

observed that the China Sea is, like the other seas enclosed by "festoons" of islands along the border of Asia, generally regarded as occupying a basin of relatively recent down-warping; and that the occurrence of several moderately drowned or imperfectly rimmed atolls in its waters suggest that the down-warping is still in progress; furthermore, these two points taken with the small relief of the summit surface of the Stewart Bank suggest that it is more probably a drowned reef which has been built on a submerged volcano than an upgrowing volcano which has never reached the sea surface. It may also be noted that the smaller depth found at the center of the bank than at its margin suggests that it is a submerged barrier reef, the central island within which had an altitude of about 800 feet over the reef when a more rapid subsidence set in, drowning the reef and eventually submerging its central island also; and hence that it is not a submerged atoll, like the larger, reef-rimmed Tizard and Macclesfield banks, which lie some distance to the southwest in the China Sea, and which have, respectively, diameters of thirty by ten miles with a central depth of forty-eight fathoms, and of seventy by thirty-five miles and sixty fathoms.¹

On the southeastward return from Hong Kong, the *Stewart* ran 135 miles south-southwest of Stewart Bank, and thus passed by intention close along the southwest side of Scarborough shoal, an imperfect atoll, eight miles in diameter, with a number of discontinuous reefs awash and a central lagoon; here the echo-soundings sufficed to indicate a steep submarine slope for the bank, previously undetermined.

It should be noted that no account is taken in the above records of the departure of the sounding echo from the vertical by reason of its being returned from a sloping bottom as a bank is approached and left behind; for although this refinement is made possible by the full use of the sonic depth finder, its application is seldom necessary, especially in reconnaissance work, because of the prevailing flatness of the ocean bottom. The errors thus introduced on such slopes as those Stewart Bank appears to possess are small, and of such a kind as to shift the contour lines a little outward, but by an amount hardly perceptible on the scale of the diagram here presented. Nevertheless, it would contribute to the scientific glory of the navy if the commander of one of the vessels equipped with a sonic depth finder should, on detecting a marked up-slope of the ocean floor indicative

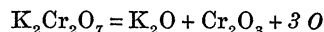
of a submerged cone or bank, thereupon so shape his course as to make a direct ascent of the steepest slope, and after passing over the highest summit of the bank, follow a direct descent down its farther side to full oceanic depth again, thus determining a diametrical profile; and then, turning 135° to one side and running 1.41 times the down-slope distance or semi-diameter from summit to full depth, turn again 135° and thus recross the summit, a fine feat of submarine mountaineering, whereby a second diametral profile would be determined at right angles to the first; thus defining the form of the bank with considerable accuracy. Such a maneuver is precisely what the sonic depth finder makes possible when its devices for determining the azimuth and dip of a returning echo from a slanting bottom are fully utilized. And let it be noted that when a bank is thus defined, the positions of the soundings on its several slopes *with relation to each other* will probably be better placed by dead reckoning from the center of the bank, aided by coincidence of close-placed summit soundings at the intersection of the crossing profiles, than would be possible if a second single line of soundings over the bank were later made independently by the same or by another vessel, the position of which would have to be determined absolutely by observation; for such a determination may depart from the similarly determined position of a first line of soundings by a mile or two; and that distance might be so large a fraction of the bank diameter as to introduce serious errors in the attempt to define its shape.

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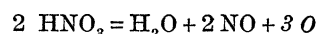
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ELECTRONATION¹

THE terms oxidation and reduction as applied to chemical reactions have come to mean much more than the simple addition or removal of oxygen or of hydrogen to or from a substance, although many chemists and most text-books of general chemistry still attempt to explain all oxidation-reduction phenomena in terms of these two elements. For example, it is assumed that when potassium dichromate acts as an oxidizing agent it decomposes as follows:



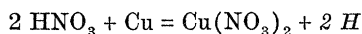
The oxygen which is liberated immediately reacts with the substance to be oxidized so that its presence is never actually detectable. Similarly, nitric acid is supposed to yield oxygen when it serves as an oxidizing agent:



¹ Read before the fifty-seventh annual meeting of the Kansas Academy of Science, Manhattan, Kansas, April 11, 1925.

