UNUSUAL CASE OF INTRA-OCULAR FOREIGN BODY*

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It may not be generally realized that the magnetic properties of certain types of steel differ considerably from those of ordinary carbon steel and that these magnetic properties may alter under certain circumstances.

Case Report

A patient who recently came under my care had been struck in the right eye by a foreign body whilst hammering a piece of steel with hammer and cold chisel. A diagnosis of intra-ocular foreign body was made, there being a small entrance wound in the centre of the cornea and an opaque lens. This diagnosis was confirmed by *x* ray. The foreign body, measuring about $3\frac{1}{2} \times 1 \times 1$ mm. was located in the posterior segment of the globe. Operation was performed on the same day (that following the injury) and an attempt was made to remove the foreign body by the posterior route. This attempt was unsuccessful, much to my surprise, as the foreign body was a large one and should have come out easily. I had originally been told both by the patient, and by his employer that the foreign body had come from the metal which he was working and not from his chisel or hammer, but I was inclined to view this with some scepticism as it is generally found that the foreign body is provided by the workman's tool rather than by the metal being worked.

After this failure to remove the foreign body I decided to investigate the matter further. Unfortunately the eye became infected and had to be removed about a week later. The foreign body was retrieved from the posterior segment where it was lying almost up against the disk, with one end in fairly close proximity to the operation wound.

The foreign body was sent to the laboratory at the factory where the patient worked, and was found to be a piece of austenitic steel of the type on which he was working at the time of the accident. It did not come from the hammer or chisel. Austenitic steels, of which stainless steel is an example, are non-magnetic in the normal state, but acquire slight magnetic properties on being cold worked—chipping with a chisel is an example of such cold working. These steels are used in industry for their heat-, scaling-, and rust-resisting properties. Fig. 1 shows the fragment of austenitic steel actually removed from this patient's eye; Fig. 2 shows fragments obtained by chipping with hammer and chisel.

Investigation

The magnetic properties of this piece of steel were compared with those of a piece of ordinary carbon steel of similar size.

Specimens

- (i) Chipping removed from the patient's eye in hospital.
- (ii) Chipping taken from a piece of spring steel.

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FIG. 1.—Steel fragment removed from patient's eye. $\times 10$.

FIG. 2.—Steel fragments obtained by chipping with hammer and chisel. $\times 3\frac{1}{2}$.

Method of Comparison.—The chipping was suspended by a light thread from one side of a balance beam. A coil with a soft iron pole piece, was interposed between the chipping and the balance pan. Weights were added to the other balance pan and the air gap between the chipping and the soft iron pole piece adjusted to a fixed distance which was kept constant during the experiment. The current to the coil was switched on and increased until the attraction between the chipping and the iron pole piece was sufficient to overcome the “ off balance ” caused by the weights on the other pan. The experiment was repeated, more weights being added to the balance pan and the current being increased until attraction (indicated by the swing-over of the balance) took place. The experiment was repeated until a stage was reached when further increases in current did not result in greater weights being overcome by the magnetic attraction. It was then assumed that the chipping was magnetically saturated. The current and the maximum attraction in milligrammes was recorded.

Points investigated	Type of Steel Chipping	
	Stainless	Carbon
Mass of chipping	0.023 g.	0.023 g.
Weight required to “ off balance ” weight of chipping plus thread to extreme left	0.070 g.	0.070 g.
Maximum weight overcome by magnetic attraction	0.159 g.	2.75 g.
Air gap between pole piece and chipping	0.081”	0.081”
Current	0.38 amps	0.38 amps
No. of turns on coil	4730	4730

The experiment was now repeated with the carbon steel chipping under identical conditions, using the same air gap between pole piece and chipping, and the same coil and current. It was ascertained in the same way as before that the current was sufficiently high to cause magnetic saturation of the chipping.

Observations.—Since both specimens were of equal mass and similar shape, and were both tested at an equal distance from the same coil carrying the same current, under conditions whereby both specimens were magnetically saturated, a direct comparator (in milligrammes) of their magnetic properties was possible. Moreover the general conditions of the experiment were similar to those which would prevail in the extraction of a metallic splinter from the eye in an Ophthalmic Department.

Type of Steel Chipping						Maximum Attraction	
Stainless ...	...	...	...	...	...	0.159	— 0.070 = 0.089 g.
Carbon ...	...	...	...	...	...	2.75	— 0.070 = 2.68 g.

$$\text{Ratio of carbon steel to stainless steel} = \frac{2.68}{0.089} = 30.1.$$

It would thus appear that, other factors being equal, to remove a piece of stainless steel embedded in the cornea or within the globe might require mechanical force thirty times greater than that required for removal of a fragment of carbon steel identical in size.