tion with the Baltic. There is also the inland line completed as far as Vorouej from Moscow, afterwards to be extended to the anthracite mines at Grushevka, which last are already in communication with the river Volga by means of a short railway. Independently of the proposed branch lines, which from their situation may well be called mineral lines, it is proposed to lay another main line from a point about 100 miles south of Kharkoff to far-famed Sevastopol.

The imaginary circle thus drawn incloses the whole of the southern coal fields, and cuts into the border of the northern. As the northern coalfield is beyond the boundary line chosen little need be said about it, although it is far from being an unimportant one. The coal is inferior in quality to that of the southern field, while at the same time the iron found there makes very good castings. According to the report of the latest investigations published last year, the northern coalfield is 114 miles long by 80 miles wide, or about 9,120 square miles. Within this boundary there are no fewer than 113 known places favorable for mining; and four of the best known of them are estimated to contain a supply for 150 to 200 years, at the rate of 400,000 tuns annually. The price at present at the pit mouth is about one dollar per tun.

The southern basin with which we have more immediately to do is more extensive, and the coal is of a better average quality. The coal seems to crop up to the surface in the government of Kharkoff so that in many places coal is turned up by the plow, and they extend to within less than 60 miles to the shores of the Sea of Asoph. The northern or Kharkoff end of this field contains coal similar to that of the Tula-Kaluga field; while in the center of the basin the best caking and steam coal is found, and at the southern extremity anthracite, containing, according to reported analysis, 98 per cent. of carbon. That part of the coalfield lying in the government of Ekaterinoslav is bounded by the rivers Dneiper, Don, and Donotz, and has a surface of over 10,000 square miles. Adjoining this in the territory of the Don Cossacks, and bordering on the Sea of Asoph, there are still 7,100 square miles under which lies the best coal and anthracite.

The now, in Russia at least, well known mines of Grushevka contain no fewer than 269 allotments, out of which, in 1866, 83, containing 93 pits or shafts, were being worked, and produced 150,152 tuns of anthracite against 85,401 tuns in 1865. The estimated quantity for the 42 square miles of this district alone is 24,000,000 of tuns. In the 7,100 square miles of the territory of the Don Cossacks, reckoning only the upper seams and only those which are more than one assheen (2ft. 4in.) thick, the estimated quantity is 700,000,000 of tuns. The seams vary from 2½ feet to 8 feet in thickness. In this black country there is much work yet to be done for both the mining and mechanical engineer. The 93 before mentioned pits are, with one or two exceptions, mere holes, and in the district generally, until within the last two years, the black diamond was left in the depths of the mine undisturbed; as soon as the water grew troublesome, another hole was struck, and the former one abandoned. At the present time, however, at Grushevka three shafts are being, or have been, sunk deeper in the water-bearing strata, and eight steam engines, from 6 to 75-horse power, are either at work or are in the course of erection. The price of the coal averages from one dollar and thirty cents to two dollars and seventy-five cents per tun at the pit mouth, according to quality.

This district is no less rich in iron ore than it is in coal. Geologists and mineralogists of different nations all agree in their statements as to the immense quantity of ore, and also to its high quality. The thickness of the layers varies in some places from 9 inches to 21 inches, and in others from 14 inches to 3 feet. The layers of ore extend in many places in an unbroken line for many miles, and are interspersed with layers of coal, limestones, and schists. The ore lies in many parts, especially in the ravines, at a depth of from only 14 feet to 28 feet from the surface, while almost the only mining as yet has been that of the aforesaid geologists. There is indeed one iron works in the district, belonging to Government; but from a mistake in the choice of a situation, caused by the wish to take advantage of water power, it is too far from the mines connected with it, and its rate of production has not as yet been very great.

The other subterranean products of this mine of wealth are in connection with iron smelting, limestone and good fire-clay, while for purposes connected with other manufactures are potter's clay, kaolin, gypsum, and the materials for good cement. There are also beds of the stone generally used here for millstones, also paving stones, and in some parts thick beds of roofing slate. Specimens of this slate were sent to the Paris Exhibition, along with specimens of the anthracite near which it was found. Limestones and sandstones for building purposes are also here, together with an inferior sort of marble. Clays of all sorts abound, suitable for brick-making, both fire and common red and yellow, and chalk enough to score up the reckonings of all the miners and puddlers in the world for centuries to come.

Lead ore, with a percentage of silver, is also to be found; while last, but not least, one of the great necessaries of life, common salt, has formed a staple article of commerce for more than a century. The yearly quantity of this article supplied by this district within the past thirty years has varied from 5,000 to 16,700 tuns. With the exception of this salt, this immense treasure vault has been little more than peeped into by scientific men; the full opening up has been as yet unattainable, not having had as in other countries, the assistance of the iron horse. The time of opening is however, now near at hand; the iron horse is on his way down south with the keys. The first sod of the Kharkoff-Taganrog railway was cut June 3d, 1868, although work had been commenced upon the line generally some time before. The question now must be who will be the first to ravish this almost virgin treasure.

