TWO REMARKABLE EVENTS IN THE FIELD OF INTRAOCULAR FOREIGN BODY: (1) THE REVERSAL OF SIDEROSIS BULBI (2) THE SPONTANEOUS EXTRUSION OF AN INTRAOCULAR COPPER FOREIGN BODY

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IN SPITE OF THE LARGE NUMBER OF PAPERS ON THIS SUBJECT, IT MUST BE REMEMBERED THAT THE OCCURRENCE OF AN INTRAOCULAR FOREIGN BODY AS AN OPHTHALMIC ENTITY IS UNUSUAL WHEN VIEWED IN RELATION TO OPHTHALMIC PROBLEMS IN THE POPULATION AS A WHOLE; YET IN HIGHLY INDUSTRIALIZED AREAS OF THE WORLD, ITS RECOGNITION IS COMMONPLACE. MUCH OF OUR INFORMATION CONCERNING THIS TYPE OF INJURY IS TO BE FOUND IN THE BRITISH LITERATURE IN THE EXCELLENT REVIEWS BY CRIDLAND,² ROPER-HALL,³ AND PERCIVAL.⁴ IN THIS COUNTRY, OUR OWN HARVEY THORPE IS CONSIDERED THE "DEAN OF THE FOREIGN BODY" AND HAS PUBLISHED ARTICLES ON THIS SUBJECT SINCE THE EARLY 1930'S.⁵

TO SUMMARIZE THE GENERAL SUBJECT, WE MAY STATE THAT THE MAJORITY OF INTRAOCULAR FOREIGN BODIES ARE METALLIC AND MAGNETIC, THAT MANY NON-MAGNETIC FOREIGN BODIES CONTAIN COPPER, AND THAT THE AIR PELLET GUN IS MAKING ITS PRESENCE KNOWN AS A CAUSE OF INTRAOCULAR FOREIGN BODY. THE MOST COMMON CAUSE OF THE INTRAOCULAR FOREIGN BODY IS STILL THE HAND-WIELDED HAMMER AND CHISEL.

IN SPITE OF THE VAST LITERATURE ON THIS SUBJECT, THE PRESENT REPORT DEALS WITH TWO UNUSUAL EVENTS STEMMING FROM INTRAOCULAR FOREIGN BODIES.
which, although reported in the literature, are generally unknown to the ophthalmologist. Since reports of both situations were presented at the American Ophthalmological Society in the remote past, it is of interest to revisit these subjects, provide photographic documentation, and to once again re-emphasize the old adage that there is really nothing new in medicine.

SIDEROSIS BULBI WITH DILATED INACTIVE PUPIL. RECOVERY AFTER REMOVAL OF FOREIGN BODY

In 1923, at the American Ophthalmological Society, Dr Nelson M. Black of Milwaukee, Wisconsin, was introduced by the president, Dr William Holland Wilmer, to present his paper on Siderosis Bulbi with Dilated Inactive Pupil. Recovery. It is perhaps of only historical interest that Dr Wilmer introduced the speaker, yet I mention it today since this year marks the Wilmer Institute's 50th anniversary and our present president, Dr Elliott Randolph, is one of our Institute's finest products.

In Black's report, a 22-year-old white male reported that he had recently noted, while shaving, that his left pupil was dilated. On testing his vision, he found that his acuity in the left eye was reduced. This recalled to his mind that six months previously something had struck him in the left eye while he was using a hammer and punch. Because of pain and slight bleeding, he had reported to the hospital where his left eye was dressed. No evidence of significant injury or foreign body was noted, so he was sent home. Following this, he had experienced no difficulty until the present observation. On examination, the right eye was normal with a light, blue-gray iris, while the left iris appeared yellowish-gray with an immobile 7 mm pupil. The vision in the left eye was reduced to 6/10. A foreign body was found by roentgenography and removed with a magnet. Two weeks later, he was noted to have a retinal detachment. It is of historic interest that he was admitted to the hospital for treatment of his detachment. The treatment consisted of “rest in bed, compress, bandage, atropine, dionin, and pilocarpine sweats.” In spite of persistence of his detachment, his pupils and iris color were equal in the two eyes three months later.

