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# Rusting, enemy of iron steel

A great leap forward in the process of civilization was surely the discovery of iron says **S.Ananthanarayanan.**

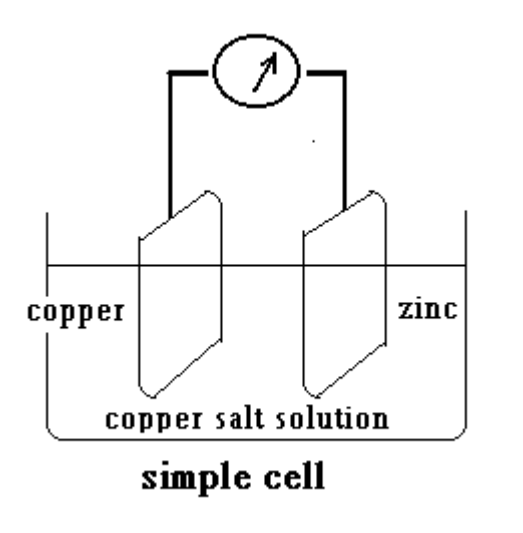
And ever since, mankind has been concerned with how to save this now ubiquitous material from degrading by rust.

**What is rusting?**

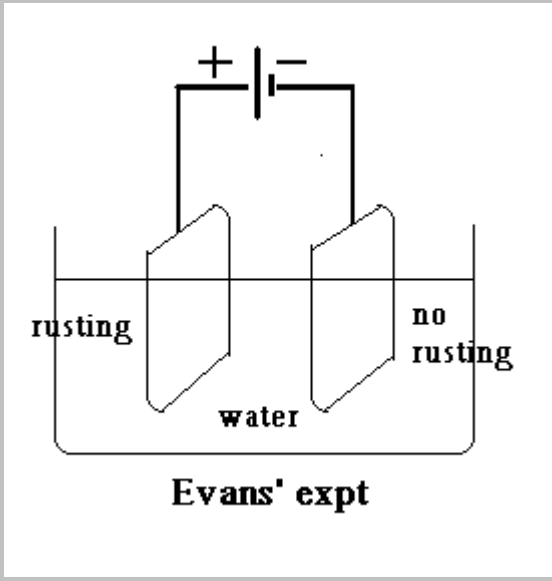
Rusting is the forming of the oxide of iron, when iron combines with oxygen, but which takes place in the presence of water. Thus, iron will not rust in boiled water, where the oxygen has been driven out and is safe in air that is dry, as in deserts. But corrosion and rusting are most serious in salty, seawater, as ship owners know to their cost!

**The role of water**

A scientist called Evans found that rusting is in fact an electric cell in action.



simple cell



Evans' expt

A simple electric cell is a plate of zinc and another of copper, connected by a wire and dipped in the solution of a copper salt. The zinc is more ‘electronegative’ than copper and it goes into the solution, to push copper atoms out of the solution and on to the copper plate. This leaves behind a negative charge, which flows though the wire to the copper plate, to neutralize the copper ions that collect there! Dry cells, which use carbon and zinc, or car batteries, which use pairs of zinc plates, use the same principle.

Evans' experiment was to dip two iron plates in water and to pass a current. It was found that the positive end rapidly rusted, by combining with oxygen from the water, which was released by passing the current.

**Electric cell in a drop of water**

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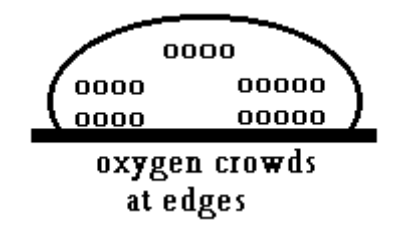
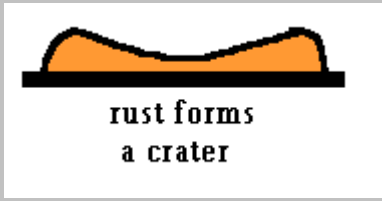
Within a little drop, unlike in a large mass of water, all parts are in close proximity of the surface. An effect of this is that the dissolved oxygen atoms, which are negative ions, really, 'repel' each other in the middle of the drop and distribute themselves towards the edges!

If a drop of water now rested upon a piece of iron, the iron at the edges is near more negative oxygen ions than the iron in the middle This makes negative charges flow from the edges to the middle, and the edges rust, while the center is safe!

You could see that the rust that forms under a drop of water is pitted, being raised at the edges, like a crater!




**Salt helps the current flow**

When we see that electricity plays a role in rusting, it is evident that adding acid, or salt, or anything that makes water a better conductor would speed up rusting! This is important to people who save iron from rusting by 'treating' water not to be too good a conductor!

**Protection from rust**

But the best protection is to keep the water away, with paint or coating with a rustproof metal, like chromium. When such a coating is scratched, the iron below and the sides of the scratch act like a little electric cell and the scratch is quickly filled with rust! Yes, in thin scratches, rust can protect from more rusting.

**Stainless steel is rust-proof**

Stainless steel is an alloy of iron, chromium, manganese, silicon and some other metals. These elements react with oxygen from water and air to form a very thin, stable film of corrosion products. The film acts like a coat of paint, just a few atoms thick and it forms very fast, with very little 'corrosive' loss of body.