***FACTORS AFFECTING CORROSION***

1. At normal temperatures iron will not corrode appreciably in the absence of moisture.
2. The presence of oxygen is also essential for corrosion to take place in ordinary water. Oxygen alone will cause considerable corrosion in acid, neutral, or slightly alkaline water. In natural waters, the rate of corrosion is almost directly proportional to oxygen concentration, if other factors do not change. Oxygen also accelerates the corrosion of iron in non-oxidizing acid solutions of moderate strength.
3. Corrosion in acid solutions is much more rapid than in neutral solutions, and the latter is more rapid than in alkaline solutions.
4. Hydrogen gas is usually evolved from the surface of the metal during corrosion in acid solutions and in concentrated solutions of alkalies; in nearly neutral solutions the evolution is usually very much less and may not be appreciable.
5. The products of corrosion consist, mainly, of black or green ferrous hydroxide next to the metal, and reddish-brown ferric hydroxide (rust) which forms the outer layer, with graded mixtures of the two in between. When iron corrodes in the atmosphere the amount of ferrous rust produced is small, but when formed under water the corrosion products often contain a large proportion of ferrous iron.
6. In natural water, the precipitated rust usually carries down some compounds containing lime, magnesia, and silica, together with other insoluble material from the water. These substances have considerable influence on the structure and density of the rust coating on the metal surface.' A loose, non-adherent coating under ordinary conditions may accelerate locally the rate of corrosion; a uniformly dense and adherent coating may cut down this rate very considerably.
7. Surface films, sometimes invisible, often play an important part in controlling the rate and distribution of corrosion. These films have been made visible by separation from some metals and have been shown to raise the potential of these metals making them more resistant in certain environments. In fact the superior resistance of metals like chromium and aluminum, for example, is undoubtedly due largely to the formation of such films.
8. In most cases the initial rate of corrosion is much greater than the rate after a short period of time. This is particularly noticeable in film-forming solutions, such as the alkalies or chromates. It should be noted, however, that the initial rate of corrosion of a highly polished metal surface is abnormally low.
9. Corrosion at normal temperature increases with increase of concentration in dilute solutions of many neutral salts, particularly chlorides, but decreases again in more concentrated solutions, other things being equal.
10. In natural waters the rate of corrosion generally tends to increase with increase in the velocity of motion of the water over the metal surface, with some exceptions where the film-forming tendency predominates.
11. Dissimilarity in the chemical composition of metals in contact with each other in an electrically conducting solution sets up a difference in potential (precisely as in the galvanic cell) and thus accelerates corrosion locally. In corroding metals these variations in potential are found between a metal and other reactive materials, or between different metals in contact. This action is accompanied by an electric current which flows through the solution from anode to cathode, i.e. from the more corrodible to the less corrodible metal in this particular solution
12. Composition of ordinary iron or steel, within the common variations found commercially, has little effect on corrosion underwater or underground, but sometimes it has a marked effect in atmospheric and acid corrosion. From the standpoint of corrosion, homogeneity of a metal is not usually so important as external conditions.
13. The condition of the metal surface in submerged corrosion may not affect the total corrosion, although it may have a marked tendency to localize the action. Corrosion of iron is rarely uniform over its entire surface.
14. Variation in the composition or concentration of a solution in contact with a metal tends to localize corrosion at certain areas and retard the action at other areas of the surface. A portion of the metal surface which is protected from diffusion of oxygen inward becomes anodic to other areas which are in contact with a solution richer in oxygen, i.e. corrosion is more active at such protected areas.
15. The smaller the anodic areas in relation to the associated cathodic areas, the greater is the rate of penetration of corrosion at the anodic points. The polarity of a certain area often reverses during the progress of natural corrosion.

In any discussion of the mechanism of a chemical reaction it is advisable to separate the factors which determine the tendency or driving force of the reaction to proceed from those which influence the rate of the reaction made possible by the existence of this tendency. This tendency is an expression of the fact that the system is not in a state of equilibrium (or inherent stability); it is measured by the difference in energy between the initial and final state of the system for any particular case. In most cases the observed rate is determined not by the absolute magnitude of this tendency but by other factors, which depend primarily upon the environment.

In considering the group of three typical reactions involved in corrosion, we shall denote as primary factors those which determine the tendency of the metal to corrode and thus influence its initial rate of solution and as secondary factors those which influence the rate of the subsequent reactions. This term in no wise implies that these secondary factors are of lesser importance; in fact, by influencing the nature and distribution of the final corrosion products, they usually determine the ultimate rate of corrosion, and the useful life of the metal, in each environment.