POLYTECHNIC ASSOCIATION OF THE AMERICAN INSTITUTE.

[Reported expressly for the Scientific American.]

On Thursday evening, the 12th inst., the usual weekly meeting of the Polytechnic Association was held at its room in the Cooper Institute, this city; C. Mason in the chair. The pre-arranged subject for the evening was "Franklinite," regarding which two reports were read, as follows:—

CHEMICAL REPORT.

The discrepancies in the chemical analysis of Franklinite are undoubtedly due to the fact that varying samples were taken. Pure Franklinite is a mineral of as definite a constitution as water. A careful comparison of the analysis and of the mineral with various isomorphous compounds, files upon the formula $(Fe\,O, Zn\,O) + (Fe_2\,O_3, Mn_2\,O_3)$, as exactly representing the composition of Franklinite. The following formula shows, in round numbers, the relative weight of the elements: O 64, Zn 32, Fe 84, Mn 56; and if the oxygen be eliminated, we have the proportion of metals in 100 parts: Zn (per cent) 18, Fe 49, Mn 33; the iron constituting one-half of the whole, the manganese one-third, and he zinc one sixth. But it is evident that, in no smelting process, could such alloy of such composition be produced. Zinc is volatile at a low red heat, and any alloy of which it forms a part would soon lose the whole of that metal at a temperature near the melting point of iron. It must therefore be concluded that zinc cannot be found in any notable quantity in the pig metal reduced from Franklinite.

In the mineral, the manganese is two-thirds the weight of the iron; should this proportion be maintained throughout the reducing process? Manganese readily alloys with iron neither metal is volatile. But manganese has a far stronger affinity for oxygen than iron, so that if the alloy be exposed at a high temperature to oxygen, the manganese is more or less converted into oxyd, while the iron is unchanged. In the smelting operation, then, as the condition of the high temperature of the alloy with excess of oxygen is found, the proportion of manganese will be materially diminished. In short, analysis of Franklinite pig shows an average decrease of about seven-eighths of manganese. The amount of loss, it is evident, in practical operation would vary within pretty wide limits.

The fact that the ore actually worked is not pure Franklinite, but contaminated with red oxygen of zinc and oxyd of iron, is of little weight in the discussion thus far, for the reason that no other metals than zinc, iron and manganese are found in the ore. The proportions of zinc in the ore are most variable; while the relative proportion of the iron to the manganese is more constant.

If the ore be wrought for iron only, it is evident that the zinc would behave unfavorably in consuming fuel for its reduction and sublimation, but favorably in conveying out of reach of the iron such volatile impurities existing in the fuel and flux as sulphur and phosphorus. The manganese would act favorably by uniting with silicious and other fixed impurities, which otherwise would contaminate the iron. Moreover, the oxyd of manganese readily combines with the flux and slag, rendering them more fluid. In the final puddling process, especially when mixed with other ores, the manganese is speedily removed, while all the time it protects the iron from all injurious foreign matters. It hence appears that a certain amount of zinc and manganese is desirable in an ore which is worked for the purest wrought iron.

The Franklinite pig metal, as ordinarily produced, should be regarded as an alloy of iron with manganese. It deserves this distinction as well from its peculiar properties as its chemical composition. It is more fusible, less oxydable, harder and of a lighter color than either iron or manganese. For many of the purposes for which ordinary cast iron is used, this compound is impracticable; while, for certain specific uses, the Franklinite pig is better fitted than any other known material. We have in this alloy a new raw material for the industrial arts. Its sources are exclusively American; science and American industry should work out the problem of its application.

Dr. Stevens.

GEOLOGICAL REPORT.