It must not be thought that the mineral wealth of Russia is confined within the boundaries of the imaginary circle drawn; on the contrary, the northern coalfield might, by deep mining, yield a better quality of coal, and it is supposed dip a great depth under Moscow and some of the other northern governments, as it has been found to make its appearance again in the government of Archangel. There is then the eastern or Ural system, and the still richer western or Polish, where coal seams have been found from 35 feet to 42 feet, and in one instance even 49 feet in thickness, made up of layers of different qualities of coal, divided by very thin layers of clay. Then we have in Siberia, the Tomsk field, estimated at 170 miles long and 70 broad, and coal of an inferior quality, but still usable, at the foot of the Caucasus. Among other projected railways, first on the list stands one to connect the frontiers of Siberia with the interior of Russia. Railway communication has commenced in the Caucasus with the opening of the Poti and Tiflis railway, and Kharkoff is looked upon as the future central station for direct communication with the Caucasus.

All these places may, at a future time, become seats of manufactures, but in the part of the country above described everything is favorable to enterprise; even at present, the climate is wholesome, and peace and plenty reign around. Some difficulty would be experienced at first in getting together workmen, but when once found and settled, the real Russian likes to remain in one place if he finds himself at home, and generally likes to stick to a good master. There is one thing, however, although trades unions and general strikes are unknown there, still the workmen taken singly are very independent and firm in their demands; the being thrown out of work does not seem to frighten them much—they can be led easier than they can be driven.

THE AINOS, OR HAIRY MEN OF YESSO AND SAGHALIEN.

In Notes on the Expedition against the Settlements in Eastern Siberia, published in London in 1856, is an account of a peculiar race of people, of which some specimens were seen to the north of Cape Lamanon, on the western coast of the island of Saghalien, the most northerly of the Japanese group. The author, Mr. Whittingham, who accompanied the expedition, thus describes the people and their manner of living: "As we came near the shore, four dark men with very long black hair flying in the wind, and clothed in seal-skin jackets, kilts, and boots, waved their arms and hands, warning us to another landing-place, toward which they waddled with a peculiar clumsy gait. With many demonstrations of respect they led the way to their huts of rough logs, covered and the interstices filled with birch bark and dry leaves; they were low on the ground, and could only be entered by stooping on the hands and knees. The larger huts were used as store houses for their fishing apparatus. One of the men was a magnificent savage, tall, lithe, straight, and strong, with hair, beard, and mustaches never desecrated by the touch of the scissors; with a high broad brow, dark eyes, straight nose, and oval face, he was a far nobler creature than the Red Indian who, I had always fancied, was the pride of wild men. His fellows were less manly in their bearing, and smaller; and as far as dirt, mal-odor, and want of light permitted me to see, the women were ugly and little." Rollin, in La Pérouse's voyage, gives the following valuable measurements of the head of one of these people:—circumference, 23·80 inches; its longest diameter, 10·30; and its shortest diameter, 6·83 inches.

In a recent communication to the Boston Society of Natural History, Mr. Albert S. Bickmore, A. M., gives the results of his late investigations in regard to the origin of this peculiar race, and adds important and interesting particulars of their manners, customs, and religion.

The first of these strange people seen by Mr. Bickmore were at Mori, on Volcano Bay, at the western side of the island of Yesso. Along the shore to the north of Mori they were met with, sometimes at work with the Japanese, but more frequently in companies by themselves.

At Urope, twenty miles north of Mori, is a village of about two dozen houses only, three or four of which are Japanese, the rest belonging to the Ainos. Mr. Bickmore describes this village as follows:

"The houses were scattered irregularly near the shore over a broad belt of sand, that has been drifted back by the easterly winds. They all have the same rectangular form, and are similarly situated in respect to the shore.

"The best are composed of a house part about thirty feet long and twenty broad. To this is attached a porch about twelve feet long and eight broad, and around the whole is a straw fence. The house and porch are built of a frame work of small poles, fastened together with strips of bark and covered with millet straw. The walls are about four feet high, and slightly sloping. The roofs project a few inches at the eaves, and rise from each side to a point in the center. In the walls under the eaves, there are two or three holes a foot in diameter, which serve as windows. In entering, you pass through the straw fence into the porch, and thence through the door into the house. The house part is generally one room, and also the porch; but in a few, a kind of partition is made in the larger room by hanging up mats. Most of the houses have no floors, but instead the sand is covered with mats of coarse straw, and on one side of the room there is a platform of boards on stones or blocks of wood, where the occupants lounge and sleep. They usually sit on the mats on the sand. In the center of the room the fire is made on the sand, and over this and about three feet above it, is a kind of frame work held up by strings from the rafters, where they place the fish they wish to smoke. It also serves for a cupboard or dresser, where the smaller iron pans and kettles may be put away. There is no chimney, and I did not even see a hole in the roof for the smoke to escape. Everything overhead is, therefore, black with smoke, and generally has a shining, oily appearance. Each house is provided with a few iron pans and kettles of Japanese manufacture, and these with two or three wooden dippers, and some large valves of the pecten, comprise their cooking utensils. They make a fire by means of a flint, steel, and tinder, which are usually kept in a bag of undressed deer skin. In several houses I saw a considerable number of lacquered dishes, which they had evidently obtained from the Japanese. Near each house there is another small one about eight feet square, perched on a platform five or six feet high, in which they store their fish, in much the same manner as the natives of Sumatra preserve their rice. In the first house we entered, the man was sitting cross-legged in one corner making spears, with a fire of charcoal and a Japanese bellows. The woman was crouched near the fire, twisting up thin strips of the inner layer of the bark of a tree into a continuous line of the size of a mackerel line. It is from such material, and in this way, that all the lines for their fishing nets are made. They had four children, all boys, the youngest two and the eldest ten. The two younger ones were without clothing, and the others had only each a long jacket, though it was quite chilly.

