Various other examples might be given, illustrating relations between colloid-chemical researches and clinical problems *e.g.*, atrophies by pressure, condition of the disc in the Foster-Kennedy syndrome etc.

Summary

Researches are made on the water-binding of the optic nerve and on that of its sheaths, and it is proved that these tissues have the possibility of swelling. The capacity and intensity of the water-binding of the optic nerve is much greater than that of the retina. Moreover the water-binding of the optic nerve is of a different type from that of the retina. The conditions of water-binding are the same in the sheaths of the optic nerve as in the sclera. Furthermore the clinical significance of the water-binding of the optic nerve and its sheaths is discussed and some remarks are made on the theories of the genesis of papilloedema.

REFERENCES

- Bauermann.—*Ber. d. deutsch. ophthal. Ges.*, p. 53, 1925.
 F. P. Fischer.—*Arch. f. Augenheilk.*, Vol. CIII, p. 1, 1930.
 J. A. van Heuven and F. P. Fischer.—*Brit. Jl. of Ophthal.*, Vol. XIX, p. 390, 1935.
 M. O. Hooker and M. F. Fischer.—*Kolloid-Zeitschr.*, Vol. X, p. 283, 1912.
 Lauber, J.—*Wien. klin. Wochenschr.*, Vol. LI, p. 1, 1934.
 Lindberg, J. G.—*Finska Läk. sällsk.*, Vol. LXXVI, p. 694, 1934.
 Marchesani, O.—*Ber. d. deutsch. ophthal. Ges.*, p. 157, 1930; p. 356, 1934.
 Sobanski.—*Kl. Ozcna*, p. 360, 1933.
 Thiel.—*Ber. d. deutsch. ophthal. Ges.*, p. 133, 1930.

ON THE SCIENTIFIC AND PRACTICAL VALUE OF IONIZATION IN OPHTHALMOLOGY. RECENT ADVANCES AND RESEARCHES

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IONIZATION—the introduction of drugs and electrolytes into the tissues of the human body or into those of the body of animals with the aid of a weak direct current—plays an important rôle in recent medical literature. This method has been studied especially in ophthalmology. And here its great therapeutic effect may be explained either by experiment or by clinical experience.

The pharmaco-dynamic effect of the current plus the electrolyte consists in a sudden alteration of the permeability of the tissues and with it also of the surface tension. We fix the electrolytes somewhat longer to the cells, we are able to irritate the sympathetic

and the parasympathetic nerves with this method in a better way and we may change the circulation in a sense which is favourable to the restoration of normal or nearly normal functions.

Another feature in adopting this method systematically is the possibility of introducing, especially into the tissues of the eye, in a new way the so-called urticariogenous group, such as histamine, acetylcholine and so on. This method has a specific effect on the vessels and with ionization these substances can be introduced directly into the tissues, whilst by injecting them subcutaneously there is no guarantee that they come in a sufficient quantity to the site of the lesion.

The technique of ionization nowadays is very simple. We use an apparatus called Sanion, which contains four pocket batteries, an exact milliamperemeter, a socket and a switch. The wires go to a hand-electrode which can be provided either with a capsule or with another wire to be connected with a metal tube. The capsule must be filled up with cotton-wool soaked in fluid. The tube must be fixed at the top with a piece of cotton-wool, which one may form corresponding to the size of the ulcer or the focus one is going to treat. The switch is put to the first position. If the patient touches the eye with the filled and wet capsule the current is closed. To have more intensity of current the switch has to be turned to position two or position three. To avoid sensations, let the capsule be brought near the eye from the touched skin.

In using the tube the physician takes it into his hand and puts it on the cornea or the sclera or the lids, after having placed the hand-electrode in the hand of the patient.

We need only small intensities of current. To obtain therapeutic results when using the capsule, intensities from 1-2.5 milliampères, time 3, 5 or 10 minutes when using the tube; intensities from 0.5-2 milliampères, time 0.5-2 minutes are sufficient.

