tion of microscopists to the subject. We suggest that they should give some expression of opinion, if they desire the integrity of this Society. For ourselves, we shall strongly support the maintenance of the American Society of Microscopists, on account of our decided faith in its usefulness, and necessity for its existence, and for the reason also, that no real cause has been shown for its disbandment.

Taking the charges of the editor of the *American Monthly Microscopical Journal* in the order presented, we would say: 1st. That we have the authority of the late President, Professor H. L. Smith, that the Society *has* received sufficient support to make it a success. 2d. That the Society has been unexceptionally fortunate in the selection of officers, that they have proved themselves to be experienced men, and *have* "directed properly." 3d. That the Society does not deem it necessary to meet in conjunction with the A. A. A. S., and has voted down all resolutions for so doing. The assertion to the contrary is therefore perfectly gratuitous, and the fact that those who propose it, also made it a reason for breaking up the Society, has the appearance of a desire to lead the Society to such an end. 4th. The demand made upon the Society by one of its members, to show cause why it should exist, appears slightly presumptuous and ill-timed. As a suggestion *before* the establishment of the society it might have had some weight, but after the third annual meeting, and the congratulations of its President on its success, the proposition is unseasonable. We would remind the editor of the *American Monthly Microscopical Journal*, when he challenges the American Society of Microscopists to show the *raisen d'etre* for its existence, that fifty delegates, representing the microscopists of the United States, in his presence passed a resolution in the following words: "*We think it desirable to have a National Organization for the promotion of Microscopical Science.*" We consider this a conclusive answer to the present querest, and to all others who in future raise such a question.

The article we have referred to states, that "if the American Society of Microscopists does not decide to meet next year in convention with the A. A. A. S., at Cincinnati, *that the next meeting will be its last.*" As the writer also states, that if it does so meet, the necessity will arise for it to be "disorganized," and as one of these alternatives is inevitable, the fate of the society would appear to be sealed.

As we believe these difficulties to be purely imaginary, we are ready to grant the American Society of Microscopists a long term of existence, and a future of utility and progress. If any of our readers are of a contrary opinion, our columns are open for an expression of their views.

LAW ACCORDING TO WHICH THE METALS, AND THEIR ORES, CAME TO, OR NEAR TO, THE SURFACE OF THE EARTH.

By Prof. Richard Owen, M.D., LL.D.

In the abstract of a paper read before the A. A. A. S., which appeared in the issue of "Science" for September 25, 1880, allusion was made, in the closing paragraph, to the connection between the law of land-forming and that of metallic development.

We might reasonably expect that the metals requiring temperatures from 2000 degrees to over 2500 degrees F. to melt them (such as iron and gold) would be the first to solidify, as our earth cooled; and therefore more likely to exist among older rocks than such metals as zinc, lead[1] and tin, which melt at a comparatively low temperature; and consequently could not become solid until the earth's crust had cooled to 773 degrees, 612 degrees, and 442 degrees, the melting points respectively of these metals. Such we find to be the fact. Furthermore, Faraday demonstrated that all substances, when suspended freely between the jaws of a powerful horseshoe magnet, would place themselves either *paramagnetically*, the same as iron and some other metals, or *diamagnetically*, the same as bismuth and numerous other bodies; and the magnetism developed, for the time being, in that horseshoe magnet, may be, and often is, produced by powerful currents of electricity.

It has been proved that there are constantly currents of electricity passing in the earth's crust, chiefly in an opposite direction from the earth's revolution, perhaps therefore operating mainly in causing a freely suspended needle to place itself at right angles to the plane of those so-called currents.

It seems therefore, further, not unreasonable to expect that metals, when about to solidify, if free to permeate cavities in all directions, should assume, relatively to these currents of electricity, respectively either a paramagnetic or a diamagnetic position. Such seems in reality to have been the case: Iron, manganese, platinum, nickel, cobalt (and probably other paramagnetic bodies, but time has not permitted this latter investigation) will be found chiefly occupying north and south belts, corresponding pretty generally with meridians, while gold, silver, copper, tin, lead, zinc, antimony, bismuth and other diamagnetic bodies will be found in east and west belts, sometimes on regular parallels, of which the terrestrial north pole is the centre, sometimes in east and west curves, having one or other of the Continental foci (pointed out in the law of land-forming) as their centre. The apparent law, then, briefly formulated, may be thus expressed:

The paramagnetic metals, in consolidating, arranged themselves along north and south belts, usually near the median line of each Continent, and are found in older rocks as well as newer. Diamagnetic metals are most commonly to be found in belts, not necessarily continuous, but running more or less east and west, and except perhaps in the case of gold, silver and cop-

[1] Although lead is found sometimes in silurian and carboniferous rocks, yet Dr. Dana shows (at page 148 of his Manual of Mineralogy) that such is not its true age. Speaking of Galena, he says: "In Derbyshire, England, the deposits contain fossils of permian rocks, showing that, although occurring in subcarboniferous limestone, they were much later in origin."

per, not so much in older rocks as in later formations. Demonstration:

I.—PARAMAGNETIC METALS AND THEIR ORES.

1. *Iron.*—A considerable portion of this metal as magnetite, both in the United States and in Scandinavia, is magnetic, possessing polarity. Specimens from Magnet Core, Ark., and from near Pilot Knob, Missouri, in the United States, and from Dannemora, in Sweden, present this character very strongly.

(*a*) Nearly all the important iron of the United States (as can be ascertained from Dana's Mineralogy, or readily seen by inspecting Map No. VIII in Cornell's Phys. Geogr.) occupies a north and south belt, between the meridians of 77° and 91° long. W. of Gr.) extending north and south from Lake Superior to Alabama, average lat., say 40°[2]. On the opposite side of the globe, this belt, prolonged in a great circle, will include the main iron belt of Asia.

(*b*) The iron of Europe is in a belt about (20) twenty degrees or nearly 800[3] statute miles in width, namely from long. 5° W. to long. 15° E., extending north and south from Scandinavia to Tunis: thus being about 90° distant from the American-Asiatic belt.

(*c*) The only other iron laid down in Cornell is in a belt from near the Urals to a deposit in Persia, half way between the European and the Central Asiatic iron belt, or about 45° distant from each of these.

(*d*) Dana mentions some iron in the region of San Francisco, which would be about 45° west of the Pennsylvania portion of the main United States belt.

2. *Manganese.*—The localities given by Dana for this metal would fall almost, if not entirely, within the iron belts of North America and Europe: showing a similar tendency to assume a paramagnetic direction.

3. *Platinum.*—The chief localities of platinum, as given in Dr. Dana's Manual of Mineralogy; namely, the Ural Mountains and North Granada, South America, as well as Canada and North Carolina, where traces have been found, fall within the United States iron belt. Borneo and places in Minas Geræs, Brazil, where some platinum has been taken out, are very slightly east of the above-named belt.

4. *Nickel and Cobalt.*—Ores of these metals are found, according to Dana, in Cornwall, Sweden, Norway, France, Saxony and the United States (Missouri, North Carolina, Pennsylvania): all again within one or other of the paramagnetic iron belts. Some nickel found in New Caledonia would occupy a position very nearly half way between the iron belt of Central Asia and the iron of California.

Without going into further details at present regarding the paramagnetic metals and their ores, let us examine some of the

II.—DIAMAGNETIC METALS AND THEIR ORES.

1. *Gold.* This metal cooling among the first on the globe is found in old formations; but appears to be also injected into, or deposited in, the fractures and fissures of rocks having a more recent age. The earlier east and west ranges or belts, in which it occurs more or less, often correspond, as already stated, with parallels of latitude; thus we find gold on a belt of the parallels 55° to 60° N. lat., comprising the gold of Alaska, Scotland, Sweden and the Urals; again in a belt ranging from lat. 45° to 50° N., embracing the gold of British Columbia, Washington Territory and Oregon, of Lake Superior, Canada and Nova Scotia, in North America. We find on the same parallels or belt, in the eastern continent, the gold of the Alps, Tyrol, Hungary and the Altai Mountains. Another zone or belt, in about lat. 35° to 38° N., runs from California and Arizona, through Georgia and North Carolina, and is prolonged through Spain, Thibet, China and Japan. A more southerly belt marks the gold of Central America and New Granada (United States of Colombia, S. A.), also of Western and Eastern Africa (about 5° N. of the Equator), as well as of Ceylon, Java and Borneo. The most southerly belt, in about lat. 22° to 32° S., embraces the South American gold localities, the gold washings of South Africa, the rich mines of Australia, and almost includes the gold of New Zealand.