In the great uplift of hypogene and metamorphic rocks, which forms the great determining contour of the Atlantic slope of the North American continent, there was revealed to the research of man, for his economic uses, the largest extended reach of metalliferous rocks known on the face of the globe. It extends from Canada through the New England, middle and southern Atlantic States, in elevated mountain ranges, having a northeast and southeast trend, and sinking below the general level of the country, is lost in the northern part of the Gulf State of Alabama. Throughout its entire extent it is rich in metals, the more important of which are gold, silver, lead, copper, zinc and manganese. Gold is sparsely distributed; manganese is common; iron is abundant throughout all this range of rocks, while zinc is confined to a few localities. In the town of Franklin, Sussex county, N. J., within 70 miles of the great commercial metropolis of our country, is found the only locality of ore where the three metals of iron, manganese and zinc, known as Franklinite, are molecularly combined, and either monometrically or amorphously crystallized. Its precise position, geologically, is in a belt of altered granular limestone, resting uncomformable to a syenitic rock below. A section of this belt of limestone, where it enters the State of New Jersey from New York, gave the following as the descending series (made by Professor Wm. Kitchell):—

6. Limestone of a dark blue color, granular silicious, with calcite	150 feet
5. Limestone of blueish gray color, compact, with numerous seams of quartz	120 feet
4. Limestone of a light blue color, with silica	65 feet
3. Limestone of a dark blue color	120 feet
2. Limestone of a dirty blue color, crystalline	30 feet
Total limestone	485

Gneiss, as seen dipping southeast of east, 20° 50′ 5″

Limestone uncomformable to the gneiss dips to northwest from 20° to 25°.

Francis Alger, Esq., of Boston, Mass., thus describes this interesting locality:—"The ridge of granular limestone commences at Sparta and runs through Stirling to Franklin. The zinc ores extend from Franklin to Stirling and no further, and are found again in Pennsylvania. Sometimes large masses of gneiss and limestone appear including large and shapeless deposits of magnetic ore. On the east side of Stirling Hill, after penetrating limestone, seven feet of Franklinite and red oxyd of zinc appear in about equal parts. Six inches of heavy coarse crystalline limestone separates from ten to twenty feet of regular pure Franklinite ore, sometimes crystallized in the cavities or against the back face of the dark limestone. Behind the bed of ore are limestone strata until we reach the body of gneiss in the hill."

Dr. Jackson describes the beds of Franklinite at Stirling Hill as averaging 32 feet wide, and the zinc at 18 2-3 feet through the hill, and the hill 167 feet high, having limestone above and gneissoid rock below.

Professor Hodge gives an anatomy of the deposit:—At Stirling Hill it forms the main substance of two large beds, separated from each other by a seam running southwest and northeast, and dipping southeast 40° from the hill against which the beds seem to repose. The upper part of the beds lie under crystalline limestone, and are composed chiefly of red oxyd of zinc, with the Franklinite interspersed in granular masses. After assuming the appearance of imperfect crystals it presents a thickness of from three to eight feet, and is traced with uniformity of structure. At times almost perfect crystals of Franklinite are found, especially when in contact with superincumbent limestone. The underlying bed appears to be pure Franklinite, amorphous in structure although exhibiting large crystals of Franklinite; it contains no red oxyd of zinc, while the overlying bed is known as red oxyd of zinc. As the underlying bed of pure Franklinite descends it becomes less pure, it being replaced by the crystalline limestone, with the Franklinite and Willemite (anhydrous silicate of zinc) thickly interspersed in grains and imperfect crystals. It preserves this feature as far as known, which is 200 feet below the outcrop. Several hundred feet westward of these main beds, and higher up the hill, another bed of Franklinite, mixed with red oxyd and silicate of zinc, runs the entire length of the hill. On Mine Hill, 1½ miles northeast of Stirling Hill, Franklinite is found in large masses. There are two distinct beds, and their relative position compared with Stirling Hill is reversed, the Franklinite being the easternmost and uppermost and the zinc being the westernmost and lowermost.