It may be mentioned here that in the past year we used activated solutions with the best effect. The common solutions of electrolytes may be used, but a better effect is afforded by the activated Sanion-solutions, because they are provided with catalysators. These catalysators give no trouble at all to the effect of the ionization and are proved to increase the therapeutic effect in the cells and in the tissues.

To prove the efficacy of ionization we mention some of the experiments on the eyes of rabbits and of guinea-pigs. In experimental work we use the dose of 3 milliampères for 3 minutes. For instance, can we produce from the *positive* pole with adrenaline (1:1,000) a mydriasis of about 11 mm., which lasts several hours. When we take a solution of adrenaline 1:1,000,000 we may produce this mydriasis 45 minutes after the ionization.

At any rate, we have an effect on the pupil with even highly diluted solutions with this method.

The ionization has not only an effect in the tissues in which the drugs are migrating; it changes, also, the whole circulation, as can be proved by measuring the intra-ocular pressure. In general, there is an increase of the intra-ocular pressure directly after ionization, even after introducing pilocarpine and eserine. This increase of the intra-ocular pressure is followed by a decrease, which sometimes assumes a diminishing of the pressure by 5-8 mm. Hg. Another proof that the circulation of the eye is influenced: if we inject intravenously 5 c.c. of a 5 per cent. solution of fluorescein (into the vein of a rabbit's ear) and we perform ionization five minutes later, for instance, of sulphate of zinc on the cornea, the whole anterior chamber is filled up with the stain after some minutes. Normally, there is only a thin line of fluorescein from the upper part of the pupil down to the bottom of the anterior chamber, the line of Ehrlich.

That there is also a specific effect on certain tissues can be proved by the following experiment: In introducing chloride of barium (1 per cent.) from the *positive* pole to the eye of a guinea-pig, we always produce a cataract, beginning immediately after the ionization, and forming within 48 hours a total cataract, whilst the cornea remains clear. The effect of the barium can only be overwhelmed by iron when introduced together with the barium by ionization. Fig. 1 shows clearly the cataract. The section

FIG. 1.

FIG. 2.

FIG. 3.

(Fig. 2) shows a normal eye of the guinea-pig, whilst the section (Fig. 3) shows the homogeneous change of the lens, the total cataract.

With this experiment we could study the problem of avoiding a cataract. It seems that thyroxin subcutaneously injected (1 c.c.) before the ionization with barium, has a certain influence in preventing cataract. Some sections of eyes in this experiment show an enormous dilatation of the vessels of the choroid which one never sees in any other condition. So that we may say that by changing the circulation with the aid of thyroxin, which we bring also by ionization in a larger quantity into the eye, the

FIG. 4.

oxidation of the eye is augmented, so that the barium is unable to alter the lens. All these experiments must, of necessity, lead to a new study of the question of cataract.

If we introduce into the eye of a rabbit a solution of hydrogen peroxide (1 per cent.) from the *positive* pole, we may produce, in some cases, a real megalocornea, with a diameter of the cornea of 12 mm. instead of 8 mm. with a low pressure of about 8 mm. after some 14 or 20 days (Fig. 4). In one case we saw after ionization bubbles in the anterior chamber. Bubbles of oxygen? These bubbles could be produced otherwise when we made a puncture of the chamber after the ionization.

All these above mentioned experiments prove that the method of ionization is a method of great pharmaco-dynamic effect, worthy of being studied and, when modified, also of great therapeutic value.

For 15 years we had the opportunity of seeing many dogs with severe diseases of the eye. In applying ionization by different methods to these diseases we could study its great therapeutic value. There is no doubt at all that this method is superior to any other method up to the present. We saw cases treated with all known means, and without any avail. The very moment of using ionization the pathological picture changed. Let us see, for instance, such a picture as keratitis in distemper with a perforation and prolapse of the iris (see Fig. 5). The conjunctiva

FIG. 5.