When Black presented his case, a review of the literature revealed that mydriasis with intraocular foreign body was not generally recognized; although reports by Clegg, Vossius, and others did report this phenomenon. It is of note that Dr William M. Sweet (of Sweet localization fame) stated, “I do not recall ever having seen a reference to a similar case,” yet a year later he too was able to report on such a phenomenon.
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Von Graefe,\textsuperscript{11} in 1860, was the first to call attention to the discoloration of the tissue of the eye from retained metallic particles; and Bunge,\textsuperscript{12} in 1890, was the first to apply the name, \textit{siderosis bulbi}. In 1908 de Schweinitz\textsuperscript{13} reported a case where the iris discoloration and wreath of yellowish-brown spots beneath the lens capsule disappeared following removal of the foreign body, but there was no reference to the state of the pupil.

Since Black's classic presentation, occasional reports have occurred in the literature. Thus, in 1940, at the Colorado Ophthalmological Society, Danielson and Long\textsuperscript{14} reported three cases of delayed removal of intraocular steel in which the only definite sign of siderosis was a dilated pupil. After removal of the foreign body, the pupils returned to normal. Unfortunately, in their report they do not mention the color of the iris.

The case report today, photographically demonstrates the sign which led to the diagnosis of an unsuspected intraocular foreign body — a dilated inactive pupil with siderosis iridis — and further documents the clinical reversal of these findings following removal of the foreign body. To my knowledge, this is the first photographic documentation of such a train of events, although its recognition dates back for more than fifty years.

\textbf{CASE REPORT}

The patient was a 17-year-old white male seen in the Retina Clinic on February 27, 1969, complaining of a dilated left pupil. The patient was unaware of any problem until his brother commented on the state of his pupil. On questioning, the patient recalled that five months previously he was using a hammer and chisel, when a piece of the chisel broke off and struck him in the left eye. The eye stung for a while, but because his vision was unaffected and there was no obvious evidence of injury, he promptly forgot about the episode. On examination, the visual acuity was 20/15 in each eye. The right eye showed a blue iris and the pupil was normal in its reaction (Figure 1A). The left eye showed a dilated pupil and the iris was green in color (Figure 1B). The pupil did not react to light or accommodation. There was a small scar in the cornea at the limbus at the 3:30 position, and an underlying hole in the iris was evident. The lens was clear and there was no anterior chamber reaction. Indirect ophthalmoscopy of the left fundus was possible without mydriatic drops, and there appeared to be a metallic foreign body overlying the retina at 3:30 position near the equator. Beneath it there was a halo of altered pigmentation in the retina and pigment epithelium (Figure 2). An ERG showed a subnormal response. On March 18, 1969, the foreign body was removed by the posterior route with a magnet. Cryotherapy and a silicone sponge buckle were placed over the removal site. Two months later, the pupil was smaller and reacted to light. Five months postoperatively
FIGURE 1
Appearance of iris and pupils on presentation to the Retina Clinic for examination.  
A. Right eye shows normal blue iris and normal pupil.  
B. Left eye shows green iris, dilated inactive pupil, and hole in the iris at 3:30 position.
the pupil reacted normally and the iris was almost equal in color to the fellow eye. Nine months postoperatively, in December of 1969, the pupils were equal and the left iris was the same blue as the right iris (Figure 3). The vision was 20/15. One year following removal of the foreign body, the patient developed a retinal detachment, which was successfully operated upon. Six years postoperatively, the vision in each eye was 20/15 and the irides were equal in color and reaction.

