of what they have seen. Both French and foreign students are furnished with circular letters of introduction to the government mining engineers, and to all managers of mines and furnaces in France, who take pains to show all needful attentions to the students. In this way there is really as good a chance to see mines and furnaces to advantage as if the school were placed in a mining region, and a long period of time were specially set apart for this purpose. At the end of their studies those government students who have sepecially distinguished themselves at the school are allowed to travel for a time in foreign countries.

Management.—The mining school is under the control of the ministry of agriculture, commerce, and public works, and is managed by a general inspector of the first class, [now Mr. Combes,] who has the title of director of the school. Under him, a general inspector of the second class, [now Mr. Gruner,] or an engineer-in-chief, is charged with the direction of the studies and the details of the management, and has the title of inspector of the school. The council of the school, which meets at least once in two months, consists of the director and the inspector of the school, of two general inspectors, and of the professors; and it deliberates on the standing of the students, and the cases of extreme punishment, and arranges the lecture courses. Another council, called the improvement council, consists of the director of the school, a general inspector of the first class, two general inspectors of the second class, the inspector of the school, and two of the professors. It meets at least once a year, and its business is to consider the merits of the work of the students taken as a whole, and to propose improvements in the instruction of the school.

Punishments.—The penalties that can be inflicted on the students are: a reprimand given either privately or in presence of their comrades, by the professors, by the inspector, or by the director of the school; temporary exclusion, for a week or fortnight, from the rooms for study, and from the laboratory or from the school; public mention; censure by the council, with or without public mention; delay of promotion from one class to the next; final expulsion from the school.

Hours.—The lectures are given at half-past nine in the morning and at noon, and there are in the first and second year, commonly, two each day. The students are required to sign their name in a register before **each** lecture, and at half-past three in the afternoon. They may leave the school between the two lectures, or from half-past eleven to twelve, for their breakfast; but they must stay there from noon until signing at

half-past three. They can stay later if they like, and some work at their drawings by lamplight.

Rank.—The rank of the students is determined by their merit, taking account of their industry, their examinations, and their capacity shown in the practical exercises, and the journals of their journeys.

Dress.—There is a uniform prescribed for the government students, but none for the others. The undress uniform is simply three narrow bands of gold lace around the cap.

The building and collections.—The school with all its appurtenances is contained within one building, which contains also the dwellings of the director and inspector of the school; but none of the students lodge at the school. Certain portions of the school have been built within the last half dozen years, and it is now handsomely furnished with laboratories, drawing-rooms, and rooms for the library and the mineralogical, geological, metallurgical and machine model collections. The collections of fossils and minerals are very large and fine; and they are open to the students and to the public on certain days in the week. The specimens, except the duplicates, are in glass cases on the tables, so that they can be easily seen but not handled. There is a small collection of fossils and minerals that is always accessible to the students, and can be freely handled. The large library is open daily and all day.

The collections of the museum of natural history at the plant garden are also open to the public on certain days of the week, and are therefore available, especially the fine collection of minerals, for the study of mining students. There are other mineralogical collections likewise accessible, in the city, as well as libraries, machine models, laboratories, for private instruction under excellent chemists, and other valuable facilities for study; to say nothing of the great benefit, both directly to the student and indirectly through its effect on the professors, of the presence in the city of a very large number of scientific men.

Further details of the organization of the school may be found in the laws and decrees of the *Annales des mines* for 1856; and details of the examinations for admission, in the same for 1861 and 1867.

CHAPTER XXXVI.

THE PRUSSIAN ROYAL SCHOOL OF MINES AT BERLIN—BY WILLARD P. WARD, M. E.

Of this excellent institution but little is known in this country in comparison with the wide reputation of the Freiberg, Clausthal, and Paris schools. The main reasons for this are the comparative recentness of its foundation and the fact that it is not situated in a mining region. The practical part of a mining engineer's education is probably best gained by studying at a school situated in some great mining region, where he will see nothing but mines and hear nothing but mining matters discussed.

On the other hand, there are many things which it is necessary for an educated miner to know which he can learn just as well in one place as another, so far as the advantages of location are concerned. These are the kindred sciences of chemistry, geology, mineralogy, the theory of the treatment of ores, assaying, &c., which are necessary to a rational system of mining.