Although masses of magnetic ore are found in this locality with the Franklinite, this bed is not to be confounded with the magnetic and specular oxyd of the hypogene rocks of this State. In geological space they are many thousand feet apart, and in sequence of time *ages-aeons*—beyond compute. They belong to two distinct eras of the earth's history. The magnetic ore is found throughout the entire range of hypogene rocks of the Atlantic slope, which re-appear in Missouri to the west, in the Lake Superior country to the northwest, and in Adirondack Mountains to the north, underlying the intervening territory, and forming the foundations of the United States. While the limestone appears as a water table to the geological structure built upon this foundation, and it is the best developed geological structure. From the crinoid of the Taconic and mollusc of the Silurian, through the palaeozoic, the carboniferous, the permian, the reptile-yielding cretaceous, the mammalian, tertiary of Nebraska to the human of Gaudaloupe, no system is wanting—the structure is entire. In this water table of limestone, the Franklinite appears, in this single locality, as an ornament of nature—a geological curiosity—a source of mineral, economically and commercially considered—as the most abundant source of pure, elegant and health-preserving pigment. It is rather as an ore of iron than zinc that it is to be considered in this report, and its history we will very briefly give.

As early as 1640, a party of Nassau miners discovered it, who came from New Amsterdam, N. Y., and explored the range of ores from the line of Pennsylvania to Salisbury, Conn. In 1770, it was examined by Lord Stirling and samples sent to Europe. In 1817 it was owned by Dr. Dowler, a mineralogist. Dr. Keating and Professor Vannuxen examined it in 1819. Dr. McClure, the father of American geology, in company with Dr. Jackson and others, explored it in 1825. Dr. Jackson revisited it in 1849, accompanied by Francis Alger, Esq., of Boston. In 1850 zinc was extracted, and in 1852 iron was successfully reduced from the ore. During the prosecution of the geological survey of the State, made by Dr. Rogers, he also reported upon this. In the recent survey by Dr. Kitchell, an elaborate report is given upon the ores and mines of the State, and this locality is carefully described.

It was first chemically analized by Berthier. From recent analyzation the per cent of iron is uniformly 66. The zinc ranges from 12 to 30, and the manganese from 7 to 21. The discrepancies of the analysis may be accounted for by the different varieties of specimens.

Dr. Jackson made an analysis which is considered fair, as follows:—

	No. 1.	No. 2.
Silica	0.280	0.127
Oxyd of iron	66.082	66.115
Oxyd of zinc	21.395	21.771
Oxyd of manganese.	12.248	11.987
	100.000	100.000

Berthier expresses it atomatically in the following formula:—

4 atoms per oxyd of iron,
1 atom sesquioxyd of manganese,
1 atom biferate of manganese.

The specific gravity is from 5 to 5.09; hardness, 5.5 to 6.5. When the ore is in contact with or influenced by the hypogene rocks, it is slightly magnetic.

In reducing the ore manganese is mostly driven off by volatilization, while the zinc is collected as a white oxyd at the top of the furnace in bags and preserved as a pigment. From the residuum a pig metal is yielded 33 to 37 feet. The pig in fracture presents the following peculiarities:—The center of it is a mass of large crystals having broad folia of lamination with well-defined edges, of intense hardness, scratching glass and cutting it. It has a silvery lustre, with thin dark lamination. Near the circumference it has the appearance of white pig, and close and granular in structure. Often the center of the pig is honey-combed as if the metal had flowed out from the walls of crystal; but examination finds the walls of the crystals to be perfect, showing that they were never filled. It melts at a lower temperature than common pig and welds at a low red heat, showing it to be more of the nature of steel than cast iron. Its specific gravity is 7.665 at 60° Fah. (Hays).

ANALYSIS.

Charcoal Pig.		Anthracite Pig.	
Ferrum (Hays)	98.364	Ferrum (Hays)	88.30
Manganese	3.204	Manganese	4.50
Carbon	2.250	Carbon	5.48
Slag silica	.640	Slag silica	.20
Alumina	.240	Sulphur	08
Lime	.170	Phosphor	.15
		Zinc	.30
	100.000	Loss	.99
			100.00

The maximum amount of carbon that steel is capable of taking up is 1.90 (Karsten). Specular pig metal is 5.25 to 5.75. It will be seen that pig from Franklinite only exceeds that of steel by 0.35 and falls below that of common pig by 3.50.

No trace of sulphur, zinc, chromium, vanadium or any other impurity, save a little phosphuret of calcium, could be detected by Dr. Hayes in the charcoal reduced pig, showing that the sulphur and phosphorus of anthracite reduced metal must have been received from another source.

ADDENDA.