THE SPONTANEOUS EXTRUSION OF AN INTRAOCULAR COPPER FOREIGN BODY

The migration of an intraocular foreign body within the eye, with or without its eventual spontaneous extrusion, presents still another feature of the unusual behavior of foreign bodies. This phenomenon may occur with all types of foreign bodies, although according to Tulloh two thirds of those which migrate contain copper. Apparently, deCastelnau in 1842

FIGURE 2
Intraocular foreign body lying just over the retina. Note the halo of altered pigmentation in the retina and pigment epithelium.
Photograph of both eyes shows return of left iris to normal color and pupillary function nine months after removal of intraocular iron foreign body.

reported the first case of spontaneous expulsion of a foreign body. This foreign body was iron. Our own Charles Kipp reported the spontaneous expulsion through the cornea of a large piece of copper foreign body in a blind eye in 1884, and mentions this and an additional case before our society in 1901. Goldsmith in his survey of the foreign body literature was especially interested in the spontaneous migration and extrusion of foreign bodies and presents an excellent review of the literature.1

CASE REPORT

The patient was an 11-year-old white male who was admitted to the Wilmer Institute on January 21, 1969, following a blasting cap explosion. The background to his injury is of interest. In the spring of 1967, the boy spent a day at a Boy Scout camp in Pennsylvania where he noted a display board of blasting caps (Figure 4) in the office of the camp ranger. This was used as a safety demonstration and since similar blasting caps were frequently found on the property, they were deposited in the ranger’s office. The boy picked up one of these extras and thinking it was a “dummy” like the ones on the display board, he brought it home to Maryland and dropped it in his “junk drawer” where it lay for two years. On the morning of January 21, 1969, while rummaging in his drawer, the cap fell onto the floor; but because he was late for school, he did not retrieve it. After school he walked into his room, which had an artificial fiber rug, turned on the television and pulled off his sweater over his head. He heard something
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Figure 4
Display board of various types of blasting caps prepared by the explosives industry for safety education. The copper cap on the extreme right is similar to that involved in the present report.

Hissing and turned toward the noise as the blasting cap exploded into hundreds of pieces of brass shrapnel.

On admission, vision in the right eye was light perception and vision in the left eye was 20/400. There was multiple fragment injuries to the body, a large corneal laceration of the right eye, and a small scleral perforation site below the limbus of the left eye at 6 o’clock position. The patient was taken to the operating room where under general anesthesia the large tulip-shaped laceration of the right cornea and the small scleral laceration in the left eye were repaired. The right fundus could not be visualized, but the left eye appeared to have two foreign bodies in the posterior vitreous. His postoperative course was uneventful, and he was discharged 18 days later on February 8, 1969. Discharge examination showed the vision of the right eye to be hand motions at one foot. The anterior chamber was formed, there was blood in the pupillary space, and the lens appeared to be disrupted. The left eye had a vision of 20/50. There were several copper fragments in the anterior corneal stroma. The scleral laceration near the limbus at the 6 o’clock position was well closed. The lens was clear and the anterior chamber showed a trace of flare without cells. The left fundus was well visualized,
Fundus drawing of left eye shows copper foreign body lying in the vitreous inferiorly. and there was a metallic foreign body in the posterior vitreous overlying the optic disc. The nature of the foreign bodies was determined from samples from the patient’s clothing and skin and found to contain 83.1% copper and 10.6% zinc. Throughout the remainder of 1969, the patient did well. The right eye became quiet, the vision was light perception, and there was a dense corneal scar with secluded pupil and adherent leukoma. The vision of the left eye returned to 20/20, although the foreign body continued to be visualized posteriorly over the optic disc. In January of 1970, or one year after the injury, he gradually developed chalcosis in the left eye with a sunflower cataract, vitreous reaction, and a posterior vitreous detachment. The foreign body was observed to have dropped inferiorly in the vitreous and now lay over the ora serrata at 6 o’clock position. Throughout this period, he was followed by Dr Ralph Rosenthal, first at Wilmer and then at Walter Reed Army Medical Center. On January 5, 1970, the patient
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External photograph shows extruded foreign body lying under the conjunctiva near the limbus at 7 o'clock position. Note shrunken lens leaving clear aphakic pupillary space.

was admitted to Walter Reed and was started on penicillamine therapy, 250 mg four times a day and pyridoxine 50 mg daily. He was discharged on January 20, 1970, and his visual acuity remained 20/25 in the left eye. He soon developed leukopenia, however, and the penicillamine was discontinued.