The large attendance of the excellent mining schools connected with Columbia College, the Troy Polytechnic, and others, shows that the American people appreciate the value of these sciences to the mining engineer.

As every young man who is about to enter upon the study of mining, for one reason or another, cannot go to Europe to spend three or four years there in prosecuting his studies, it is a fine thing for the country to have these schools, which I believe to be excellent; and far be it from me to say anything to injure them in any way. Still some—partly because they appreciate the advantages of a European residence, and partly because they consider the advantages to be enjoyed there greater than those offered by the schools of this country—will go to Europe to study; and to each a knowledge of the merits of the Berlin school may be of value.

The advantage of being a member of this school consists not only in being able to hear the lectures and have the valuable advice and friendship of the professors, but it gives one free entrance to all the mines and smelting works of Prussia. So great is the courtesy of the Germans that almost anybody, on making proper application, can see nearly all their works; but a letter of introduction from the director of the Berlin school will secure a degree of civility which under other circumstances would be wanting, and admission to certain works which would otherwise not be shown at all, or shown in such a way that one would be but very little the wiser after seeing them.

With regard to the lectures it may be said that they are all of the best. The Prussian government has spared no pains or money to give the students all the opportunities possible for obtaining a thorough theoretical and, so far as models and collections can be of assistance, practical knowledge of his profession. The student has the advantage in Berlin of being able to attend the lectures of Gustav Rose on mineralogy, whose name is almost as familiar to mineralogists as that of his lamented brother, Henry Rose, is to chemists; of Beyrich on geology, who is regarded by many in Germany as a second Cuvier in the realms of paleontology; and to make use of the large mineralogical and paleontological collections of the largest university of Germany.

The director of the school and professor of mining, Hauchecorne, is a man of very extended practical knowledge in his branch. He has been for many years a mining superintendent in Westphalia and Upper Silesia.

Professor Kerl, on general smelting and assaying, is sufficiently well known, even in America, to render anything I could say of him superfluous. Professor Wedding, on iron smelting, has a large experience in his subject, but is probably better known in England than in this country. Professor Rammelsberg, on mineral chemistry, and Professor Hoffman, on general chemistry, are professionally, and through their books, well known in this country. Professor Werner, on machinery, is regarded as authority in Germany. The large and well-appointed laboratory is under the charge of Dr. Finkler, one of the most promising of the former pupils of Henry Rose. There are but few, if any, other schools which possess such corps of instructors.

In the summer vacation trips are made to various mining regions by the professors of metallurgy and mining accompanied by the students, the travelling expenses of the party being paid by the government.

To the above general account I add the following, translated from official publications, for which I am indebted to Professor Bruno Kerl, of Berlin :

REGULATIONS OF THE ROYAL ACADEMY OF MINES.

§ 1. *Object.*—The Royal Academy of Mines, at Berlin, is established for the purpose of affording to those who would educate themselves in the management of mining, metallurgical, or saline works, opportunity to obtain the necessary professional knowledge.

§ 2. *Control and administration.*—The academy is under the general control of a director, appointed by the King, and responsible to the minister of commerce, trade, and public works. The financial and statistical departments (bureau work) are conducted by officials of the ministerial department of mines, furnaces, and salines.

§ 3. *The curatorium.*—This consists of five members or curators, appointed by the King, and assists in the arrangement of the organization, the determination of the various courses, and the nomination of instructors.

§ 4. *Duties of the director.*—Besides the general management of the institution, the director has the following special functions:

1. The issuance of permissions to enjoy the benefits of the academy, according to the conditions in §§ 10–12.

2. The superintendence of the systematic progress of lectures and instruction.

3. The control of collections and apparatus, (for which the instructors in each branch are primarily responsible,) and the preservation of buildings and personal property.

4. The preparation and transmission of estimates.

6. The procurement of apparatus, furniture, &c., and the receipt of moneys within the limits of the estimates.

6. The transmission of annual accounts, and the reception and editing of notes and reports.

7. The rendition of annual reports.

8. The convocation of regular instructors, to consult upon the plan of instruction, and other matters relating thereto, as often as may be required, and at least semi-annually.

§ 5. *Regular instruction.*—Regular instructors (professors) are appointed by the minister of commerce, trade, and public works, on the nomination of the director and approval of the curatorium, for the principal subjects included in the courses, and are bound to deliver certain lectures and give certain instruction in their respective branches.