Tensile strength of various iron (square inches):—

Salisbury, Conn. (Walter R. Johnson)........lbs.	58,000
Sweden	58,000
Center county, Pa	58,000
Lancaster county, Pa	58,000
Essex county, N. Y.	58,000
English cable bolt, E. V.	59,000
Russian	76,000
Carp River, Mich. (Maj. Wade)	89,582
Franklinite (John A. Dalghren)	66,000

Fredgood states the strength to be as follows:—

Best Swedish bar iron	72,840
English bar iron	61,660
American Franklinite	77,000

Franklinite, when mixed in proportion of ½ with common anthracite pig, with a small proportion of Scotch pig, increases the tensile strength of the casting about 80 per cent—100 feet (Cady, Cornell and others). A mixture of Cloverdale pig (a sort of chemical pig) 10 parts, and Franklinite pig 1 part, gave a tensible strength of (square inches) 28,200 lbs., with intensity of 78·24.

John A. Dalghren.

DISCUSSION.

Dr. Stevens read chemical tests of Franklinite, showing its superior qualities to those of iron.

Mr. Johnson said that Franklinite fused at a higher temperature than copper, and that was an objection.

The president exhibited a bar of iron, composed of 80 per cent of magnetic and 20 per cent of Franklinite ore, from which horse-shoes and nails are made; and also two other bars of different degrees of porosity and fineness. Their tenacity, strength and flexibility were yet to be considered.

Mr. Curtiss said that the workmen (in Morris county, N. J.) called it "hard and frizzly." It breaks easily and shows the effect of silicates upon ore. Horse-shoes were made by the second heating, and manufacturers say it is less liable to cracks and flaws. Ax-blades were superior that had been made from it.

Mr. Pomroy (a smelter) said that Franklinite had an

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affinity for sulphur and oxygen. Zinc takes up the sulphur from the ore. In smelting it becomes granular because it is not sufficiently scorified; it is always a semi-steel. The zinc is taken off by anthracite coal and charcoal takes up the sulphur. An oxyd of zinc in a flocculent form is a product and passes off. The oxygen and carbon combine and form carbonic acid, and thus produce a mineralizer, a chemical compound between the impurities—the bases of the earthy salts; and the iron is not scorified. A stream of water or steam is let in and acts on the carbon to combine with the oxygen to produce its hydrogen. The hydrogen will take up the carbon and leave it entirely soft and pure. The hydrogen and zinc (both contaminating principles) are taken up and removed. A metal is then made which is graduated in quality according to the degree of temperature. Sulphur is a principal compound for mineralizing, and Franklinite requires a great amount of heat, and is therefore expensive. A little Franklinite was sprinkled in the puddling furnace, with which the iron of the blasting furnace combined, producing a purer quality.

The president remarked that there was a great resemblance in structure between a bar of iron and wood; the operation of lengthening the fibers in each case was similar, as was also their comparative quality.

Mr. Seely said that the president had anticipated his idea of the composition of Franklinite. The scorification was very easy compared with smelting. If Mr. Pomroy has found that hydrogen has a greater affinity for carbon than oxygen it is valuable. The zinc was not so difficult to remove as the manganese. There was a remarkable fact that at a high temperature iron is not oxydized, but the manganese is oxydized. He wished to determine what effect the different proportions of manganese in the Franklinite have on fusibility and hardness; also whether it is possible to make an alloy of manganese and pure iron without carbon. A scale of manganese would become soft if submitted to a crucible.

Mr. Tillman considered that carbon had a greater affinity for oxygen than any substance under the force of heat.

Mr. Seely then said: "Take charcoal at red heat and pass over it vapor of water, which decomposes. The hydrogen will unite, or the oxygen may unite; and one has as great affinity as the other."

Dr. Reuben introduced the subject of illuminating gas. By experiment, hydrogen and oxygen, at a high temperature, united with carbon; then the oxygen and hydrogen separated from each other and united with the carbon, producing an illuminating gas. Professor Sanders passed vapor of water over carbon at a high temperature and obtained a carbureted hydrogen.

Mr. Garvey did not know that carbureted hydrogen was made for illuminating.

Mr. Seely said it was an old statement, and known as water gas.