In some cases, without making the belt so broad, gold localities can be traced on one and the same curve, using either the northern focus of each continent for a centre, or occasionally the more southern continental focus. For instance, using the Boothia Felix focus as a centre, an arc unites the gold of Oregon with that of Canada, while from the Lake Superior focus a curve sweeps from the gold of the Sierra Nevada and the Sacramento Valley in California to that of Georgia and North Carolina.

2. *Silver.* The most noted localities for this useful metal can be readily traced in North America, Europe and Asia, on belts running east and west, often at vertical intervals of about 4° to 5° apart, or say every 300 statute miles. Thus we have a belt from the silver of Norway to that in the Urals; then another, from Montana, Idaho, Wyoming and Lake Superior regions, continued through England, France and Saxony to the Altai Mountains; a third silver girdle runs from California and Arizona, through Utah and Colorado, thence to Spain. A fourth shows that of Mexico on the same parallel with the silver of China. Then come the rich mines of South America, in three successive belts (that of Venezuela, of Brazil and of Bolivia), with nothing to correspond in the eastern continent.

3. *Copper* can equally readily be traced along belts on diamagnetic parallels; such as one in Scandinavia connecting with the Urals. A second, on the parallel of the rich Lake Superior region takes in the copper of Cornwall, of France, Thuringia, Hungary, Siberia, China and Japan; a third can be found embracing the mines of Arizona, New Mexico, Tennessee and North Carolina, also of the Island of Cyprus, of Turkestan and Persia; a fourth gives us the copper of Cuba, Africa, Arabia and Hindostan, as shown in map No. VIII, of Cornell's Phy. Geogr., by Steinwehr. Of the two copper belts in S. America, the more Southerly is on the same parallel with the copper of Australia.

4. *Tin* (although sparingly distributed, except in two or three localities) follows the same rule: First belt, Massachusetts, New Hampshire, Cornwall (England), Saxony, Austria, and Russia. Second belt,

[2] A degree of longitude in latitude 40° is about 53 statute miles; consequently the width of the belt is nearly 750 miles.

[3] The average latitude of European iron being about 54° to 55° N., we may call a degree equal to 40 statute miles, thus giving the above result.

California and Spain. Third belt, Dureago (Mexico), Peru and China. Fourth belt, Malacca and Banca. Fifth. Bolivia, (S. America) Queensland and Northern New South Wales, in Australia, in about the parallel of 22° to 23° S. Lat.

5. *Lead.* The diamagnetic arrangement of the localities in which this metal is most abundantly found, may be rendered equally apparent, whether we follow the Galena and other ores in belts, on parallels around the globe, or connect these metallic deposits by curves from the Boothia Felix focus, for North America, and the Scandinavian focus for Europe. Thus, first belt in North America, from Arctic focus, Idaho, Wisconsin, Iowa, Northern Illinois, Vermont, New Hampshire and Maine; second belt, Nevada, Utah, Colorado, Missouri, Southern Illinois, New York, Connecticut; third belt, California, New Mexico, Arkansas, Tennessee, and North Carolina; fourth, Fort Yuma, and Arizona; fifth, the argentiferous Galena of Mexico.

In Europe there are from the Scandinavian focus four belts; first, that of Scotland and Saxony; second, of England and Bohemia; third, the lead mines of France; fourth, those of Spain, often argentiferous.

6. *Zinc.* From the Scandinavian focus, we trace one curve, which marks the zinc belt of England, Belgium and Germany; another that of France and Austria. In Asia, from the North Siberian focus, a belt connects the zinc of the Alati mountain with that of China. In the United States, if we take the Lake Superior focus as a center, we can bring within one belt the various zinc ores of Tennessee, Virginia, Pennsylvania, and the abundant deposits of New Jersey, as well as the zinc localities of New York, Vermont, New Hampshire and Maine.

7. *Antimony.* From the Lake Superior focus, a semicircle unites, in one belt, the ores of Antimony found in Maryland, New Hampshire and Maine, while just outside is a curve or zone uniting the mines worked in Sonora (Mexico) with those of New Brunswick.