"In the next house we entered—the dimensions of which I have given above as a model—we found an old man, his son, and three women. The old man said he was seventy five, and his white hair and white beard made it appear probable, yet a young woman, apparently of twenty, was presented to me as his wife. She was demurely at work in one corner, making a straw mat after the Japanese style. The other young woman was weaving a piece of cloth about ten inches wide, from strings made of bark as already described. These strings, which represented the warp, were fastened at one end to a post and at the other end to a board which she kept leaning against while she changed them and pushed through the filling and pressed it down with a sharp edged board. This kind of cloth seems to be the only one they have, and it is all made in this slow and laborious manner. In front of this house, that is, on the side toward the shore, there was a kind of rack filled with sticks, each having on its top the skull of a bear. In this single place I counted twenty-nine skulls of this animal, a number that must make our old friend and his son rank high in the estimation of his Aino companions. In another house we entered, we found a man and his wife seated by the fire. The woman was sewing, but the man was doing nothing, and yet the bay was swarming with fish. He showed us the bow he used in hunting the bear, but would only sell a model of it, declaring that in their estimation it was most disgraceful for an Aino to part with the bow he was accustomed to use. However I secured a real arrow The after part of the shaft was of reed, the fore part of solid wood to make it fly point foremost, and the barbed part of bamboo. They carry short knives, but they appear to rely on their bows and arrows when they attack a bear or kill a deer. I saw no lances, nor any implements of stone or bronze. I also purchased of this man a pair of snow shoes, each made of two strips of wood bent like an ox bow, with the straight part fastened together with deer skin. The woman sold me a short knife, with a scabbard of wood and ivory rudely chased. It was the only piece of ornamental work I saw. As I was anxious to ascertain the hight, the distance round the chest, and the length of the arm, hand, and foot of an Aino woman, my interpreter bribed the husband with a small piece of silver to make the desired measurements, but the paper was unfortunately lost, and now I can only state from memory, that the peculiarity which struck me most was that the regions of the waist and chest did not appear as separate as in most women, but it remains to be seen whether this is a permanent character. The mammæ were very largely developed, and gourd shaped.

"When a woman marries they tattoo her upper lip and sometimes the under one also. A favorite pattern has the ends curved up, in just the way exquisites sometimes curl up the ends of their mustaches. Several times I inquired what was the cause or origin of this strange custom, but invariably received the unsatisfactory answer—'because it is the Aino fashion,' which is, perhaps, as good a reason as could be assigned for a thousand foolish customs in the most civilized lands. At all events it gives these Aino women the appearance of trying to add to their charms by artificially making up for what they seem to consider a defect in nature's handiwork. The women also tattoo the backs of their hands in narrow transverse bands, but no other parts of the body. They never blacken their teeth or compress the feet. In each Aino village, the oldest man, or a very old man, is the chief, and he in turn is responsible to a Japanese official styled the 'Aino Interpreter.' As the chief was away fishing, we called on the Interpreter, who was also absent, but a subofficial gave me some further items in regard to the strange people under his charge. They cultivate millet and potatoes, but no rice. In one hut I saw the thick midrib of some wild plant finely chopped. When they kill a bear, they are allowed the head, but the skin belongs to the Interpreter. They are permitted however to wear deer skin, and the woman I saw first at Mori had on an outer dress of that kind. It is said that when young cubs are found they are brought home and nursed by the Aino women like their own children, but this is quite incredible.

"On my return to Hakodaki I found that eight Ainos had just arrived in a couple of junks from a place on the south coast, a short distance east of Endermo Bay. With the prospect of a small present they readily came to the residence of Colonel Rice, whose kind hospitality I was then enjoying.

They all sat down cross-legged, in the Turkish style, not in a semicircle, like our American Indians, but in a straight line, the oldest man on the extreme left, the highest position of honor; the rest arrangingthemselves according to their ages, to the youngest on their right. They could not tell, however, how old they were, but said that the Japanese officials kept a record of their ages. As soon as they were seated they began their salutation, which consists in slightly inclining the body forward, at the same time raising both hands as high as the eyes, with the palms inward and the fingers extended and nearly touching each other. The hands then pass down along the beard to the chest. This is repeated three times, and when they wish to show still greater respect they accompany these motions with a low guttural muttering. Saki (Japanese rice whiskey) being their favorite drink, each was offered a glassand a chop stick. Taking the glass in the left hand and the stick in the right, they dip the end of the stick into the liquor they are about to drink, and slightly raising it, describe a circle with an upward and inward motion. While describing these motions with the stick, they uttered a long prayer, in a low monotonous tone. This prayer, they afterward informed us, was not in our behalf, in return for the saki, but addressed to the god of the sea, asking that they might be preserved in their boats, and find an abundance of fish. One of their number spoke Japanese fluently, and Mr. James J. Enslie, the Japanese interpreter at the British Consulate, and himself the author of two interesting papers on the Ainos, kindly volunteered to ask them a list of questions I had prepared. In this way the following information was obtained directly from the Ainos themselves. As some of the questions proved quite perplexing, they became tired before the list was completed, and I failed therefore to get replies to all my queries.