§ 6. *Extraordinary instruction.*—The director may also, with the consent of the curatorium, grant permission to any regular instructor of the academy, to any professor or teacher of other institutions of learning, and to other duly qualified persons, to lecture upon special subjects.

§ 7. *General plan of instruction.*—The lectures at the academy continue from the 15th of October to the 15th of the following August, with an Easter vacation of three weeks.

§ 8. *Subjects.*—The following subjects are included in the plan of regular instruction: mines, salines, general metallurgy, metallurgy of iron, mechanics, machines, surveying, drawing, construction, projections and shadows, recitations and colloquies upon mineralogy, geognosy, and paleontology, and on mathematical processes, mining law, mineral chemistry, iron founding, mechanical technology of the metals, applied chemistry in the arts, blow-pipe assaying, general chemical analysis, with practical instruction in the laboratory, assaying in the dry and humid ways, theoretically and practically, &c., &c. A catalogue of the lectures and lecture fees is published semi-annually.

§ 9. *Reception of students.*—Permission to attend the academy is granted by the director, according to the conditions of §§ 10–12, upon application made during the first 14 days of the semester, and accompanied by the necessary attestations. This permission is endorsed upon the application and given to the student by the registrar of the academy.

§ 10. *Qualifications of students.*—The following have a right to be admitted to the academy:

1. Those students of mines, furnaces, and salines, who desire to devote themselves to the Prussian government service.

2. The matriculated students of the Royal Frederick William University of Berlin.

3. The matriculated students of the Royal Academy of Practical Arts, (*Gewerbe Akademie*.)

§ 11. *Admission of other students.*—The director may also grant to other persons the permission to attend such lectures as they may name in their applications.

§ 12. *Applications.*—The students admitted according to §§ 10 and 11, note, in the proper column of the application blank, the lectures which they desire to attend during the semester, and deliver it to the registrar for signature.

§ 13. *Fees.*—Within four weeks after the beginning of the semester, (half year,) the applications (§ 12) are to be handed in, the fees paid into the academical treasury, and the students are to report themselves to the instructors.

§ 14. No instructor is allowed to accept the application of a student, or admit him to lectures and recitations, before the fee has been paid and receipt endorsed upon the application-blank, except where fees are remitted. (§§ 19, 20.)

§ 15. *Fees.*—Lectures and recitations are partly for fees (privations) and partly gratuitous, (public.)

§ 16. In the case of private lectures included in the regular courses, the fee shall not exceed one thaler (73 cents gold) for each weekly hour per semester. The fee for a course of lectures occupying five hours of each week through the half-year, for instance, would be five thalers. Fees for instruction in drawing and practice in the laboratory are subject to special arrangements.

§ 17. The fees for extraordinary lectures are fixed by the instructors in accordance with the curatorium. The rule adopted for ordinary lectures is in general, however, not to be exceeded.

§ 18. The fees paid in for extraordinary instruction are received by the respective instructors from the treasury at the end of the semester.

§ 19. *Remissions.*—In cases of personal indigence, attested by the proper authorities, the minister of commerce, trade, and public works may, on the application of the director, remit to native students half the fees for ordinary instruction. There is no remission of the fees for special courses of lectures.

§ 20. The remission is endorsed by the director on the application-blank; and the student binds himself thereupon, in writing, to refund to the treasury of the academy the amount so remitted within six years after leaving the institution.

§ 21. *Refunding of fees.*—Fees are refunded to students when the lectures do not take place, or are broken off during the first half of the semester, or are held at different times from those first announced. The amount so refunded must be drawn from the treasury during the first four months of the current semester, otherwise the claim is void.

§ 22. *Certificates.*—Remarks as to the degree of industry and proficiency manifested by the student are entered at the close of each semester in the proper columns of the application-blank. At the request of the students the director will issue, upon surrender of the application-blank, a certificate as to his conduct and progress while in attendance at the academy.

Students who have attended the academy for at least two semesters may be subjected to an examination and receive certificates of their

attainments. With reference to this point the following rules are established:

REGULATIONS FOR THE EXAMINATIONS OF THE ROYAL ACADEMY OF MINES AT BERLIN.

