cerpted quotations which distort the original author's meaning or intent and on paraphrasing without due credit to the source of inspiration for the idea. The line between creativity and plagiarism is often blurry, and sometimes rubbed out entirely by the omission of a source; the only defense in such a crime is that it was not conscious or deliberate.

Our sister journal, the *Archives of Ophthalmology,* under the competent aegis of David G. Cogan, utilized the American Documentation Institute as a repository for lengthy bibliographies. Inasmuch as it is uncommon for an article to have more than 200 references, the amount of editorial labor and page space saved by this mechanism does not seem appreciable. The amount of labor that devolves upon the hapless reader, on the other hand, is appreciable. Having struck a promising vein only to find that its core is much more deeply buried, that he must write away to obtain additional material, he is brought sharply to a dead-end; the search must be suspended until it arrives. And when the material does come, less than a minute's glance may tell that it is not what had been hoped for. THE JOURNAL will likely continue indefinitely to publish extensive numbers of references when they serve a purpose and are related to the article to which they appear.

Frank W. Newell

CORRESPONDENCE

HISTORY AND DEVELOPMENT OF PHOTOCOAGULATION*

Editor,

American Journal of Ophthalmology:

It was in spring 1946, when I was 26 years old, that the idea of applying photocoagulation for therapeutical purposes suddenly came to me. The idea arose during the night when I could not sleep. I was afraid I would forget it so I made a note of only two words "light" and "coagulation." I remember quite well that at this very first moment numerous clinical indications came up to my mind including such things as prophylactic treatment of retinal detachment and destroying small tumors. I also remember that some details of the technical solution of the problem were already present in my mind's eye.

It was of course not by accident that this idea came to me, because at that time I was working on two different problems:

The first one was construction of a new machine for diathermy treatment of retinal detachment. For this purpose I performed experiments to determine the electrical resistance of different ocular tissues to high-frequency current. I recorded these experiments at the meeting of the German Ophthalmological Society at Heidelberg in 1948.

The second point was that my first teacher, Marchesani, asked me to guide the doctor thesis of a young student of medicine, who was describing his own macular burn which he received while watching the sun during the eclipse of July 10, 1945. His thesis was accepted at the University of Hambourg in 1947.

Thus the two presuppositions, knowledge about eclipse burns of the retina and detailed knowledge about the action of high-frequency current on ocular tissue, were well present in my mind at that time.

Studying the literature I found the experiments of Czerny, Deutschmann and Widmark, but not those of Verhoeff (1916) and of Eccles (1944). I have described in my booklet that it took me more than four years to translate this idea into the first instrument for clinical use.

The first experiment was started with a huge carbon arc from an old episcope. The first model which I constructed myself at home was a small machine with a few lenses and mirrors. Finally, at the end of 1946, I was able to perform nicely localized coagu-

lations in a ra
seconds.

The first e
ment in huma
fore enucleatic
exposure time
were necessar
poorly localize
that the optica
a considerably
human eye. I
apparatus whi
source. This i
made use of a
the movement
would remove
of the instrum

With this s
sible to treat
sunny day. I
we used to pl
roof of the e
called by phor
ment when a
expected. But
and everythin
appeared and

In 1949, I
with a high-in
ventor as th
(fig. 2) wa
hundred patie

All carbon
tage that the
the process o

* Dear Dr. Vail: Thank you very much for your kind letter in which you asked me some questions about the history and development of photocoagulation. I will try to answer your questions as exactly as possible.

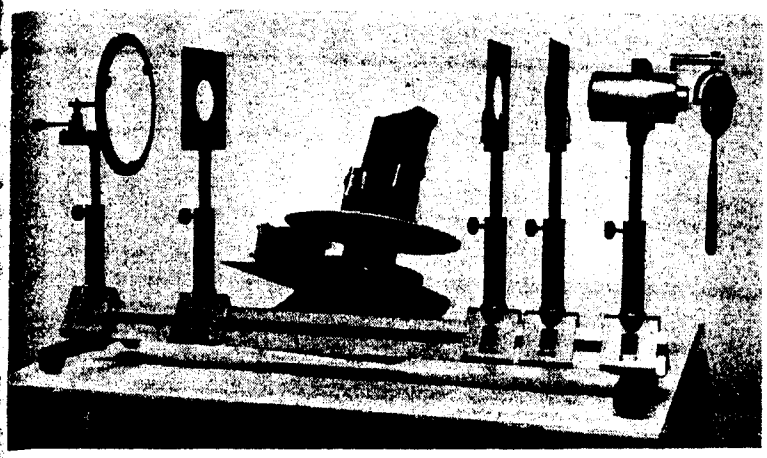

Fig. 1 (Meyer-Schwickerath). Sunlight photocoagulator with heliostat.

lations in a rabbit's eye within one to two seconds.