The patient was referred to the Retina Service on February 14, 1970, thirteen months post injury, for evaluation. The right eye was quiet with a healed corneal scar and adherent leukoma. The left eye had 20/20 vision. There were several corneal foreign bodies as previously described. The left pupil dilated well and there was a classical sunflower cataract. The vitreous showed cells and greenish strands. The retina appeared to be normal. There was a free-floating, golden-hued foreign body near the ora at the 6 o'clock position. It was thought best not to attempt to remove the foreign body. In June of 1970, the vision was still 20/20, although the lens was partially dislocated inferiorly. By September, 1970, (20 months after injury) the patient noted decreasing vision. Since his last visit he had had an episode of inflammation in the left eye treated with steroid drops. His vision had dropped to 20/50 and his cataract was increasing. One month later his vision was 3/200 and his lens had become quite opaque. However, his lens appeared to be shrinking, and with pupillary dilatation there was a clear aphakic area inferiorly through which he could see 20/40 with a +11.00 lens. The foreign body could still be visualized inferiorly (Figure 5). He was placed
on a regimen of dilating drops and he wore an aphakic correction. The lens continued to mature and shrink in the pupillary area. On August 31, 1971, some 32 months after his injury, it was noted that the foreign body could no longer be visualized. In September, 1972, the patient was given a contact lens and his vision was 20/40 with the aid of mydriatic drops. He did well until September of 1973, when he was struck in the left eye by a finger while in a wrestling match. The next day his eye was swollen shut, but he received steroid drops from a local physician and gradually improved. When seen on January 30, 1974, (five years after injury), he felt his vision had decreased slightly. Examination revealed an acuity of 20/40. The cornea appeared slightly hazy. There was an aqueous flare and some cells in the anterior chamber. There appeared to be a foreign body lying in the episclera at the 7 o'clock position near the limbus (Figure 6). His intraocular pressure was 14/5.5 Schiötz. He was given Decadron drops and his ocular inflammation quieted. On July 23, 1974, under local anesthesia, the foreign body was removed and found to be metallic and brownish in color. It measured $2 \times .5 \times 25$ mm. The foreign body was submitted to the Department of Biophysics and analyzed by Dr Roberto Poljak by x-ray diffraction and identified as cuprous oxide (Figure 7).

Since this time the patient has done well. The eye is quiet and his most recent visual acuity is 20/25 with aphakic correction. He still uses mydriatic drops on occasion.
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DISCUSSION

The first case illustrates the phenomenon of an occult intraocular iron foreign body. The incidence of such cases must be rare, yet its recognition is of paramount importance, since removal of the foreign body may reverse the clinical picture of siderosis bulbi and permit the long term retention of a functioning eye. Since most foreign bodies are metallic and iron-containing, the picture of siderosis is a primary clue to the presence of such an event. Thus the eye becomes stained from the iron pigment and this is most obvious in the iris. According to Wise, the iron is released from the metallic foreign body as free ions which may become loosely bound to the acid mucopolysaccharides (AMPS) in the eye. These ions or complexes diffuse throughout the eye to become bound to the enzymes of cells. A particular cell may either detoxify and store the ions or, if sufficient intracellular enzymes are destroyed, the cell may degenerate and die, releasing the iron pigment which is picked up by macrophages. There is great epithelial affinity for the iron deposition; thus, retinal ganglion cells, retinal pigment epithelium, the iris muscles, and the epithelium of the lens are especially susceptible to the iron.

A second clue to unsuspected intraocular foreign body is iridoplegia with mydriasis. Verhoeff felt that the impaired motility of the iris was due to the impairment of the function of the muscle from the iron deposition, rather than from a selective action on the nerve terminals as suggested by Tuckett. The picture of clinical reversal of siderosis as seen in this case by return of normal iris color and pupillary function would seem to indicate that if the source of iron is removed in time before the cellular enzymes are poisoned, the process may be reversed and normal function return. The present case does not answer the questions as to whether siderosis of the retina may be reversible. An initial ERG showed reduction. Three years after removal of the foreign body the ERG was still 50-75% reduced but we must remember that there had been an intervening retinal detachment. Nevertheless, the visual field is full by normal testing. We must consider that a portion of the retinal cell function had been destroyed by the iron foreign body.