§ 1. The students of the Royal Academy of Mines may, upon leaving the same, for the purpose of obtaining proofs of their acquirements, undergo an examination, the result of which will be embodied in an official certificate, made out for them.

§ 2. Only those students can apply for such an examination who have attended the lectures or taken part in the practical exercises of the academy for at least two semesters. Nothing more is necessary for admission to examination than proof of such attendance.

§ 3. The examination may cover all the sciences and accomplishments taught at the academy. The candidates have to name those branches in which they desire to be examined.

§ 4. The commission conducting the examination consists of at least three members, including the director of the academy as president, and the instructors in those branches covered by the examination.

§ 5. The examination is both written and oral. The candidate must present, upon a subject named by the commission, a written thesis, for the preparation of which a period of six weeks is allowed him. If he is to be examined in several branches, he may choose the one to which the subject of the thesis shall belong. The candidate is also at liberty, however, to present, besides this one obligatory work, other written productions or drawings. All work so presented is to be accompanied with the written assurance that it has been performed without assistance; and the thesis must be in the candidate's own handwriting.

§ 6. Applications for examination must be addressed in writing to the director of the academy at least six weeks before the close of the semester, and accompanied with the necessary proof of two semesters' attendance. The examining commission then determines the subject for the thesis, so that this may be prepared during the vacation. The completed work is to be handed in to the commission within the six weeks before mentioned, a discretionary prolongation of which period is only to be made by the commission in cases of extraordinary hindrance. The oral examination takes place at the beginning of the following semester.

§ 7. The examining commission prepares a diploma or certificate concerning the result of the oral examination and the examination of the written thesis. These degrees of proficiency are recognized and entered on diplomas with the words, "*mit Auszeichnung*," (with distinction,) "*gut*," (well,) and "*genügend*," (pretty well, or sufficiently.) Each examiner proposes the verdict in his own department, and the question is determined which grade of proficiency shall be certified by the vote of a majority of the commission. For those branches in which the candidate has not borne examination even "sufficiently" well, no entry whatever is made.

§ 8. The candidate is free to apply after the lapse of half a year, to be re-examined in those branches in which he failed on the first trial; but after a second failure no further application will be granted.

§ 9. The examination fee, payable to the academical treasury when the application is made, is 10 thalers for an examination covering not more than four branches. For every additional branch an additional fee of three thalers is required; but the whole fee can in no case exceed 20 thalers.

The following are the regular courses of lectures for the winter semester of 1868-'69:

Lectures and instructors.	Half-yearly fee.
1. Mining Technology—five lectures weekly by Bergrath Hauchecorne.....	5 thalers.
2. Technology of Saltworks—one lecture weekly by Bergrath Hauchecorne..	1 “
3. General Metallurgy—four lectures weekly by Professor Kerl.....	4 “
4. Metallurgy of Iron—four lectures weekly by Bergrath Wedding.....	4 “
5. Founding and Moulding—three lectures weekly by Dr. Dürre.....	4 “
6. Chemical Technology—two lectures weekly by Professor Kerl.....	2 “
7. General Assaying—six lectures weekly by Professor Kerl.....	9 “
8. Blowpipe Assaying—two lectures weekly by Professor Kerl.....	3 “
9. Assaying of Iron—three lectures weekly by Bergrath Wedding.....	4½ “
10. Petrography—four lectures weekly by Professor Beyrich.....	4 “
11. Geology, with special attention to the stratified formations—four lectures weekly by Professor Beyrich.....	4 “
12. The Geological Formation of the Globe—one lecture weekly by Dr. Lossen.	Gratis.
13. On Volcanoes—one lecture weekly by Professor Roth.....	Gratis.
14. Mineralogical Repetitions—four lectures weekly by Professor G. Rose.....	Gratis.
15. Mineralogical Exercises—four lectures weekly by Dr. Eck.....	4 thalers.
16. Chemistry of Minerals—three lectures weekly by Professor Rammelsberg..	Gratis.
17. Repetitions of Analysis of Minerals—four lectures weekly by Dr. Finkener.	Gratis.
18. Practical Instruction in the Analysis of Minerals—(a,) quantitative; five hours daily by Dr. Finkener.....	20 thalers.
(b,) qualitative; four hours weekly by Dr. Finkener.....	8 “
19. Analytical Geometry—five lectures weekly by Professor Bertram.....	5 “
20. Mechanical Science—six lectures weekly by M. Hormann.....	6 “
21. Applied Mechanics—six lectures weekly by M. Hormann.....	6 “
22. Surveying of Mines—four lectures weekly by Berg-Assessor Kauth.....	4 “
23. Instructions in Drawing—eight lessons weekly by Berg-Assessor Kauth...	Gratis.
24. Laws of Mines—two lectures weekly by Geh. Oberbergrath Ackenbach....	Gratis.