"They have many gods, but fire—not the sun, the moon, or the stars—is the principal one, and they are accustomed to pray to it in general terms for all they may need. They do not buy their wives, but are expected to make presents to the parents of saki, tobacco, and fish. At their marriages they make no great rejoicing or display. Their only feast is at the beginning of the new year, when they make offerings to all the gods. When a wife dies they burn the house in which she lived, but when a man dies they bury him without any funeral ceremony (perhaps the interpreter meant if he was a common man). To inter a body they dig a hole in the ground and lay in planks in the form of a box. The body is then clothed in white, and placed in at full length, with the head to the east, 'because that is where the sun rises.' A widower may marry again in two or three years, but a woman can only marry once. (This the interpreter probably intended to say was their law but not the universal custom.) A man can have only one acknowledged wife, but any number of concubines, each of whom always lives in a separate house. At present they have no king, but a great chief living in Saru. The interpreter had met other Ainos whom he could not understand (that is to say, there are at least two different dialects in the Aino language). They keep no cats, but catch rats in traps. They have 'only Japanese horses.' They keep fowls but no ducks. They eat their fowls and what wild birds they can take, but never eat eggs. They have no special burying grounds, and they desire only to forget their deceased relatives as soon as possible. They never speak of the dead, and if a man should call on a friend, and inquire for his deceased wife and say, 'Oh! is she dead?' such an act would be considered the grossest breach of good breeding. They say that they can make poison, but refused to tell how, and further declared that they kept it such a secret that even the Japanese officials knew nothing of the process. They have sorcerers whose advice they are accustomed to ask. They have no written characters, and only oral traditions.

"After this questioning I took measurements of two of them. These measurements were made from men of medium size. They show, that although the Ainos are stout and strong, they are hardly taller than the Japanese, and not near as tall as the average of the people in the north of China. The relative size of the hands and feet to the rest of the body seems to vary considerably.

"One of their chief peculiarities is the great development of their hair, not only the head and face, but over the whole body. Their eyebrows and eyelashes are very thick, and like their beards and hair, always of a jet black, till past middle life, when, as with us, they change to gray and in extreme old age to white. Their hair appears coarse compared with ours or with that of the Japanese. They wear it long—down to the shoulders. The men wear theirs as long, or longer than is the custom with their women. Their eyelids are horizontal and open widely, as in the Indo-European races, and are not oblique and open, but partially, as in the Mongols, Manchus, Chinese, Japanese, and also the Coreans. Their eyes are bright and sparkling, and always black. The fine development of their chests, with their full heavy beards, gives them the appearance of noble and hardy men as compared with their effeminate Japanese rulers. They seem to be endowed with great vitality, and the fact that they so successfully resisted the repeated attacks of a more enlightened race for eighteen hundred years, sufficiently proves their daring and perseverance.

"The dress of the men consists of a strip of cloth covering the loins in the same way as is customary among coolies in the East. In summer this is their only clothing, but in winter they wear long, loose coats, or dressing gowns woven from strings of bark. This is folded over from right to left, and bound at the waist with a sash. Their heads, feet, and legs are usually bare. The women have a shorter dressing-gown coming down to the hips, and beneath this a piece of cloth wrapped around the waist and hanging down nearly to the knee.

"As they have no written records, the earliest accounts of this people have come down to us through Japanese histories. According to a Japanese chronology, compiled from the best sources, and translated by Father Nicholai, for the Russian Legation, Jin-mu, the first Japanese emperor appeared on Kiusiu at Hunga (or Hewng-nga) in B. C. 667. In B. C. 663, he first came to Niphon, but was defeated and driven back by the aborigines. In B.C. 660, he returned and effected a permanent settlement on the southeast part of that island. In most of the Japanese histories, at least, no mention appears of the arrival of any new people, and the Japanese all believe that these aborigines were the ancestors of the present Ainos. Thus, these people, although so little known to this day, are mentioned half a century before the time of Nebuchadnezzar, and six hundred years before the northern and western parts of Europe were first described by Cæsar in his Commentaries, and more than two thousand one hundred years before the discovery of this continent by Columbus. In A.D. 272 the Ainos, for the first time, brought presents to the Japanese authorities, and acknowledged them as their rulers. In A.D. 352 they rebelled, and in the year 366 they defeated the Japanese and killed their general. During the next two centuries, however, they appear to have been completely subjugated; for an educated Japanese states that as early as A D. 655, the Japanese sovereign then reigning established a kind of government over the Ainos in Yesso, which was located near Siribets, a volcano on the north shore of Volcano Bay. In A. D. 1186, Yoritomo usurped the ruling power in Niphon, and becoming jealous of his brothor Yosi Tsunay, had him put to death according to history, at a headland on the east coast, now called Shendai. But according to tradition, Yosi Tsunai escaped to Yesso, and treating the Ainos here with the greatest kindness, was deified by them and is now their chief hero.

"In their eyelids which are horizontal and open widely, in the abundance of their hair, and in the full development of their chests, these people differ totally from the Chinese, the Japanese, and the Coreans on the South, the Manchus on the west, and the Gilyaks and Kamtschadales on the north; but in these same characters they call to mind the bearded peasants in Russia of the Slavonian branch of the Aryan family.