In Europe, with Mount Rosa for a center, the Tertiary circles (radius nine degrees), described in the former communication, passes through the zinc of Cornwall (England), of Spain and of Hungary.

8. *Bismuth.* A belt in the United States, with Lake Superior for a center, unites the bismuth found in Montana, Arizona and Colorado, with that of Georgia and South and North Carolina.

In Europe, the bismuth of Norway and Sweden are in one curve from the Scandinavian focus; that of England, Saxony and Bohemia constitutes a second curve. Bismuth is also found in Australia, nearly on the parallel of latitude on which it is obtained in Chili and Bolivia (South America).

These demonstrations, or coincident facts, may, perhaps, suffice to test the truth of the law, which appears to be similar in character to that governing the formation of land.

Metals and metallic ores would seem, then, most frequently, to have arranged themselves, particularly when diamagnetic, as a large majority of bodies are, in curves, equi-distant from some dynamic focus.

It is hoped the above generalization may aid the miner and mineralogist in their search after mineral wealth.

THE UNITY OF NATURE.

By the Duke of Argyll.

II.

Man is included in the Unity of Nature, in the first place, as regards the composition of his body. Out of the ordinary elements of the material world is that body made, and into those elements it is resolved again. With all its beauties of form and of expression, with all its marvels of structure and of function, there is nothing whatever in it except some few of the elementary substances which are common in the atmosphere and the soil. The four principal gases, with lime, potash, and a little iron, sodium, and phosphorus, these are the constituents of the human body —of these in different combinations—and, so far as we know, of nothing else. The same general composition, with here and there an ingredient less or more, prevails throughout the whole animal and vegetable world, and its elements are the commonest in the inorganic kingdom also. This may seem a rude, and it is certainly a rudimentary view of the relation which prevails between ourselves and the world around us. And yet it is the foundation, or at least one of the foundations, on which all other relations depend. It is because of the composition of our body, that the animals and plants around us are capable of ministering to our support—that the common air is to us the very breath of life, and that herbs and minerals in abundance have either poisoning properties or healing virtue. For both of these effects are alike the evidence of some relation to the organism they affect; and both are in different degrees so prevalent and pervading, that of very few things indeed can it be said that they are wholly inert upon us. Yet there is no substance of the thousands which in one manner or another affect the body, which does not so affect it by virtue of some relation which it bears to the elements of which that body is composed, or to the combinations into which those elements have been cast.

And here we ascend one step higher among the facts which include Man within the unities of Nature. For he is united with the world in which he moves, not only by the elements of which his body is composed, but also by the methods in which those elements are combined—the forces by which they are held together, and the principles of construction according to which they are built up into separate organs for the discharge of separate functions. Science has cast no light on the ultimate nature of Life. But whatever it be, it has evidently fundamental elements which are the same throughout the whole circle of the organic world; the same in their relations to the inorganic; the same in the powers by which are carried on the great functions of nutrition, of growth, of respiration, and reproduction. There are, indeed, infinitely varied modifications in the mechanism of the same organs to accommodate them to innumerably different modes by which different animals obtain their food, their oxygen, and their means of movement. Yet so evident is the unity which prevails throughout, that physiologists are compelled to recognise the fundamental facts of organic life as "the same, from the lowest animal inhabiting a stagnant pool up to the glorious mechanism of the human form." [1]

This language is not the expression of mere poetic fancy, nor is it founded on dim and vague analogies. It is founded on the most definite facts which can be ascertained of the ultimate phenomena of organic life, and it expresses the clearest conceptions that can be formed of its essential properties. The creature which naturalists call the Amœba, one of the lowest in the animal series, consists of nothing but an apparently simple and formless jelly. But simple and formless as it appears to be, this jelly exhibits all the wonder and mystery of that power which we know as Life. It is in virtue of that power that the dead or inorganic elements of which it is composed are held together in a special and delicate combination, which no other power can preserve in union, and which begins to dissolve the moment that power departs. And as in virtue of this power the constituent elements are held in a peculiar relation to each other, so in virtue of the same power does the combination possess peculiar relations with external things. It has the

[1] On the Nervous System, by Alex. Shaw. Appendix to Sir Charles Bell's "Anatomy of Expression."