Bergrath (mining councillor) Hauchecorne is the present director of the academy.

CHAPTER XXXVII.

THE SCHOOL OF MINES AT CLAUSTHAL, PRUSSIA.

Since the annexation of the kingdom of Hanover to Prussia, the old and famous academy at Clausthal, in the Hartz mountains, has been, so to speak, dismantled. Some of the best professors have been called to Berlin; the former director (the celebrated mineralogist, Roemer) is dead; and little that is important remains of the school except its excellent courses of practice in mining and metallurgy. These are retained, because the location of Clausthal, in the midst of an ancient and still actively worked mining region, renders it peculiarly suitable for such practical instruction as cannot be imparted at the Berlin school. Prussia maintains, therefore, at Berlin a school of theory, and at Clausthal a school of practice. The method pursued at the latter place will appear from the following description:

The object of the practical course is to impart to the student a complete insight into all particulars and details of every branch of mining and smelting. This is effected—

1. By examination of all interesting mines, dressing and smelting works of the Upper Hartz.

2. By inspection of all the apparatus and machinery used.

3. By study of different processes in actual operation and of their proper manipulations.

4. By actual experience in every department as a workman.

The course begins in the first week after Easter, and lasts six months, of which two are devoted to mining, two to metallurgy, and two to the study of dressing-works and processes, including hydraulic engineering.

In all these departments, complete theoretical instruction is given at the academy in Clausthal. The practical course in each department is placed under the supervision of a mining official of high degree, as teacher, who assigns the pupils, in squads of two or three, to subordinate officials, connected with the administration of mines and furnaces in operation. Under the guidance of his special instructor the student enters the mines every morning, (Saturday and Sunday excepted,) and is made to take note of everything in their operations. Beginning with the simplest manipulations and proceeding to the most intricate and difficult, all is explained to him. The peculiarities of special cases before him, difficulties and the means by which they are overcome, the improvements which progress in the art of mining has effected, are all illustrated by actual examples, such as can only be furnished in mines of great antiquity, and among a population to whom this profession has been for centuries hereditary. In this manner about six weeks are spent in one or two mines, each of which is a labyrinth of shafts, drifts, and stopes, and an epitome itself of the history as well as the science of mining. The student having during this period obtained a general knowledge of the subject, and, by manual labor, acquired a certain necessary familiarity with details, he spends the next fortnight under the same guidance in excursions to the important copper, lead, iron and zinc mines of the Upper Hartz.

The courses in dressing ores, hydraulic engineering, and metallurgy, are similarly conducted. In the latter the student takes part, with the assistance of the friendly workmen, in the whole course of the metallurgical processes, and finally produces, with his own hands, the pure silver bar from the ore. Copper, iron, zinc, and lead furnaces, sulphuric acid, alum and copperas works, and the art of the assayer, are all made subjects of attention, and that familiarity with their practical operations is acquired which doubles the value of subsequent theoretical study.

Saturdays are given to the sketching of machinery, and to explanations by the instructor of those points not fully made clear during the week.

The Clausthal administration has earned the gratitude of all by its liberality in this arrangement. We say gratitude, for the sacrifice of time and valuable labor involved in such a system has been incurred only for the good of science. Of this no one will entertain a doubt when we state that the fees paid by the student for this six months' practical course amount to \$13 in American gold.

APPENDIX.

Statistics of bullion, ores, &c., at San Francisco, for the year ending December 31, 1868.

IMPORTS OF TREASURE.

The imports of treasure (exclusive of those from Victoria, which are included in the receipts from coastwise ports,) for the past five years have been as follows:

1864.....	\$1,845,909	1867.....	\$2,252,851
1865.....	1,872,697	1868.....	2,815,961
1866.....	1,298,311		

RECEIPTS OF TREASURE FROM THE INTERIOR.