"Are they, therefore, an extreme branch of the North Turanian family, or, as is more probable, in the same manner that the Indo-European races migrated from the high plateau of Central Asia through the plateau of Iran to the west, and the Persians and Indians to the south, did another part of that same family pass on to the east until they finally reached the islands now forming the empire of Japan; and do their living representatives now appear before us in the persons of this ancient and isolated people, the Ainos?"

Subsequently, Mr. Bickford was enabled to visit the Ainos of Saghalien, whose habits of living resemble those of their brethren at Yesso, in all important particulars. The following details of their customs in regard to marriage and the burial of the dead were learned of a Cossack who had been sent to live among them in order to acquire their language and learn their customs:

"The Aino name for Saghalien is Karapto. They have no written characters, but the old men can send intelligence to each other by means of sticks notched in different manners. They are superstitiously afraid of the Japanese, and believe that they have supernatural power to injure them, and can at pleasure cause them to sicken and even die. When a man dies they bury him clad, not necessarily in white, but in the best suit he may happen to have, and usually in furs when he possesses any. The bodies of persons of all ages are placed at full length in boxes, with the face upward. At such times they cry and mourn very bitterly, even to the children. The Cossack said that one time he wanted a little child that was visiting her parents, and when he came to their house he found her crying with the others over the loss of a friend. When a widow laments, they do not beat her with sticks as a Japanese doctor reported to me was the custom of the Ainos on Volcano Bay. Every friend who comes to mourn with a widow is very careful not to mention her husband's name; not from any superstitious fear of the dead, but for fear of reminding her of her loss, and thus adding to her sorrow. When a man dies, the next youngest brother takes the widow as his wife, either for life or until she has an opportunity to marry again. A widower may marry again in a month, but a widow is expected to remain single somewhat longer. They have no marriage ceremonies. A man does not buy his wife, but works for her father. A man may have two or three wives; the Cossack did not know any man who had more than three. (The Gilyaks, their immediate neighbors, usually have two.) If a woman is unfaithful, the husband merely reproves her, and if no one but he and the guilty parties knew of it, he would probably not mention it to any one. When a woman is in labor, she remains with the other members of the family, but is kept from her husband for one month afterward."

"They keep dogs to travel with in winter and also use them for food. They have no cattle, and do not cultivate the soil. They reckon time by twelve moons or months, and three seasons: when the snow melts, when the flowers appear, and when they fade.

"These people are undoubtedly passing away. Even during the last century and a half that the northern of the Kurile chain has been a part of the Russian empire, their numbers on those islands have been ascertained to have greatly diminished, though the Russians have unquestionably treated such obedient subjects with the greatest kindness. The causes of this decrease are supposed to have been the ravages of the small-pox, and the considerable numbers lost while crossing from island to island in their frail boats over those stormy seas."

Artificial Crystals and Minerals.—"The Crosse Mite."

Among the experimenters on Electricity in our time who have largely contributed to the "Curiosities of Science," Andrew Crosse is entitled to special notice. In his school-days he became greatly attached to the study of electricity; and on settling on his paternal estate, Fyne Court, on the Quantock Hills, in Somersetshire, he there devoted himself to chemistry, mineralogy, and electricity, pursuing his experiments wholly independently of theories, and searching only for facts. In Holwell Cavern near his residence, he observed the sides and the roof covered with Arragonite crystallizations, when his observations led him to conclude that the crystallizations were the effects, at least to some extent, of electricity. This induced him to make the attempt to form artificial crystals by the same means, which he began in 1807. He took some water from the cave, filled a tumbler, and exposed it to the action of a voltaic battery excited by water alone, letting the platinum wires of the battery fall on opposite sides of the tumbler from the opposite poles of the battery. After ten days constant action, he produced crystals of carbonate of lime; and on repeating the experiment in the dark, he produced them in six days. Thus Mr. Crosse simulated in his laboratory one of the hitherto most mysterious processes of nature.

He pursued this line of research for nearly thirty years at Fyne Court, where his electrical room and laboratory were on an enormous scale: the apparatus had cost some thousands of pounds, and the house was nearly full of furnaces. He carried an insulated wire above the tops of the trees around his house to the length of a mile and a quarter, afterwards shortened to 1800 feet. By this wire, which was brought into connection with the apparatus in a chamber, he was enabled to see continually the changes in the state of the atmosphere, and could use the fluid so collected for a variety of purposes. In 1816, at a meeting of country gentlemen, he prophesied that, "by means of electrical agency, we shall be able to communicate our thoughts simultaneously with the uttermost ends of the earth." Still, though he foresaw the powers of the medium, he did not make any experiments in that direction, but confined himself to the endeavor to produce crystals of various kinds He ultimately obtained forty-one mineral crystals, or minerals uncrystallized, in the form in which they are produced by nature, including one sub-sulphate of copper—an entirely new mineral, neither found in nature nor formed by art previously. His belief was that even diamonds might be produced in this way.

Mr. Crosse worked alone in his retreat until 1836, when, attending the meeting of the British Association at Bristol, he was induced to explain his experiments, for which he was highly complemented by Dr. Buckland, Dr. Dalton, Professor Sedgwick, and others.