The second case illustrates the phenomenon of spontaneous expulsion of a copper foreign body and points up the fact that intraocular copper does not necessarily spell the death knell of any eye. The factors concerned in the migration and extrusion of copper particles from the eye are well summarized in Tulloh’s article of 1956. A copper foreign body abhors entrapment and whether because of its chemical nature, its non-magnetic characteristics which favor its retention, its size and shape, or the forces of gravity and intraocular pressure, it heads for the surface and may
be expelled. The conservative approach to this case should be viewed in the light of present day advances in the techniques of surgery of the vitreous and one wonders how a surgeon skilled in such surgery would have handled the problem when the vision was 3/200, there was a cataract present, and the foreign body could still be seen inferiorly.

SUMMARY

Two unusual events concerning intraocular foreign bodies are presented. The first patient had an occult or unsuspected intraocular foreign body. He showed iridoplegia with mydriasis, siderosis iridis, and an intraocular piece of iron lying posteriorly near the retina. The foreign body was removed and the patient regained normal iris color and pupillary activity. His vision remains 20/15 six years postoperatively despite ensuing retinal detachment one year after removal of the foreign body.

The second patient was a young boy injured by a blasting cap explosion. He lost one eye from the injury and had a piece of intraocular brass in his left eye. In spite of the development of chalcosis and a mature cataract, the lens gradually shrank in the pupillary space permitting a clear aphakic area and 20/25 vision. The brass fragment migrated forward and inferiorly and was finally extruded under the conjunctiva five years later, where it was removed and chemically analyzed by x-ray diffraction.

REFERENCES

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DISCUSSION

Dr Tryve Gundersen. I feel honored and very happy to have been called on to open the discussion of this fascinating paper by Robert B. Welch on Siderosis Bulbi and Spontaneous Extrusion of a Copper Intraocular Foreign Body. It gives me a chance to further glorify the great name of Wilmer and that of my cherished friend, our president, M. E. Randolph. There is nothing that I can add nor detract from Doctor Welch's well-written and well-documented report on these unusual cases. The spontaneous extrusion of an intraocular foreign body is certainly unusual although not unique. I have surely never witnessed such an amazing case. Still, as early as 1881, Landmann reported on the spontaneous extrusion of an intraocular foreign body, and there have been at least nine or ten reports since that time. The reversal of siderosis has been documented more frequently. Even I have witnessed its occurrence in two patients and one finds many references to it in Duke-Elder's System of Ophthalmology, Volume 14, Part 1. I have wondered how I might add any information or stimulate interest in this fascinating subject.

In one of my two patients who had an early siderosis from a tiny intraocular foreign body, I noticed that in addition to the indirect or generalized siderosis, there was a finely pigmented ring on the anterior lens capsule. I was struck by the fact that its size corresponded exactly to the average size of the 19 Vossius rings which I reported before this Society at the November meeting in 1945. When I told of this observation to D. G. Cogan, he told me that he had seen such a ring of that size on the lens of a patient with a mild anterior uveitis.

Why should I bring up the name of Vossius and his famous ring in connection with this paper? Well, because I found one in a patient with typical siderosis bulbi, many months after he sustained a subclinical perforation of the globe with a minute ferrous foreign body. Certainly it was not a forced imprint of the iris on the lens capsule. This is still the generally accepted theory of its formation. Again, I refer to Duke-Elder's text.