Mr. Garvey (returning to the subject of Franklinite) said he did not know why the metal would not be strengthened by manganese.

Dr. Reuben replied that the results are to be found in statistics. The alloys of copper and zinc have greater strength than either of the metals; and they acquire greater strength in proportion to the mixture of zinc which by itself is a weaker element. Steel is not pure iron and it is the strongest metal. It is found that tungsten increases the strength of metal, and sustains more than ordinary alloy. Calvert Johnson, of England, says that alloys, to a certain per cent, are the strongest. It is not small atoms creeping into large ones, as stated, but the power of aggregation or cohesion that gives strength. We may take sulphuric acid and water and press them into a volume, and affinity binds them; and it is very easy to suppose that there is an affinity.

Mr. Pomroy said that if hydrogen and carbon did not combine, there would be no gas-light. He was investigating Franklinite continually and produced new conclusions. The zinc took up the oxygen and semi-steel was made. Hydrogen is then introduced to take up the carbon; the oxygen and the carbon are removed, and the base of carbonic acid is destroyed. He had divested the iron from these gases.

Mr. Nash wished to know whether alloys of zinc and copper were not made by electrical action; and if hydrogen and oxygen could be manufactured into water unless by combining electricity.

Mr. Pomroy considered a course of lectures would give some light on it.

Dr. Dick stated that in England an ore was used, like a species of Sweedish ore, which might bear characteristics similar to Franklinite.

Mr. Butler had made an experiment and found an electrical effect. Thus: he partially melted a bar, and on examination afterwards found scales, dissimilar from the soft original which were tough.

Mr. Curtiss said that the Pembroke iron of England has 12 per cent of Franklinite, and was made into chain cable. So in America, at Albany and New York city, water pipes had a certain per cent of it. He had compared bars with a certain per cent of Franklinite and those without, the latter being more brittle.

A motion was carried to refer the whole matter to a committee (of which the president was acclaimed chairman), to make a general report at the next meeting.

[We advise the members of the Polytechnic Association not to be so rambling in their discussions hereafter; because it is exceedingly difficult to understand what some of them mean, as their ideas are either very far from being scientific in their character, or the language employed to communicate them is inappropriate.—Eds.

DEFECTS OF CALF-SKIN LEATHER.

We have heard of persons purchasing several pair of boots at once, in order to lay some of them away for long keeping, under the impression that leather when kept in a dry situation improved in quality by age, like oil-cloth. Upon inquiry we find that such notions are very generally entertained, but why this should be so we cannot imagine, for they are the very reverse of all facts and experience in the case; and we call attention to this question for the first time, we believe, as "a word of warning." Calf-skin leather, instead of improving in quality with age, when made into boots, deteriorates rapidly. It is subject to a species of dry rot—eremacansis; and in the course of three years it becomes as tender as a piece of brown paper. Dealers in boots and shoes experience a considerable loss from this cause when such articles are left on their hands for more than two years. This dry-rot in calf-skin boots first appears at the edge near the soles, in the form of a black glassy sweat, resembling varnish, and from thence it gradually proceeds until the whole leather becomes rotten. The application of grease rather accelerates than arrests the progress of this decay; such leather endures much longer when worn on the feet than when laid aside in a dry situation, but whether this decay is caused by the grease used by the curriers, or is some peculiarity in the skin, is not known at present. Cow-skin and kip leather do not seem to be subject to this rapid deterioration, but all kinds of calf-skin, even the very best French, is just as subject to it as the poorest qualities.

This is a subject deserving of practical scientific investigation in order to discover some remedy for the evil. At present the practical application of this information by purchasers of calf-skin boots and shoes is an easy matter—be careful not to buy aged articles.

Value of our Forests.—The Baltimore *Exchange* says:—"Those persons who have been accustomed to regard the pine forests of the South as of little commercial importance, will be surprised to learn that the annual value of the hewn timbers, the sawed plank, boards, scantling, resin, pitch, and turpentine, is estimated to be not less in the aggregate, than from twelve to fifteen millions of dollars." This estimate is probably far too low for the present, and certainly falls far short of what may be expected in a few years, when the fact is demonstrated that no point where timber is abundant is inaccessible to the wants of commerce. It appears that the forests constitute not only the staple product but the real wealth of North Carolina. Her tar, pitch, and turpentine, are used in every corner of the globe The amount shipped to England during the year 1859 is valued at $2,176,870.