Shortly after Mr. Crosse's return to Fyne Court, while pursuing his experiments for forming crystals from a highly caustic solution out of contact with atmospheric air, he was greatly surprised by the appearanceof an insect. Black flint, burnt to redness and reduced to powder, was mixed with carbonate of potash, and exposed to a strong heat for fifteen minutes; and the mixture was poured into a black-lead crucible in an air furnace. It was reduced to powder while warm, mixed with boiling water, kept boiling for some minutes, and then hydrochloric acid was added to supersaturation. After being exposed to voltaic action for twenty-six days, a perfect insect of the Acari tribe made its appearance, and in the course of a few weeks about a hundred more. The experiment was repeated in other chemical fluids with the like results; and Mr. Weeks of Sandwich, afterwards produced the Acari in ferrocyanuret of potassium. The Acarus of Mr. Crosse was found to contribute a new species of that genus, nearly approaching the Acari found in cheese and flour, or more nearly, Hermann's *Acarus dimidiatus*.

This discovery occasioned great excitement. The possibility was denied, though Mr. Faraday is said to have stated in the same year that he had seen similar appearances in his own electrical experiments. Mr. Crosse was now accused of impiety and aiming at creation, to which attacks he thus replied:

"As to the appearance of the Acari under long continued electrical action, I have never in thought, word, or deed, given any one a right to suppose that I considered them as a creation or even as a formation, from inorganic matter. To create is to form a something out of a nothing. To annihilate is to reduce that something to a nothing. Both of these, of course, can only be the attributes of the Almighty. In fact, I can assure you most sacredly that I have never dreamed of any theory sufficient to account for their appearance. I confess that I was not a little surprised, and am so still, and quite as much as I was when the Acari made their first appearance. Again, I have never claimed any merit as attached to these experiments. It was a matter of chance; I was looking for silicious formations, and animal matter appeared instead."

These Acari, if removed from their birthplace, lived and propagated; but uniformly died on the first recurrence of frost, and were entirely destroyed if they fell back into the fluid whence they arose.

One of Mr. Crosse's visitors thus describes the vast electrical room at Fyne Court:

"Here was an immense number of jars and gallipots, containing fluids on which electricity was operating for the production of crystals. But you are startled in the midst of your observations by the smart crackling sound that attends the passage of the electrical spark; you hear also the rumbling of distant thunder. The rain is already plashing in great drop against the glass, and the sound of the passing sparks continues to startle your ear; you see at the window a huge brass conductor, with a discharging rod near it passing to the

floor, and from the one knob to the other sparks are leaping with increasing rapidity and noise, every one of which would kill twenty men at one blow, if they were linked together hand in hand and the spark sent through the circle. From this conductor wires pass off without the window, and the electric fluid is conducted harmlessly away. Mr. Crosse approached the instrument as boldly as if the flowing stream of fire were a harmless spark. Armed with his insulated rod, he sent it into his batteries; having charged them, he showed how wire was melted, dissipated in a moment, by its passage; how metals—silver, gold, and tin—were inflamed and burnt like paper, only with most brilliant hues. He showed you a mimic aurora and a falling star, and so proved to you the cause of those beautiful phenomena."

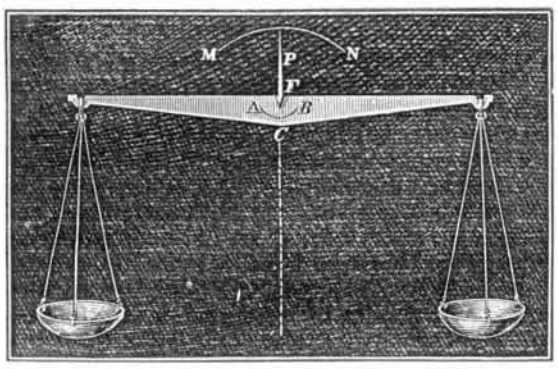
Mr. Crosse appeares to have produced in all "about 200 varieties of minerals, exactly resembling in all respects similar ones found in nature." He tried also a new plan of extracting gold from its ores by an electrical process, which succeeded, but was too expensive for common use. He was in the habit of saying that he could, like Archimedes, move the world "if he were able to construct a battery at once cheap, powerful, and durable." His process of extracting metals from their ores has been patented. Among his other useful applications of electricity are the purifying by its means of brackish or sea water, and the improving bad wine and brandy. He agreed with Mr. Quekett in thinking that it is by electrical action that silica and other mineral substances are carried into and assimilated by plants except fungi; and positive electricity he ascertained to be injurious to fungi, but favorable to everything else.

Mr. Crosse died in 1855. His widow has published a very interesting volume of *Memorials* of the ingenious experimenter.—*Timbs' Curiosities of Science.*

THE BALANCE.

The balance is an instrument so universally used that it seems strange that the principles of its construction should not be generally understood, yet such is the case. To satisfy ourselves that we are correct in this statement, we have conversed with a large number of grocers, druggists, and others, and have only in a very few instances found them posted. Chemists, assayers, and others who have occasion to use very fine balances, are always acquainted with the subject; but we do not write with the view of giving such any information. Our intention is simply to be the means of popular instruction.

The center of gravity in a body is a point so situated that, if the body be suspended from it, the mass may be revolved about this point and will remain at rest wherever it is placed. The balance is a lever having its fulcrum *above* the center of gravity of the beam. When it is balanced the center of gravity lies on a line joining the point of support and the earth's center of attraction. If either end is depressed, the center of gravity describes an arc the radius of which is the distance between the point of support or fulcrum and the center of gravity in the beam. This center of gravity is thus raised or carried away from the earth's center of attraction, and consequently tends to return to it as soon as the weight or other depressing force is removed.



