II. *Note on the Electrical Relations of certain Metals and Metalliferous Minerals.*

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I HAVE ascertained that the crystallized grey oxide of manganese holds a much higher place in the electro-negative scale than any other body with which I have compared it, when immersed in various acids, and alkaline solutions; and the other metals and minerals which I have examined, appear to rank after it in the following order:

Manganese.
Rhodium.
Loadstone.
Platina.
Arsenical pyrites.
Plumbago.
Iron pyrites.
Arsenical cobalt.
Copper pyrites.
Purple copper.
Galena.
Standard gold.
Copper nickel.
Vitreous copper.
Silver.
Copper.
Pan brass.
Sheet iron.

These five hold nearly the same place, varying in their mutual relations according to the time of their remaining immersed, and the nature of the liquid.

The same may in some degree be said of the three other bodies included in the larger bracket.

I have also compared the action of different metalliferous combinations in various diluted acids, &c. on the needle of the galvanometer, and some of the results are given in the following Table, in which cases sea-water, and also muriatic acid diluted with thirty-two parts of water, were employed. The figures show the angles of deflection observed when the needle became stationary, which may serve to give some idea of the relative effect of the combinations in question on the needle; but I find that the results are often considerably modified by the bodies being exposed for a longer or shorter time to the action of the acids, &c.; indeed this is so remarkable in the case of copper with zinc, that the needle often moves back much more than ten degrees from its maximum angle of deflection in one or two minutes after immersion; whereas in the case of iron with zinc, for example, the immediate retrograde motion

of the needle is very inconsiderable, and it is still less, if anything, when some of the ores are substituted for one or both these metals. May not these phenomena depend on the relative degrees of tenacity with which the electric elements are retained by different bodies, it being apparently greatest in the case of compound bodies?

	Zinc.		Copper.		Iron.		Lead.	
	Sea Water.	Diluted Muriatic Acid.	Sea Water.	Diluted Muriatic Acid.	Sea Water.	Diluted Muriatic Acid.	Sea Water.	Diluted Muriatic Acid.
	°	°	°	°	°	°	°	°
Manganese* (crystallized)	56	60	35	45	52	54	50	56
Loadstone	41	58	21	29	33	48	32	47
Platina	21	46	1	5	21	23	15	21
Plumbago	52	56	23	31	45	45	42	45
Iron pyrites	34	38	7	8	20	29	20	19
Copper pyrites	49	57	36	31	43	44	45	43
Purple copper ore	44	45	14	10	33	40	32	38
Galena	47	50	19	27	36	41	37	37
Gold	26	38	11	14	14	30	25	24
Vitreous copper ore	42	51	16	24	17	25	24	32
Silver	56	59	22	21	47	45	44	42
Sheet copper	55	58	....	....	19	37	40	38
Pan brass	34	43	—	—	11	17	11	30
Sheet iron	36	46	—	—	....	....	—	—

If we regard the electrical relations of different metalliferous minerals in a geological point of view, it is curious to observe how nearly many of those which are usually associated in the same veins agree in this respect, their reciprocal voltaic action being generally very small. Were it otherwise, it may be assumed that the evidences of decomposition *in situ* would be much more decided and general than they now are. There is, however, a sufficiently strong action in some cases to account for the electro-magnetic phenomena which have been observed in copper and lead veins: thus, when copper pyrites and vitreous copper form a voltaic combination in water taken from a mine, or *even in spring water*, they are capable of producing considerable deflections of the needle. It is not, therefore, surprising, that when two parallel veins, or two portions of the same vein separated by imperfect conductors, are connected with the galvanometer, the action on the needle should be very decided. The degree of influence on the needle does not seem to depend, in the case of metalliferous minerals, upon extensive voltaic surfaces; for only *one or two inches of surface* may produce nearly the maximum effect in deflecting it, if the wire used in the galvanometer be small. Hence, the considerable deflection, which has been sometimes observed when two masses of ore were connected by the wires, proves that their reciprocal action, taken in the aggregate, must be very great; and it appears to be highly probable that the metalliferous veins, and perhaps even the rocks themselves, impregnated as they are with different mineral waters, and thereby rendered imperfect conductors, if not exciters of electricity, may have an important influence in the economy of nature.

* The contact of the wire with the manganese and other *minerals* was produced by pressure only, and the deflections would doubtless have been greater if the contact had been more perfect.

† I have ascertained that the electro-magnetic action of mineral veins was the same whether copper or zinc conductors were employed for making the contact with the ores.