The first experiments with this instrument in human eyes (eyes with tumors before enucleation) were disappointing, since exposure times of more than 10 seconds were necessary to obtain a fairly mild and poorly localized burn. The reason for this is that the optical system of the rabbit eye has a considerably greater aperture than the human eye. I, therefore, developed a new apparatus which used the sun as the light source. This interesting instrument (fig. 1) made use of an heliostate to compensate for the movement of the earth which otherwise would remove the sun out of the optical axis of the instrument.

With this sunlight instrument, it was possible to treat patients, but only on a bright sunny day. I remember that in those days we used to place one of our patients on the roof of the eye clinic and then had to be called by phone from the out-patient department when a longer period of sunshine was expected. But often enough, until the patient and everything else was ready, the sun disappeared and we had to postpone treatment.

In 1949, I therefore started experiments with a high-intensity arc known after its inventor as the Beck arc. This instrument (fig. 2) was used clinically on several hundred patients between 1950 and 1956.

All carbon arcs have the great disadvantage that the filaments become used up in the process of burning. Another disadvantage is the liberation of gas and carbon particles. Fortunately at that time the xenon high-pressure lamp from Osram became available. This source of light is mounted in the Zeiss photocoagulator (fig. 3) which is the product of a long-standing fruitful cooperation with Dr. Hans Littmann and his co-workers from the Zeiss laboratories in Oberkochen.

In your letter you asked about the first treated cases. The first one was a peripheral horseshoe-shaped tear with practically no detachment in a young man's eye. The second one was a traumatic macular hole in a boy's eye.

In the first years macular holes seemed to be one of the most interesting and exciting indications, but nowadays this indication only plays a small role. The postoperative corrections with photocoagulation were one

Fig. 2 (Meyer-Schwickerath). Beck arc photocoagulator which its constructor, Meyer-Schwickerath, used between 1950 and 1956.

Fig. 3 (Meyer-Schwickerath). Zeiss photocoagulator with xenon arc.

of the first indications. The first intraocular melanoblastoma was treated in 1952. It was a one-eyed patient who is still alive, under control and has full vision.

In regard to your question about the most exciting developments during the last years I would like to mention the typical Eales' disease. I have the impression that many of my colleagues do not believe the very high cure rate which we obtain by using photocoagulation in this disease. Most cases which I have seen treated at other centers were treated insufficiently. My belief is that, from the clinical point of view, the treatment of Eales' disease is one of the most important and most interesting steps forward obtained by photocoagulation.

A second development which I would like to mention is that I believe that photocoagulation will be used more and more as a routine procedure in retinal detachment surgery. At this point I always hear the remark that photocoagulation will not work when the retina is separated. My answer is: "Does diathermy coagulation or cryosurgery work if the retina remains separated?"

The point is that we have to bring the retina back to the choroid anyway and, if we succeed, we can apply photocoagulation. Of course, the type of surgery, which we are using to reattach the retina, must be chosen in such a way that photocoagulation is possible either at the end of the operation or a few days later. We call this latter type of surgery the two-step operation and we are using it more and more.

Finally, I would like to mention the treatment of intraocular tumors. As you know we had a symposium on intraocular tumors on the occasion of the International Congress in Munich in August, 1966. There is no question that small intraocular malignant melanoblastoma and retinoblastoma can be destroyed successfully with photocoagulation if the right technique is used. This was not only recorded by my co-workers but also by Jules François from Ghent and several others using the same technique that I do. For those who are less lucky with their treatment of intraocular tumors one must presume that their technique differs from ours in one point or another. My co-worker O. E. Lund has shown, in a histopathologic study, the destroying action of photocoagulation in several cases of malignant melanoblastoma. François, Lund, Meyer-Schwickerrath and Dufour have recorded 118 treated cases, 82 of which were successful.

Last but not least, I think that you expect a word about our own experience with laser photocoagulation. To make it short I would like to say that this experience was rather disappointing. The short exposure time of all flesh lasers of about 0.5 msec has proved to be a disadvantage rather than an advantage. First preliminary experiments with continuous gas lasers seem to indicate that this type of light source might be a very good one for photocoagulation.

G. Meyer-Schwickerath
Essen-Holsterhausen, Germany

PAINFU

Editor,

American Jour

I was interes
cle, "Painful o
Lawton Smith
(Am. J. Ophth.
a resident in
Eye Hospital,
ber the former
pital, Mr. L. H
tion. I therefor
er he knew wh
erence to the c
has recently wr
ing reference.

In *A Textbo*
cine, edited by
lished in 1922,
the nervous sy
paragraph ent
from orbital
was written by
follows:

"This condi
the common f
to cold. It may
berty onward
syphilis have
tion is absent.
exposure to c
of the nose a
sometimes wit
dy commence
is often sever
some proptos
derness on
This is soon
ment of the
sphenoidal fi
first and som
but usually th
lowed by the
firth, the thi
the fifth in
that of a tot
thesia of th