In the engraving, F represents the point of support or fulcrum, C, the center of gravity of the scale beam, and A B, the arc of oscillation. The dotted line represents a line drawn from the fulcrum to the earth's center of attraction, and M N, the arc described by the pointer, P. C, being the lowest point to which the center of gravity can attain, it will remain there unless some force acts upon it. The shorter the distance between F and C, the less will the center of gravity be raised in describing any number of degrees of arc, and the less force will be required to move it. Hence the nearer the center of gravity in the beam lies to the fulcrum, the more delicate will be the action of the balance, all other things being equal. If the beam were suspended from a point coincident with its center of gravity, the latter would not be raised, however much the beam might oscillate; the beam would not then return to its original level, but would remain wherever it was placed. Such a balance would show differences in the weights of bodies, but any difference in weights attached to the ends of the beam, sufficiently great to overcome friction, would continue to move it until it assumed a perpendicular position. The only basis for the estimation of the difference would be the rapidity of this motion, and not the angle which the pointer, P, makes with the perpendicular, as is the case with the properly constructed balance.

If the point of support should be placed below the center, the beam would be reversed by any difference in weight sufficient to overcome friction. Friction is as much as possible avoided by the use of knife edges for supports, and in very delicate balances these edges rest upon pieces of polished agate. A delicate balance with from one to 2,000 grains on each dish should be sensitive to a difference of from .001 to .0005 of a grain.

CAPEWELL'S REVOLVING CARRIAGE WHEEL FENDER AND STEP.

In turning an ordinary carriage short, the wheel is liable to cramp against the body of the wagon, endangering its overturn and wearing and defacing the vehicle. To prevent this is the design of the device exhibited in the engravings. It is a roller, A, turning in projections under one edge of an open work triangular frame, B, of metal which is secured to the under side of the carriage rail. The sides of the frame are of such an angle that the wheel, when backed toward the wagon for turning around, shall engage the face of its tire squarely with the roller, thus effectually preventing cramping or friction. The construction of the roller is seen in Fig. 2, which is a longitudinal vertical section. It consists of alter-

Fig. 1

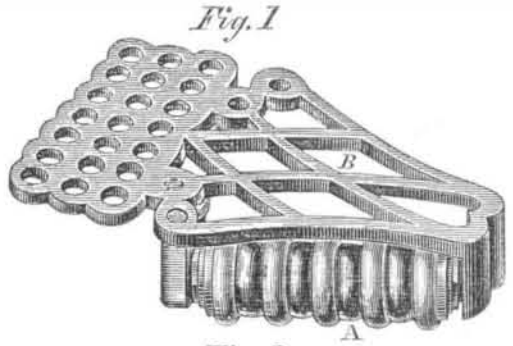
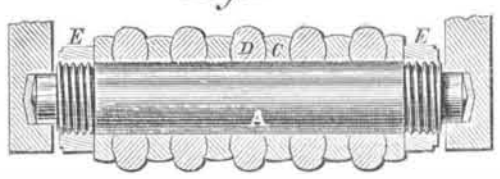


Fig. 2



nate disks of iron, C, and rubber, D, the latter cushioned or compressed by nuts, E, at either end. As the rubber stands above the iron washer rims, it receives the pressure of the wheel and renders the action noiseless. The roller may be placed on either side of the frame, B, to suit either the right or left side of the carriage. Besides its use as a fender, it makes an elegant and handy step to the carriage.

Patented through the Scientific American Patent Agency, September 17, 1867, by Geo J. Capewell, whom address, at West Cheshire, Conn.

Correspondence.

The Editors are not responsible for the opinions expressed by their correspondents

Provincial Protection to Inventors.

Messrs. Editors:—A question which interests many persons in this Province, is the manner in which the Dominion will treat the Patent question. A Government measure was introduced at the recent session, passed the Commons, was amended in the Senate in an important feature, and was consequently withdrawn by the Government. The matter, therefore, stands open to the next session, some eight months hence; and meanwhile it is important that correct notions on the subject should be sent abroad.

Each Province has, at present, a different system. That of the late Province of Canada is, as you know, exclusive—giving no right to a Canadian, the assignee of a foreign inventor, to obtain a patent in Canada. In New Brunswick, on the contrary, our system is most liberal. Here, any assignee of a foreign inventor can obtain a patent for the invention, subject to precisely the same regulations and under the same conditions which are applied in the case of New Brunswickers patenting their own inventions. The fees, too, are moderate, and the mode of application simple. Now, what we desire in respect to a patent law for the whole Dominion is, that it should copy the liberality and simplicity of our local Act. The present law of the Dominion should give its protection to the *creations* of genius, skill, and application, whether the possessor of these qualities lived on one side of the line or the other. We have always found fault with the United States Congress for not passing a copyright law, by which the intellect and the labors of British writers would be protected in the Republic. Not that it would have been of much service to us, for New Brunswick literature is not very extensive; but because we consider it right, just, and politic. What applies to literary creations, applies equally to inventions and discoveries in the arts and sciences.