FIG. 6.

is suppurating, after some days the cornea is affected, becoming opaque; there is loss of epithelium, an ulcer is forming and suddenly the ulcer perforates. The iris is attached to the cornea. A certain vascularization is evident after some time. The cornea remains cloudy, the iris is attached to the cornea in spite of the use of atropine. We begin treatment after anaesthesia with cocaine 2 per cent. or pantocain 1 per cent., with 0.25 per cent. sulphate of zinc with some drops of adrenaline (1 : 1,000) 1 milliampère 1-2 minutes. The next day there is a change in the appearance of the eye. The vessels of the livid vascularization are spreading in the direction of the hole in the cornea. The second treatment consists in applying calcium chloride 0.5 per cent. with drops of adrenaline to the whole cornea. So we change calcium with zinc, always with adrenaline. At the end of a week we have quite another system of vascularization, the cornea is transparent, the iris has been drawn back from the cornea and we have a round pupil

again (see Fig. 6). The vascularization consists of a few vessels only, which provide the cornea with better nutrition, for the vessels look quite red instead of the livid colour of the former vascularization. With the aid of zinc we secure the progress of the growth of epithelium, with adrenaline we exercise an irresistible traction on the iris, with the frequent application of calcium we sensitize the sympathetic nerve so that we get an active hyperaemia instead of the passive hyperaemia which makes only a congestion of vessels and produces that livid ring of vascularization. It is impressive to observe how only a few vessels are necessary for the healing of a big ulcer, so that the cornea again becomes transparent. We see here the confirmation of a real biological law: minute irritation leads to an ideal restoration of the severely damaged cornea. This restoration is even possible in spite of the continuing suppurative exudation of the conjunctiva. There is no possibility any more of infection of the cornea, so great is the effect of the method on the resistance of the tissues. All the cases were treated without any bandage.

From an experimental point of view we tried to treat some cases of staphylomata of the eye, which we saw by chance. Such dogs are otherwise killed by the veterinary surgeon. It was astonishing to observe the vascularization migrate to the top of the staphyloma. The cornea cleared up and at the end of a week a prolapse of the iris appeared. After some 10 days this disappeared and a round globe developed out of the former staphyloma (see Figs. 7 and 8). Such a therapeutic effect is really convincing and no scepticism is any more permissible.

With the above mentioned method we could in every acute case of perforated cornea bring back into the anterior chamber the prolapsed iris, in most of the cases even with a free moving pupil. But also in old cases of iris prolapse we had a good result. We mention the case of a dachshund which had a subconjunctival prolapse of the whole of the upper part of the iris. After 10 treatments the iris was completely in the anterior chamber. The cornea, which had a hunch in the upper part, became quite clear and normally curved, the irritation of the eye which had existed several months had ceased altogether. One year later the eye was in the same good condition.

From all these experiences, experimental and clinical observations, the idea developed to study such a method systematically in the treatment of various diseases and pathological changes in the eyes of human beings. And also in this field the method of ionization brought new and interesting results. There existed already a good deal of scientific literature, especially of an ophthalmological character, with reports of interesting therapeutic results. We mention the papers of Wirtz, 1908, and Schnyder, 1919. These

FIG. 7.

FIG. 8.

authors confined their iontophoretic work to but a few diseases. The results were worth taking into account, but scepticism arose and the method was only performed by a few ophthalmologists. Bos published a larger paper on ionization in 1929. He reported on the results in treating ulcers of the cornea, further on the result with ionization of atropine in cases of iritis. His results were better than with the usual methods. His chief, Dr. Rochat, the director of the eye clinic of the University Groningen, gave new communications on this subject in the International Congress of Ophthalmology in Amsterdam, 1929. A condensation of my work was given by me in Amsterdam, and in 1932 in a pamphlet in the "*Jahreskurse für ärztliche Fortbildung*," J. F. Lehmanns, Verlag, München.

But even since that time the systematic ionization of some new drugs led to the extended application of the method in the diseases and changes of the posterior part of the eye—the results in these diseases are of the most remarkable significance.

Indications.—Besides the usual therapy the conjunctiva may be treated in cases of acute inflammation with iontophoretic introduction to the everted lids. Zinc sulphate is to be applied to the tube, 0.25 per cent., 1-2 milliampère, 1-2 minutes.

