

the theory of the distribution of destructive corrosion in orthopaedic screws is in course of preparation.

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<sup>1</sup> Bowden, F. P., Williamson, J. B. P., and Laing, P. G., *Nature*, **173**, 520 (1954).

It may be useful to describe in a little more detail the nature of the welded particles of metal which are transferred from one surface to the other. Fig. 1 shows two taper sections, taken by Dr. A. J. W. Moore, illustrating typical fragments of copper which were welded on to a mild steel surface after the copper had slid over it once. There is evidence that, with most metals, the particles penetrate the oxide layer and adhere to the underlying metal. Since the resistance to corrosion of a stainless steel is due to the protection of its superficial oxide layer, the dissolution of these embedded foreign fragments, if they are anodic, may lead to a serious breakdown of the oxide layer and to the onset of continuing corrosion. If the adherent particles are cathodic (with these stainless steels the relative electrode potential is very dependent on the extent to which the oxide layer is disturbed and also on the surrounding medium; see, for example, Evans<sup>1</sup>) continuing corrosion may again result. It would be unwise to assume that the transfer of 65  $\mu\text{m}$ . of material, anodic or cathodic, to the screw head would allow the corrosive dissolution of only 65  $\mu\text{m}$ . from the head.

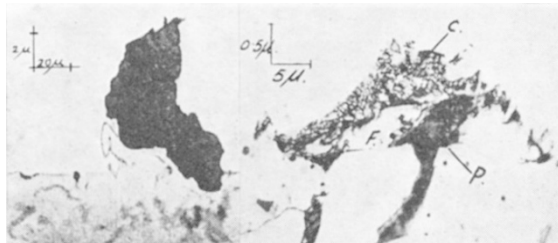


Fig. 1. Taper section photographs illustrating adherent metal fragments of copper (dark) on to steel. Note the rupture and penetration of the steel surface. C, copper; F, ferrite; P, pearlite

The particular screws and plates associated with the tissue reaction described in our article did not show any signs of gross destructive corrosion. It is well known that the corrosion can be influenced by a mechanical deformation of the surface, by differential aeration, by fretting corrosion and by changes in the pH value of the medium caused by sepsis. The relative importance of the different factors has been discussed by a number of workers.

Our experiments have indicated that there is another factor which should be considered—the transfer of metal from the tools. The presence of these adherent fragments of foreign metal is a possible cause of the observed tissue reaction adjacent to the regions handled, and the experiments suggest that attention should be given not only to the buried metals but also to the tools used to insert them.

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<sup>1</sup> Evans, U. R., "Metallic Corrosion, Passivity and Protection" (Arnold, 1946).

In our article we were not discussing heavy localized destructive corrosion and superficial tarnishing of orthopaedic components, since these are rarely found except when non-identical metals have been inserted or when sepsis has occurred. In all the cases we have examined there was no obvious sign of corrosion, but examination of the biopsy specimens showed that cellular reaction and iron infiltration had occurred in the tissue adjacent to the buried metals. This reaction is greatest near the screw and bolt heads, which have been handled by tools, and least near unhandled regions of the metal. It occurs in the absence of any concentrated destructive corrosion in the region of contact between the two components or between metal and bone.

The mechanical rigidity of the fixation will inevitably be destroyed within a month by the loosening of the screws in the bone. Evidence suggests that this is due, not to corrosion of the metal but to bone absorption caused by the pressure of the screw. Such absorption is known to be produced in other circumstances where no corrosion is possible, for example, where pressure is exerted by a locally enlarged artery.

The physical experiments have shown that localized transfer of a different metal can occur. Since this is a potential source of corrosion and of cellular reaction it is very important, from the surgical point of view, that it should receive due attention and, if possible, be avoided until our understanding of these physiological processes is more complete.

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### Structure of Cobalt Complexes with Salicylideneanilines

THE structures of cobalt inner complexes with salicylideneanilines have not been determined, whereas the planar form of copper complexes of this type has been established beyond doubt by the isolation of *cis* and *trans* isomers<sup>1</sup> and by X-ray investigation<sup>2</sup>. A difference in reactivity has now been observed between copper and cobalt ions with various salicylideneaniline bases which suggests a tetrahedral structure for the cobalt complexes. Attempts have been made to prepare complexes of the type *bis*-(salicylideneaniline)cobalt with bases containing aromatic amines bearing substituents in the *ortho*, *meta* and *para* positions. The compounds prepared are tabulated below together with the corresponding copper complexes previously prepared<sup>3</sup>.

The method of preparation has already been outlined<sup>4</sup>. It appears that cobalt shows a reluctance to form complexes with bases bearing bulky *ortho* substituents in the aniline ring, whereas copper forms complexes easily with *ortho*-, *meta*- or *para*-substituted amines. The one exception has been the *o*-anisidine cobalt complex. For those cases where cobalt failed to give the expected product, dark red

Amine component	Cu			Co		
	<i>o</i> -	<i>m</i> -	<i>p</i> -	<i>o</i> -	<i>m</i> -	<i>p</i> -
Toluidine	+	+	+	-	+	+
Chloroaniline	+*	+	+	-	+	+
Anisidine	+	+	+	+	-	+
Nitroaniline	+	+	+	-	-	+
	$\alpha^-$	$\beta^-$		$\alpha^-$	$\beta^-$	
Naphthylamine	+	+		-	+	

\* Prepared by the author.

+ Complex of expected type isolated.  
- Complex of expected type not isolated.