But beyond this, we think that the Dominion Patent Act should make patents already existing in each Province, patents for and throughout the whole Dominion. Objections to this there may be, but we conceive that the reasons in its favor are overwhelming. It would make what is property in one Province, property throughout the Confederacy; it would simplify the settlement of the patent law question; and it would prevent conflicts of jurisdiction, of local patent laws with the Dominion patent law, of local patents with Dominion patents—which must otherwise arise. We cannot see that it would work injustice to any person, because, of course, all existing rights would be protected in any legislation for the purpose.

Your experience in the matter of patents and patent laws, will enable you to give us advice and assistance in this matter. Although of very great importance, the subject of patent laws is little understood in New Brunswick. J. E.

Woodstock, N. B.

Water Test for Boilers.

Messrs. Editors.—I have a second-hand steam boiler and am desirous of knowing whether it will stand inspection or not, and I have no way of ascertaining except by sending to Chicago, a distance of one hundred miles, which would be an unnecessary expense in case of its not being strong enough to stand the test.

I propose to fill the boiler full of cold water, and then heat, it until it expands sufficient to produce the desired pressure which I think will take place before the water becomes very warm and before any steam has generated. I conversed with several machinists and engineers in regard to this way of testing, all of whom seemed to think it would not answer, but they could not give any reasons for thinking so. I cannot consistently place much reliance on such groundless opinions, and therefore would like to get your opinion and advice on the matter before trying the experiment.

De Pue, Ill. J. H. Hassler

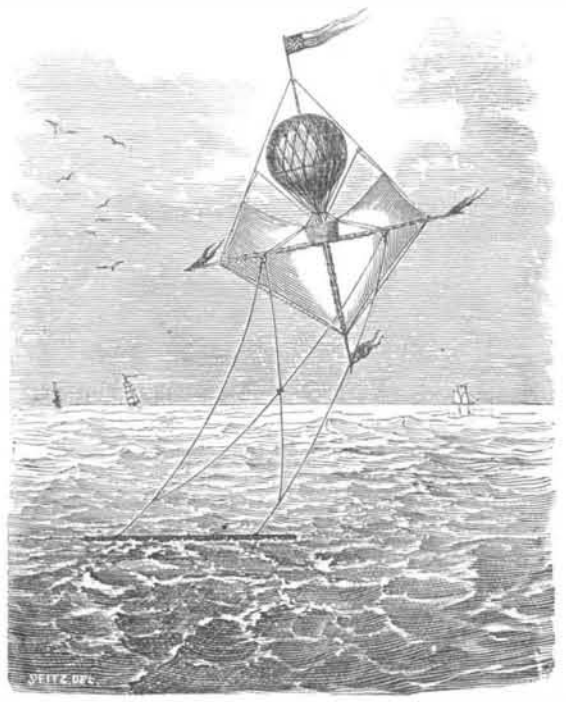
[We cannot advise the plan proposed; we do not think it would work. Dalton says that 1,000,000 parts of water at 32° Fah., becomes 1,046,600 at 212° Fah.; 1 in 23.3. Will not the shell of the boiler expand as much as the water and render nugatory the attempt to determine pressure? The boiler must be fitted with a force pump for feed, and it would be very easy to rig a contrivance to work it by hand so that you could apply the usual hydraulic test. If there is no steam gage to indicate pressure, the weight of the safety valve can be set to the point to which the boiler is to be tested and then the pump used until it rises.—Eds.

Marine Aeronautics.

Messrs. Editors:—In your last number I notice an article entitled "The Great Aeronautical Exhibition." One paragraph particularly attracted my attention, and I quote it:

"In this class we notice only the following, chiefly on account of its absurdity. The expectation that a body floating in a current of air, and propelled by no other force, could be guided by sails, is a folly which our readers will appreciate without further remark."

Probably the most of your readers concur in your opinion, that it is folly to suppose that a body floating along in a current of air or water, propelled only by the force of the current itself, would exert any resisting force upon the fluid by which its direction could be changed. It is a fundamental principle of mechanics, that a body, moved by a single force in a given direction, requires a second force, acting in another direction, to produce any change in its course. A ship propelled through the water by means of sails, can be guided by her sails alone, to some extent. The second force in this case is the resistance upon her keel. If the keel were movable upon a central pivot—proper strength and other difficulties not being considered—the ship might be guided by its keel so as to sail as close to the wind as it now does by the use of the rudder. Many of your readers are acquainted with the old method of utilizing the force of river currents to propel ferry-boats across streams; the ends of the boat being connected by ropes to grooved pulleys running upon a rope stretched from one bank to the other. The end



of the boat lying in the direction the boat is required to move, is hauled up stream by shortening the rope at that end, so that the boat makes an oblique angle with the direction of the current. The force of the current upon the side of the boat propels it across.

So far no means have been discovered of guiding vessels—not locomotive—except by the resistance of one medium to the force of propulsion afforded by another. The difficulties of effecting locomotion in air-navigation are very great, for reasons which I need not here mention.

It occurred to me, some years since, that an application of the principles to which I have alluded, might be made to the guidance of balloons over large bodies of water. Since I first conceived the idea, I have made some experiments which have confirmed my first opinion, and as the subject of aeronautics is now attracting much attention, I have ventured to send you a drawing and a description of the apparatus which I have been experimenting with, representing it, however, as I should suppose it would appear when made upon a suitable scale for actual use. The sails are, however, probably too