My previous observations on the Vossius ring were made on soldiers wounded in battle, chiefly by shell fragments or from fragments of exploding land mines.
As mentioned, these rings were always of the same size, 2.25 to 2.75 mm in diameter. This was strange since the injuries sometimes occurred at midday under a bright Italian sun or at midnight in starlight illumination. Surely the pupils were not of equal size during these times of day. Secondly, no ring was seen earlier than four days after injury. Nor has anyone ever reported seeing a ring immediately after an injury. Furthermore, the ring has a sharp border at its periphery and fades towards its center. This is contrary to what one might expect from an imprint of the posterior surface of the iris. Finally, it is important to note that the Vossius ring does not occur except in youthful individuals. These arguments then enforce my conviction that the "abklatch theory" of Vossius regarding the formation of his ring is fallacious. Bear in mind that the thinnest part of the anterior lens capsule is where the lamellar portion ends and in all probability it is just in this ring-like zone where fine pigment particles fail to penetrate and become deposited on its surface. The fact that a typical Vossius ring can occur in siderosis as well as in anterior uveitis is worth recording and should once and forever negate the "abklatch theory" of its formation.

Dr David Harrington. Mr President. I congratulate Dr Welch for his documentation of these cases and would like to present two additional cases of chalcosis.

In 1926, Dr Frederick Cordes examined a 6-year-old child with bilateral intraocular metallic foreign bodies from a percussion cap explosion. The right lens was cataractous but X-ray localization revealed foreign bodies in the vitreous of both eyes and a metallic splinter was visible ophthalmoscopically in the left eye.

The patient was seen again in 1928, 1932, and 1934 at which time Dr Cordes and I reported the findings (Am J Ophthalmol 18:348, 1935). Vision in the right eye was light perception. The cataract had absorbed but there was a capsular membrane. Vision in the left eye was 20/30. The anterior surface of the left lens showed a brownish, metallic disciform opacity directly beneath the anterior capsule. The fundus was easily seen. No foreign body could be found and repeated X-rays revealed no evidence of foreign body in either eye.

The lack of severe reaction to an intraocular foreign body is unusual. The appearance of typical chalcosis in the left eye would indicate that the foreign body contained copper and that it had been retained for a long time and was gradually absorbed rather than extruded.

The second case which I would like to call to your attention was reported by Dr William Delaney (Ann Ophthalmol 7:378, 1975). His patient had well established chalcosis with heavy macular metal deposition. The foreign body was removed; the intraretinal metal disappeared within fourteen months and vision of 6/6 was retained.

Dr Brendan D. Leahey. I would like to add another case of spontaneous absorption of copper deposits on the lens and probably the absorption of the intraocular foreign bodies.
In March 1947, a 15-year-old boy was injured by a dynamite cap explosion with two perforations at the limbus at the 4:30 and 7:30 o'clock positions. Roentgenograms were negative. When the vitreous cleared, two very minute shiny foreign bodies could be seen well back in the lower vitreous. The roentgenograms were rechecked and were again reported as negative. Vision slowly returned to 20/20 and no surgery was performed.

Six months later he began to develop a slight greenish sheen on the surface of the lens in the pupillary area. There were faint peripheral lens opacities near the 4:30 position, but there were no aqueous cells. A few months later the green copper deposit had increased slightly. Vision was 20/20, and both tiny gold-colored specks could still be seen in the lower vitreous. We insisted there were foreign bodies present, but new roentgenograms were again negative. No soft tissue roentgenograms were taken, however.

Three and a half years after the injury, the greenish copper deposit was very marked. There was a sunflower pattern and there was also slight increase in the lens opacities. Vision had fallen to 20/40.

Four years after the injury he developed very severe iridocyclitis. The anterior chamber was full of fibrin and cells and the vision was reduced to shadows. After five months of intermittent recurrent inflammation, the iridocyclitis cleared. We were amazed to find the copper deposits on the lens surface had entirely disappeared. Vision returned to 20/50. The vitreous foreign bodies could not be found.

In 1969, 22 years after injury, vision in this eye had fallen to 10/200 due to the cataract. There was no copper deposit. The lens was removed intracapsularly with a resulting vision of 20/20. There were a few vitreous opacities, but we were unable to find either of the tiny foreign bodies.

Absorption of copper from Descemet's membrane in Wilson's disease has been achieved many times by prolonged use of penicillamine as a chelating agent (Sternlieb I, Scheinberg IH; Penicillamine therapy for hepatolenticular degeneration. JAMA 189:748, 1948). No such treatment was used in this case, however, and it is probable that the acute intraocular inflammation was a very important factor in absorbing the heavy copper deposit on the lens as well as the tiny foreign bodies themselves. The iridocyclitis occurred before the days of corticosteroids. Since the patient had prolonged foreign protein therapy, this may also have been a factor.