In chronic cases the application of a mixture of calcium chloride and zinc sulphate is of better avail. The dose is the same as before. Calcium chloride 0.5 per cent., zinc sulphate 0.25 per cent. *and partes.*

The follicular conjunctivitis reacts very well and very quickly to the application of calcium chloride 0.5-0.25 per cent., 1 milliampère, 2-3 minutes. Nümi, a Japanese author, gives iontophoresis with a solution of 25 per cent. of calcium chloride. He reports very good results (see *Klin. Monatsbl. für Augenheilk.*, April, 1935).

The different kinds of catarrhal ulcers of the cornea are a proof of the strong influence of the ionization. With the tube one touches the ulcers and the surroundings. Zinc sulphate with one or two drops of adrenaline, 1-1.5 milliampère, 1-2 minutes. Sometimes a small vascularization is developing which disappears shortly afterwards. After some ionizations with zinc, calcium with two drops of adrenaline is to be applied.

As to the *ulcus serpens corneae* we have seen very good results with ionization of optochin 1:600. Dose 1-1.5 milliampère, 1-2 minutes. In severe cases it is necessary to treat the ulcer twice a day. If optochin is lacking one can use a mixture of zinc sulphate with quinine chloride, to which solution is added one drop of adrenaline. Zinc 1/400, quinine 1/200 *ana partes.* Dose the same as above.

The scars after ionization with this means are much more transparent than those obtained with any other method. Bos, Arruga and Malkin report similar good results. Arruga alleges that the bactericidal effect of optochin, for instance, is due to the fact of optochin migrating into the depths of the tissue, an opinion which corresponds to all of our reported observations.

The effect of epithelialisation of zinc is shown best in cases of herpes of cornea. After some treatments with zinc every day, the loss of epithelium diminishes and the final vision is much better than with every other method. In herpes and all sorts of neurotic disturbances only one thing is important; no large dose, 0.5-1 milliampère, 0.5-1.5 minutes. When four or five treatments with zinc have been performed, calcium should be taken, also with the capsule 3-5 minutes, 1 milliampère.

The rare keratitis disciformis can be wholly cured with the ionization of zinc in a very short time. In a paper in 1922 I stated that I could heal such a keratitis in less than three weeks, with nearly normal vision. Fuchs says in his textbook of ophthalmology about keratitis disciformis: "The course is protracted, as it takes one or more months for the eye to become free from congestion and for the infiltrate to be transformed into a corneal opacity which is permanent."

The post-operative infections of the flap in Elliot's operation can be cured, sometimes in one sitting, by ionization with sulphate 0.5 per cent. We use the tube, 1.5 milliampères, 2 min.

Very impressive is the therapeutic effect of the method in all cases which last months and months without any reaction to other therapeutic methods. We have seen sufficient cases to be convinced of the method. Let us describe only a few.

A patient was treated more than three months daily in a clinic on account of keratitis ulcerosa. The cornea was sowed over with a multitude of infiltrates when we saw the patient first. After some ionizations with zinc the cornea was free of infiltrates, no irritation at all and the vision was normal. No further recurrence occurred.

Another patient, a bus driver, suffered six months from a recurrent keratitis with irritation of the iris. After three ionizations with zinc and adrenaline we did not see the patient for three weeks. He came back with a normal eye and told us that he had driven his open car in bad weather directly after the last treatment, because he had no trouble at all. No recurrence.

Two years ago a man came to us. He had been treated in a clinic six weeks. His right eye was blind from old kerato-iritis. His left eye suffered from the same disease. An operation (iridectomy) was indicated as the last remedy. The vision of the highly inflamed eye was 1/30. We performed ionization with zinc,

calcium and adrenaline daily. After the second treatment the vision arose to 1/10. After 14 days the eye was not any more inflamed, the vision was 1/4, the patient had no trouble with his eye and began to work. To avoid recurrences we treated him with calcium once a week for some months. The patient has been well for two years.