¹ W. U. Moore and P. W. Bassett-Smith, "China Sea. . . Results of an examination . . . of Tizard and Macclesfield banks," Hydrog. Dept., Admiralty, London, 1889. P. W. Bassett-Smith, "Dredgings obtained on the Macclesfield bank," *ibid.*, 1893; also, "Report on the corals from Tizard and Macclesfield banks, China Sea," *Ann. Mag. Nat. Hist.*, vi, 1890, 353-374, 443-458.

Some text-book writers prefer to explain the oxidizing effect of nitric acid, on metals at least, in terms of "nascent" hydrogen:



The hydrogen which is formed reacts with some of the unchanged acid and reduces it to nitric oxide and water. Dhar has pointed out that the adherents of this explanation run into difficulty when they come to explain the oxidizing effects of nitric acid upon organic substances, where there would be no chance for the formation of "nascent" hydrogen.

There are many good arguments which have been presented against such a conception of oxidation and reduction processes. While in some few cases it may be possible that oxygen and hydrogen are formed and do actually serve as the oxidizing and reducing agents, in the majority of cases a study of the mechanism of the reaction does not warrant any such general interpretation. One of the most powerful arguments against this prevailing theory is that oxidation can take place in the absence of oxygen and that reduction can take place in the absence of hydrogen. One familiar case that the student of general chemistry will recall is that ferrous chloride can be oxidized to ferric chloride by free chlorine. Certainly there is no oxygen here and yet this is a type of reaction that all chemists agree is oxidation.

The authors have reported elsewhere the results of an investigation upon this same topic and have shown that typical oxidations can take place in liquid ammonia (a solvent containing no oxygen); for example, thallous ion may be oxidized electrolytically to thallic ion and hydrazobenzene may be oxidized to azobenzene, care being taken to choose an electrolyte that contains no oxygen. The last case is of interest in that hydrogen is removed from a compound, one of the definitions frequently used for oxidation. Similarly, it is possible to reduce substances in the absence of hydrogen. Thus in phosphoric oxychloride (a solvent containing no hydrogen) it is possible to electrolytically reduce ferric to ferrous ion and iodate ion to free iodine, the electrolyte being so chosen that it contained no hydrogen. It follows from such experimental proof that the explanation of oxidation and reduction in terms of oxygen and hydrogen is untenable, but possibly as long as the term oxidation is used it will be impossible for the student to get away from the idea that oxygen is necessarily involved.

Other terms have been suggested to cover the general phenomena of oxidation; Richards some years ago suggested the word "perduction" and somewhat later Getman suggested the word "adduction"; the term reduction was to be retained. An examination

of the literature and of the text-books of general chemistry fail to show their adoption. Within the last few years Franklin has shown that reactions similar to oxidation and reduction take place in liquid ammonia. These are similar to the change that we have cited in this solvent, *i.e.*, the conversion of hydrazobenzene to azobenzene. Franklin calls changes of this type "nitridations." For example, hydrazoic acid, HN_3 , is a nitric acid of the ammonia system of compounds and as such serves as a nitridizing agent.

Obviously, a multitude of words could be coined to cover analogous processes in other solvents or with various reagents; for example, "sulfidation," "carbination," "cyanation," and so on. Still other terms as chlorination and bromination have been in use for many years. As these processes are but separate cases of a general phenomenon we have thought best to propose a new word for the general process.

In casting about for a word suitable for this general phenomenon we finally decided upon the word *electronation*. Our reasons for this are as follows:

(1) At the present time the electron theory is exceedingly popular in explaining such topics as electrolytic conduction, the structure of atoms and the mechanism of organic reactions. On account of this popularity it should not be difficult to introduce the term into the literature and the text-books.

(2) There already exist in many text-books of general chemistry a definition of oxidation and reduction in terms of electrons. This definition has the advantage of being the shortest and most concise definition of the process of any yet offered. To state it in terms of our word, "*Electronation is the addition of an electron (or electrons) to an element; de-electronation is the removal of an electron (or electrons) from an element.*" The first of these processes will be seen to be equivalent to that now known as reduction and the second is equivalent to that now known as oxidation. It can be seen that the words admit readily of forming the corresponding verbs.

(3) By using these terms the explanation of the phenomenon is freed entirely from any assumption that oxygen and hydrogen are involved, an assumption which we have pointed out is very common and quite erroneous. To our minds this is one of the chief advantages of the word.

The greatest objection that can be brought against the word is that it conveys a negative idea to one accustomed to the terms oxidation and reduction. If the term is generally adopted, however, this objection would soon disappear.

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