Zinc Nails.—These are now extensively employed in the manufacture of boots and shoes in place of wood or iron. It is said that zinc nails are also substituted for sewing in ladies' slippers. An iron last is employed, and the nails, on being driven in, strike the last and become headed or riveted on the inside, thus forming a very secure fastening.

OIL FUEL FOR STEAMERS.

Messrs. Editors:—In the last number of the first volume of the new series of the Scientific American, there are some very original and sensible opinions expressed on the important subject of coal oil for ocean steamers, yet I think one of the largest items of economy has been rather cautiously dealt with. I assume, without fear of successful contradiction, that one pound of coal oil, properly consumed and the heat economically distributed through the furnaces and flues of the boilers, will evaporate as much water as four pounds of coal. I am of the opinion that there will yet be such boilers constructed, and such combustion effected, that coal oil will be largely used as fuel in steamships and for fire and other engines, where great economy of space and weight are important. All that is requisite for inventors in this field is to distribute sufficient warm air among the gases generated from the oil, so as to effect complete combustion in the furnace. The heat generated must also be applied economically, so as not to allow so much of it to escape up the chimney, as is now the case in most instances where steam power is employed.

Let us suppose the fire-box of a furnace to be constructed with corrugated plates, to take up considerable of the space now required for the burning coal, and that instead of grate bars a perforated bottom plate for small vertical tubes, placed close together and secured by screws or otherwise, to extend about three inches upwards. Now, let the spaces between these tubes be filled with pumice-stone or other incombustible loose material, and let the oil be fed towards the surface to within half an inch of the top of the tubes. When properly ignited and the furnace highly heated, as the oil rises near the surface of the porous material it will be converted into gas, and when it has received its full complement of warm air from the chamber below the tube plate, and through the tubes, perfect combustion will be effected, both with the carbon and the hydrogen of the oil. This is an important subject both for chemists and mechanical inventors, and it will yet bring out some important results.

If one pound of oil can evaporate as much steam as four pounds of coal, of course steamships in which it would be used for fuel could carry a much greater amount of freight, as you have stated in the article referred to. In a large steamer consuming 100 tuns of coal per day, for 11 days steaming between New York and Liverpool, no less than 825 tuns of extra space could be applied for cargo, as 275 tuns of oil would be all that was required. A vast economy would thus result from the use of oil in steam navigation. The large fields of cannel coal situated in different parts of the country will yet, I believe, supply much of the fuel for generating steam, especially for long voyages, where the economy of space is an important consideration.

J. E. H.

Newark, Ohio, Jan. 21, 1860.

Gum-chewing.—The Utica *Herald* gives the gum statistics of Jefferson county, N. Y. It makes our jaws ache, now, to think of such gum-chewing. It says:—"Probably few persons outside of Watertown are aware to what an extent the manufacture of chewing gum is carried on at that place. O. G. Staples, the 'gum man,' who keeps some twenty hands constantly engaged in its manufacture, informs us that in the six months ending Nov. 15th, he had manufactured and sold over 35,000 boxes—each box containing 200 sticks or rolls—making a total of 7,000,000 rolls. Allowing four chews to a roll, which is a fair estimate, this would give a 'chaw' each to 28,000,000 persons. Think what an army of gum-chewers this would be! We infer from these figures that gum has become somewhat of a staple article."

An Inventor Creating a Sensation.—At the President's levee, last week, a stranger in the room attracted considerable attention by the peculiarities of his attire, which consisted of a military uniform, with a silk scarf thrown over his shoulders. It was said that he had come to Washington as an applicant for a patent for a steam plow, and that his brilliant costume was worn in accordance with the advice of some of his boarding-house acquaintances, who suggested to him that, to succeed in securing his patent, he must make himself somewhat prominent in Washington society, and thus attract the attention of the influential politicians.

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