Trachomatous conjunctivitis was, in former times, treated by ionization with a mixture of zinc and copper. Now we favour a mixture of calcium chloride 1 : 300, zinc sulphate 1 : 400, quinine chloride 1 : 500 *ana partes*, which solution is brought to the everted conjunctiva, 1-1.5 milliamperes, 2-3 minutes, every second day. The same solution is applied to the cornea with the tube, but only a small dose, 0.5 milliamperè, 1 minute. Very effective is also the solution applied to the closed eye with the capsule 2-3 milliamperes, 3-4 minutes.

In acute cases a Japanese author recommends the ionization with a 25 per cent. solution of calcium. Nümi uses this solution during 10-15 minutes, 2-4 milliamperes. He has seen development of scars after 1-2 weeks. Amongst 55 cases he could cure wholly 39 cases and 14 cases showed improvement (Report in the *Klin. Monatsbl. für Augenheilk.*, p. 561, 1935).

In 1925 we saw a patient with a large ulcer of the cornea due to a trachomatous infection. This ulcer rose above the level of the cornea and could not be influenced by any of the usual means. We declined cauterisation, proposed by a consultative colleague. The very nervous patient finally gave his permission for the iontophoretic treatment. After three treatments with zinc the ulcer began to diminish in size and colour. After some eight days, instead of the ulcer there was to be seen a thin macula. Vision improved from hand movements to 1/3-1/2. A year later on, the other eye was perforated as the consequence of a similar ulcer and became blind, this eye not having been treated by ionization, as our representative did not know the method.

An interesting confirmation of the excellent effect of ionization is a report of Korrenjewicz, Kiew. He treated one eye with a pannus trachomatosis by ionization, the other with the same pannus as usual. In the eye treated with ionization the inflammation ceased surely and rapidly.

Episcleritis and scleritis react well to the ionization with histamine 1 : 10,000 or acetylcholin 1 : 400. The tube is put to the boss, dose 1 milliamperè, 1-2 minutes. Treatment every day or every second day.

Infiltrates in tuberculous keratitis can be treated by ionization with calcium chloride 1 : 300. We use the capsule, 1.5 milliamperes, 3 minutes twice a week for a very long time. A specific treatment is no hindrance. The resorption of the exudates is hastened with

this proceeding. (Report in the *Zeit. für Augenheilk.*, Berlin, April, 1935. "Especially impressive are the results in myopic opacities of the vitreous and even in tuberculous haemorrhages.")

A good field for ionization is the inflamed iris. We cite Rochat, who gave a lecture on ionization with atropine at the International Congress of Ophthalmology, Amsterdam, 1929. Atropine 1 : 1,000 is introduced into the inflamed iris, not more than 1.5 milliampères, not more than 2 minutes. No intoxication is possible. The treatment can be repeated every day or every second day without any danger. Rochat asserts that this treatment saved the patients from surgical interference.

We apply to the iris calcium with adrenaline, with the tube, 1 milliampère, 1.5-2 minutes, and in many cases after the treatment get the iris bloodless. When we then instil atropine in the common 1 per cent. solution, we strengthen the effect of the atropine. Sometimes we go with the tube only to the limbus and treat especially those spots where synechiae are present, because the adrenaline can sever the attached iris from the lens.

In subacute and even *chronic iritis* one should try at any rate an ionization with calcium first, then with calcium-adrenaline. The first treatment has to be done with the tube, then we combine the tube treatment with a treatment with the capsule. Tube: 1-2 minutes, 1 milliampère; capsule 5-10 minutes, 1-2 milliampères. It is only this method which in some old desperate cases changed the inflammation all of a sudden and produced sometimes surprisingly good vision.

Here let us remember the possibility of intensifying the effect of subcutaneous or intra-muscular injections of specific or non-specific means by making five minutes later on the ionization. In all the diseases of the iris it is often necessary to make such injections. Never forget to make the ionization *after* the injection.

The influence of silver-nitrate 0.2 per cent. from the positive pole, found experimentally in the rabbit's eye, could be proved. The tension can be diminished after a short time. An acute glaucoma in a dog's eye could be cured in one sitting. The intra-ocular pressure was diminished from 80 mm. Hg to 25 mm. Hg. Dose: 2 milliampères for 2 minutes.