The receipts of treasure from the northern and southern mines of our State during the past five years have been as follows :

	Uncoined.	Coined.	Total.
1864	\$40,130,090	\$5,330,325	\$45,460,415
1865	41,903,649	4,361,951	46,265,600
1866	39,299,850	4,565,359	43,865,209
1867	43,807,656	4,812,788	48,620,444
1868	39,318,042	6,614,694	45,932,734

RECEIPTS OF BULLION.

The receipts of bullion from Washoe, Esmeralda, and Reese river (Nevada State) for the past five years have been as follows :

1864	\$15,797,585	1867	\$18,000,000
1865	15,181,877	1868	15,250,000
1866	15,215,218		

RECAPITULATION.

The imports, coastwise receipts, (including Victoria, V. I.,) and receipts from northern and southern mines, (including Nevada State,) during the year 1868, were as follows :

Imports	\$2,815,961
Receipts coastwise (including Victoria).....	3,757,137
From northern and southern mines.....	45,932,736
Total for 1868.....	52,505,834
Total for 1867.....	56,726,856
Decrease 1868.....	4,221,022

TREASURE EXPORTS.

The exports of treasure during the years 1867 and 1868, respectively, were as follows :

To—	1867.	1868.
China	\$9,039,530 07	\$6,192,995 40
Chile	723,450 97	
Central American ports.....	654,498 85	728,474 00
England	5,905,799 49	6,226,097 68
France	1,659,951 00	1,091,343 26
Japan	648,049 52	777,459 46
Mexico	34,000 00	13,000 00
New York	29,356,424 67	21,104,611 17
Sandwich Islands	47,032 32	89,110 00
Society Islands	500 00	
Vancouver's Island.....	155,000 00	135,000 00
Total	48,224,236 89	36,358,090 97
Add net duties	7,622,827 00	7,760,411 16
	55,847,063 89	44,118,502 13
Decrease 1868.....		11,728,561 76

The recapitulation for 1868 is as follows :

	Steamers east.	China, &c.	Total.
Gold bars.....	\$16,302,848 98	\$1,262,375 92	\$17,565,224 90
Silver bars.....	10,966,672 75	2,935,421 79	13,902,094 54
Gold coin.....	1,894,004 38	748,868 05	2,642,872 43
Gold dust.....		30,606 60	30,606 60
Mexican dollars.....		2,217,292 50	2,217,292 50
Total.....	29,163,526 11	7,194,564 86	36,358,090 97

MINT STATISTICS.

The coinage of the United States branch mint for the month of December has been \$2,340,000 gold and \$82,000 silver; together, \$2,422,000. The coinage for the year, monthly, as compared with the year 1867, has been as follows :

Months.	Silver.	Gold.	Total coin.	Total.
			1868.	1867.
January.....	\$17,000	\$80,000	\$97,000	\$124,000
February.....	120,000	520,000	640,000	1,022,000
March.....	60,000	515,000	575,000	978,535
April.....	15,000	695,000	710,000	1,895,000
May.....	54,000	660,000	714,000	2,505,000
June.....	57,000	865,000	922,000	1,420,000
July.....	50,000	2,305,000	2,355,000	1,152,000
August.....	70,000	1,395,000	1,465,000	2,380,000
September.....	10,000	2,445,000	2,455,000	1,989,000
October.....	25,000	2,390,000	2,415,000	2,361,000
November.....	47,000	2,550,000	2,597,000	2,369,000
December.....	82,000	2,340,000	2,422,000	1,900,000
Total.....	607,000	16,760,000	17,367,000	20,095,535

In the first months of the year, when freights were low to the eastward, and the supply of coin abundant, the disposition was to ship bullion. In the latter months of the year coin became scarce and eastern credits full. The mint, therefore, absorbed the larger proportion of the supply, and the operations have been immense. Every 60 days an amount has been turned out equal to the whole projected capacity of the mint for a year when it was built. In the last two months there has been silver coinage from deposits of White Pine bullion. The total supply of bullion reported has been, for the last three years :

Bullion.	1866.	1867.	1868.
Sent to mint.....	\$17,617,096	\$19,265,376	\$17,367,000
Export gold bars per steamer.....	23,707,064	18,222,246	16,302,849
Export gold bars per sail.....	1,268,460	1,404,927	1,262,376
Export gold dust per sail.....	20,060	62,770	30,606
Export silver per steamer.....	9,039,036	9,759,890	10,966,671
Export silver per sail.....	3,946,114	5,468,370	2,935,422
Total.....	55,597,770	54,183,593	48,864,924

The decline in the supply of bullion is due to the falling off in the product of the Washoe mines. In the last quarter of the year, however, the White Pine region has become very productive. The leading

mine there, the Eberhardt, has sent down over \$500,000, of which a considerable portion has passed through the Refining Company.

