IV.—CHEMISTRY.

ART. LI.—*On the Conducting Power of various Metallic Sulphides and Oxides for Electricity, as compared with that of Acids and Saline Solutions.* By WILLIAM SKEY, Analyst to the Geological Survey of New Zealand.*

[*Read before the Wellington Philosophical Society, 29th January,* 1871.]

IN papers read before this Society last year,† I showed that the metallic sulphides and arsenides generally were capable of exhibiting strong electro-motive power when paired either among themselves or with metals electrically negative to them, from which circumstance it appears that their capacity to conduct electricity is greater and more general than is at present contemplated for them.

It therefore became a matter of some interest to ascertain what are the exceptions to this general electric conductivity on the part of these minerals, and also to compare those which do conduct electricity with our best conducting solutions of acids or salts; the very low electric conductivity asssigned to even the best conductors among these ores in our most recent works on electricity, and the fact that they are all placed in these works (under one head ing, that of "ores") below the feeblest liquid saline conductors, when coupled with that of their general conductivity, made it especially desirable that a strict comparison should be instituted between the minerals and saline solutions referred to, in respect to their relative conducting power for electricity; and I have therefore attempted this in the manner below described.

I had hoped to furnish absolute results, but the time at my disposal, and my inability to possess myself of a sufficiently delicate resistance coil, has limited me for the present to seeking only after relative results.

The following is the method I employed:—

A voltaic cell of constant power was connected with a galvanometer, and this with platina wire electrodes of equal diameter, the free ends of which were ground plane, and fixed at a determinate distance from each other. In the case of testing liquids the wires were immersed in them to a uniform depth, and the indications, when they had attained constancy, were read off upon the galvanometer. In the case of solids the ends of the wires were firmly

* [This and the following Chemical Papers have been revised for the press by the Author.—ED.]

† See *Trans.* N. Z. Inst., Vol. III., p.p. 222 and 232.

placed on a flat surface of them, at the same distance from each other as before used.

When a solid had to be compared with a liquid the ends of the wires were allowed to be well under the surface of the latter, the same distance being maintained between the wires as before. It was afterwards found, however, that their immersion to a considerable depth did not materially affect the reading of the instrument.

In the annexed table the results of these experiments are embodied; those substances which have proved the best conductors by this process being placed superiorly. All the ores were selected for compactness and purity, and were mostly crystallized.

Mispickel	Binoxide of manganese
Galena	Iron pyrites
Sub-sulphide of copper	Nitric acid (concentrated)
Ferro-sulphide of copper	Per-chloride of iron (concentrated)
Proto-sulphide of iron	Sulphuric acid (concentrated)
Tin pyrites	Sulphuric acid (weak)
Nickel pyrites	Sea water
Sulphide of bismuth	Titanic iron
Magnetic iron ore	Boulangerite
Oxide of zinc	Hematite (impure)
Graphic tellurium	

The following minerals were proved to be non-conductors or comparative non-conductors :—Sulphides of molybdenum, zinc, antimony and manganese; cinnabar (red variety, cryst.), orpiment, bournonite (cryst.), proustite, pyrargyrite, silver glance, carbonate of iron (black variety, cryst.), chrome ore (cryst.), wolfram (cryst.), specular iron ore (cryst.), rutile, braunite, tin ore (cryst), leverite (cryst.), sub-oxide, and protoxide of copper, iserine, oxychloride of copper.

The table above given discloses the fact that a great number of our ores are superior in conducting power for electricity to the best liquid non-metallic conductors we are at present acquainted with; indeed, most of the minerals which fall in this class are by approximate admeasurements very far superior in this respect to such liquids.

I should state that all the minerals cited here are native ores.

All the ores of silver named above were found to be more or less antimonial, from which circumstance their refusal to conduct electricity may be due, as the pure sulphide, chemically prepared and fused, conducts very well. The effect of antimony in impairing conductive power is well exemplified in the case of bournonite and boulangerite, as compared with the non-antimonial lead ore, galena.

In the case of the silver ore, however, this variation may be due to a difference in molecular arrangement, as sulphide of mercury, though a non-conductor in the state of cinnabar (red variety), conducts freely when its precipitate is simply dried or sublimed, so long as it retains its dark colour.

Several other interesting questions are started by the knowledge of some of the facts above disclosed; for instance, the conducting power of native oxide of zinc for electricity is remarkable; the specimen tested, I may state, being nearly pure, and of a reddish colour. Possibly this circumstance (that of its conductivity) tends to show that it is rather a mixture of a higher oxide with the protoxide than a simple protoxide as now supposed.

Why some sulphides conduct so readily, and others do not conduct to any notable extent, is another most important question in physics, and one which the results above stated are too few in number and not sufficiently varied in kind to enable us to solve. I firmly believe, however, that when they are checked and largely added to by results of experiments upon larger mineralogical collections than the one to which I have had access, and especially upon minerals prepared chemically pure, and in different allotropic states, the question raised above, and others allied thereto, will receive their proper answers, and electrical science be enlarged.

I may state in conclusion that I have frequently found the testing of unknown ores in regard to their electric conductivity a very useful preliminary to their chemical investigation or analysis. It is a test easy of application, and does not of course necessitate breaking up or damaging them in any way.

ART. LII.—*On the Electro-motive and Electrolytic Phenomena developed by Gold and Platina in Solutions of the Alkaline Sulphides.* By W. SKEY, Analyst to the Geological Survey of New Zealand.

[*Read before the Wellington Philosophical Society, 29th January,* 1871.]

IN some former papers upon the absorption of sulphur by gold and platinum* I adduced evidence to show that this absorption was a chemical act; that a true chemical combination had been effected between the sulphur and the gold or platinum, as the case might be, the result being a sulphide of the metal used; and I stated that, so far as this evidence could be deemed worthy of acceptance, it impugned the correctness of the general belief that the absorption of certain gases by platinum was in every instance simply mechanical.

Irrespective, therefore, of the primary question raised, it became of some importance, upon general grounds, to obtain further and, if possible, decisive

* See *Trans.* N. Z. Inst., Vol. III., pp. 216 and 221.