Dr A. Edward Maumenee. I would like to thank Dr Welch for bringing these two very interesting cases to our attention. Since the question of pigmentation in the lens has been brought up, I would like to briefly mention a case that I have seen recently. This patient had an iron containing intraocular foreign body which his physician had attempted to remove but was unable to obtain. He referred the patient to Wilmer Institute approximately a year after he had received his intraocular foreign body. He had definite heterochromia, depression of his electoretinogram, and typical siderosis. He had some focal pigmentation of his
lens, but the remainder of the lens was entirely clear. The intraocular foreign body was removed, and after about six months a cataract progressed to the point where he had a cataract extraction. There were pigment deposits that appeared to be on the surface of the lens capsule. However, on histopathologic examination it was found that these pigment deposits were iron deposits in nodules of proliferated lens epithelial cells under the capsule. This appears to be the area where iron accumulates in the lens.

Thank you.

Dr Joseph Dixon. We know that when a dynamite cap explodes it sprays large numbers of small particles of copper, I would like to ask Doctor Welch how he can be sure that this one he recovered from the conjunctiva is the same one he saw in the fundus.

Dr Robert Brockhurst. Mr President. Members and Guests. First I would like to congratulate Dr Welch on his excellent presentation. I noticed that in one of his slides of the patient with siderosis there was a notation that the ERG was subnormal. I recently saw a patient with unilateral uveitis who had been treated for nine months with cyclophosphamide. Heterochromia was present and a perforation of the iris was noted. The ERG was found to be quite subnormal. One year after removal of a magnetic foreign body the ERG returned to normal. Although the ERG has been an important tool in the diagnosis of degenerative disease, this represents one practical clinical application of the ERG first to document deficient retinal function in the presence of a foreign body. After removal, it gives us a guide as to the prognosis. I would like to ask if the electroretinogram was repeated following removal of the foreign body, and if so, did it show improvement.

Dr Robert B. Welch. First of all I would like to thank all the discussers of this paper for their interesting comments. It certainly brings out the old adage that not only is there nothing new in medicine, but that everything starts at the AOS. I especially would like to thank Dr Gundersen for discussing the paper and for providing us with the information as to the cause of the Vossius ring, which most of us were taught was due to the imprintation of the iris on the lens capsule from blunt trauma. His clarification of the phenomenon is most valuable. I would like to thank Dr Harrington and Dr Leahey for bringing out the fact that perhaps the copper foreign bodies in their cases absorbed rather than migrated, although in the light of the present report migration must be kept in mind. Certainly, foreign bodies can absorb and this brings up still another interesting aspect of the behavior of foreign bodies. Dr Maumenee's report of the case of siderosis with removal of the lens and histological documentation provides further information on siderotic involvement of the eye. I knew someone was going to ask me how I could be sure that the foreign body under the conjunctiva was the same one that had been seen in the fundus, and Dr Dixon did it. Don't think for a minute that I didn't ask myself the same question. Yet
the facts were there — I had observed the large foreign body in the vitreous since its inception, had watched it sink inferiorly and had noted its disappearance 31 months post injury. At this time I wondered about its absorption and had mentioned this fact to several colleagues who wondered if I'd lost my grip in doing indirect ophthalmoscopy. When the patient presented with the foreign body under the conjunctiva, I wondered if this was something that had been ground into his eye (he's a champion scholastic wrestler) and that is why I removed it and sent it to Dr Poljak for analysis by x-ray diffraction. When it came back copper I was convinced. In response to Dr Brockhurst, I did mention that the ERG was subnormal in the case with siderosis. I repeated the ERG three years after removal of the foreign body and it was still 50% reduced, but we must remember that the patient had had an intervening retinal detachment. Nevertheless, the retina was reattached and the Goldmann fields were normal. I do not think we can say that we reversed the posterior siderosis in spite of the dramatic clinical change in the anterior segment.