The exports of bullion have been less than last year, the falling off having been greatest in the last six months of the year. The silver bars have been rather less abundant, and the gold has gone rather to the mint than abroad. In the first part of the year the low freights caused the shipments to be considerable, leading, with other operating causes, to a scarcity of coin in the autumn. The opposition steamers being then withdrawn, freights advanced and the bullion was turned into the mint. This movement is seen in the following table, showing the monthly deposits of gold at the mint, the monthly exports, and the range for bars:

Months,	Gold.		Prices of bars.
	Minted.	Exported.	
January	\$80,000	\$2,715,692 12	900 to 910
February	520,000	1,215,400 61	910 to 920
March	515,000	2,039,925 22	910 to 920
April	695,000	1,604,651 11	890 to 900
May	660,000	2,267,520 95	880 to 900
June	865,000	1,578,139 94	880 to 900
July	2,305,000	1,851,846 70	880 to 890
August	1,395,000	1,442,501 31	880 to 890
September	2,445,000	750,906 31	860 to 890
October	2,390,000	699,152 21	830 to 870
November	2,550,000	585,458 51	840 to 860
December	2,340,000	813,827 21	850 to 860
Total	16,760,000	17,565,022 20	860 to 865

Thus, for the whole year, about half the gold bullion was sent to the mint, a good deal of it extracted from the silver refined for the China market by the San Francisco Refinery Company, and the other half exported. Of the deposits at the mint the San Francisco Assaying and Refining Company made \$9,400,000 of gold, and \$225,000 of silver; together, \$9,625,000—or more than half the whole. In the first six months only \$3,928,000 was sent to the mint, and \$11,431,676 was exported; in the last six months, \$12,632,000 went to the mint, and \$6,133,356 only was exported—reversing the operation. The coin thus turned out by the mint was greatly needed in the autumn months. The disposition of it for the year was, monthly, as follows:

	Exported.	Duties paid.	Total drain.	Coined.
January	\$454,894	\$592,279	\$1,047,173	\$80,000
February	239,190	668,691	907,881	520,000
March	160,140	759,753	919,893	515,000
April	369,345	683,094	1,072,439	695,000
May	152,263	672,554	824,797	660,000
June	154,787	652,202	806,989	865,000
July	89,471	910,082	999,553	2,305,000
August	149,270	740,361	889,631	1,395,000
September	202,042	881,779	1,083,821	2,455,000
October	225,564	654,873	880,237	2,390,000
November	147,533	713,782	861,315	2,550,000
December	211,393	631,022	842,415	2,340,000
For 1868	2,642,872	8,560,411	10,403,283	16,760,000
For 1867	4,001,825	7,541,247	11,543,217	18,331,287

The actual drain diminished monthly as the year drew to a close; at the same time the mint supply was larger, giving a greater surplus for general use:

	1867.	1868.
Coined.....	\$18,331,287	\$16,760,000
Shipped.....	\$4,001,825	\$2,642,872
Duties.....	7,541,247	7,760,411
	<u>11,543,072</u>	<u>10,403,283</u>
Excess coinage.....	<u>6,788,216</u>	<u>6,356,717</u>

Thus the result for the 12 months shows nearly as great a supply of coin; but if we divide the year into periods of six months the result will correspond with the above table of coinage:

	1867.	1868.
First six months, excess coinage.....	\$2,197,119.	Deficit, \$1,666,521
Second six months, excess coinage.....	4,591,098.	Excess, 8,023,238
Year, excess coinage.....	<u>6,788,217.</u>	<u>Excess, 6,356,717</u>

COAL STATISTICS.

The receipts of coal from the Monte Diablo, California, mines for the past five years have been as follows:

	Tons.		Tons.
1864.....	37,458	1867.....	83,174
1865.....	60,530	1868.....	109,095
1866.....	84,024		

The aggregate imports and receipts from all sources have been:

	Tons.		Tons.
1864.....	143,492	1867.....	230,884
1865.....	154,251	1868.....	262,889
1866.....	188,519		

EXPORT OF COPPER ORES.

To—	Tons.	Value.
Great Britain.....	1,503	\$51,750
United States—Boston.....	130	9,800
United States—New York.....	3,444	166,375
Total for 1868.....	5,077	227,925
Total for 1867.....	7,833	421,546
Decrease, 1868.....	2,756	193,621

EXPORT OF QUICKSILVER.

To—	Flasks.	Value.
Australia and New South Wales.....	1,550	\$47,828
Central America.....	1	45
China.....	16,785	505,081
France.....	500	15,000
Great Britain.....	3,500	105,000
Mexico.....	14,121	440,518
New Zealand.....	30	1,238
Peru.....	2,500	79,425
Vancouver's Island and British Columbia.....	20	919
New York.....	4,500	135,000
Total for 1868.....	43,507	1,330,054
Total for 1867.....	28,824	929,726
Increase, 1868.....	14,683	400,328

EXPORTS OF FLOUR AND WHEAT.

Total to all ports for the years 1867 and 1868.

	Flour, bbls.	Value.	Wheat, sacks.	Value.	Total value.
1867.....	519,428	\$3,178,598	4,604,080	\$9,340,497	\$12,519,095
1868.....	465,273½	2,973,538	4,071,837	8,635,854	11,609,392
Decrease, 1868.....	54,154½	205,060	532,243	704,643	909,703

Total value of domestic exports other than treasure during 1867 and 1868.

1867.....	\$16,654,638
1868.....	17,821,809
Increase, 1868.....	1,166,971

This increase is mainly in the items of barley, lumber, salmon, leather, mustard seed, skins and furs, and wool. The exports of ores have been as follows:

Ores.	1867.		1868.	
	Tons.	Value.	Tons.	Value.
Gold.....	93	\$16,475	1	\$500
Silver.....	106	24,763	68½	15,310
Copper.....	7,883	421,546	5,077	227,925
Lead.....	184	8,665	-----	-----
Manganese.....	-----	-----	1,657	26,830
Various.....	458	17,629	69½	1,860
Totals.....	8,724	489,078	6,873	273,225
Decrease in 1868.....	-----	-----	1,851	\$215,853

The cessation of the export of lead ores is due to the establishment of metallurgical works at San Francisco, which manufacture at home the lead ores formerly exported.

IMPORTATIONS OF METALS, ETC., DURING 1868.

Castings, barrels	33	Iron :	
packages	56, 150	Railroad bars, number	178, 186
bundles	23, 054	Safes, number	303
pieces	82, 068	Old, tons	10
Fire-clay, barrels.....	188	Steel bars, number.....	2, 753
casks.....	182	bundles	5, 321
Coal:		cases.....	1, 016
Eastern, tons	31, 413	Lead:	
hogsheads.....	935	Bar, cases	13
casks	2, 706	kegs.....	266
Chili, tons	8, 511	Pigs, number	5, 672
English, tons	29, 868	Sheet, casks	5
Sydney, tons.....	32, 390	rolls	25
Russian Asia, tons	204	Pipe, reels.....	235
Vancouver, tons.....	23, 397	Marble, tons.....	400
Coos bay, tons	10, 425	packages	5, 000
Bellingham bay, tons	14, 000	boxes.....	406
Copper, packages	768	Yellow metal, cases.....	715
Steam engines	40	old, packages	50
Iron:		Mineral water, packages.....	989
Bars, number	271, 151	Coal oil, cases	127, 186
bundles	134, 371	Ore:	
Sheet, bundles	18, 609	Copper, sacks.....	70
number	17, 393	Silver, sacks	233
cases	550	Plumbago, packages.....	40
Plates, number.....	23, 001	Tin:	
Hoop, bundles	10, 902	Plate, boxes	38, 496
cases	1, 743	Pigs, number	1, 820
Pipes, number	16, 512	Foil, cases.....	20
Tubes, number.....	15, 435	Ware, packages.....	409
bundles	14, 734	Zinc, rolls	30
Fig, American, tons	2, 642	casks	775
Scotch, tons	15, 371		