Some human eyes with absolute glaucoma were treated in the same manner, with the result that the planned enucleation could be avoided.

In chronic glaucoma we treat the eyes in order to improve the circulation by ionization with a solution of calcium chloride 1/300, capsule-electrode, 5 minutes, 1.5 milliampères. Our friend, Professor Itoh, from the University clinic for eye diseases in Chiba, Japan, told us that he obtained good results with ionization of pilocarpine 1 : 1,000 in chronic glaucoma. He told us that he

had observed that not the pressure changed as much but that the vision and the field of vision remained at the same condition as in beginning the treatment.

As to the question of ionization-treatment in cataract the practical part of this question can only be solved in common with the work of many ophthalmologists who are adopting this method. It seems to us that this treatment must consist in improving the oxidation of the lens, which may be done directly and indirectly. Indirectly by all methods which improve the whole circulation, directly by applying with the aid of the ionization means which are improving the circulation of the whole eye, as eserine salicylate in a solution of calcium (calcium chloride 1/300 with 1-2 drops of eserine salicylate (0.5 per cent.)). We use the capsule, 5-10 minutes, 1-2 milliampères once a week. We dare not say that this method is able to prevent the final progress, because a very large series of cases must be treated in order to gain a distinct impression of its effect. But of all experience we say the study of treatment of cataract must be done at any rate. We state from the experiment on the guinea-pig's eye that it is possible even in nearly totally non-transparent opacities of the lens to clear up these opacities under certain circumstances. And this observation leads to the conclusion that one day the medical treatment of the cataract will be possible.

The study and the systematic application of the ionization revealed its great and very often astonishing effect in treating many of the acute and chronic diseases of the eye with following improvement of inflammation and with it of vision, but the therapeutic effect of the method on the posterior part of the eye was a long time without producing satisfactory results.

The possibility of exercising a therapeutic effect with ionization on the posterior part of the eye, on the vitreous, the choroid and retina and even on the optic nerve, was given with the introduction of the so-called "urticariogenous" group. These systematically applied by ionization are histamine, acetylcholin, doryl, dionin. The effect of these is different only in qualitative aspect. For most of the treated cases the application of histamine, acetylcholin, dionin proved to be satisfactory. In application of acetylcholin we have worked out a new technique.

All these substances are formed in the tissue itself. Feldberg and Schilf have called them "Gewebshormone" (hormones of the tissue). These substances may be produced in the tissue by different stimuli. All these substances are working upon the vessels, dilating them and relieving spasm, producing arterial hyperaemia, intensifying the velocity of the blood corpuscles and increasing the flow from the veins. Histamine, besides, produces a marked oedema.

If we introduce such substances by ionization into the tissue of the eye we imitate a natural process, but with the difference that we may dose it to a therapeutic effect. This therapeutic effect may be got by the circumstance that ionization fixes the substance somewhat longer to the tissue, so that a prolonged effect is produced. The effect on the retina and choroid is, perhaps, not a direct one. There may chiefly be reflectory effects, if we dilate the vessels of the conjunctiva and those of the orbit. Another idea is possible :

By introducing these substances into the sclera we sensitize the ganglion cells, which are to be found in the sclera, as Dr. Goldstein, New York, told me, and as has been communicated by Dr. Ernyei (Hungarian Ophthalmological Society, February 16, 1935). These cells are of sympathetic character, so that the ionized substances have a direct effect on the sympathetic and with it are always producing a better hyperaemia than the usually applied means.

Very interesting are the communications of Ruhmann, who could show that the ionization of acetylcholin produces the same micro-capillary picture as an energetic massage. We cannot massage energetically the eye ball, but we are able to make a powerful dilatation of the vessels by the ionization of the sclera with acetylcholin.

The technique for the ionization of histamine is very simple. We anaesthetise the eye with some drops of 2 per cent. cocaine or of 1 per cent. pantocain. Then we use the tube with cotton-wool and a solution of histamine (1 : 10,000) and put the tube to the sclera far from the limbus, ordering the patient to look in the opposite direction. It is sufficient to treat the sclera at the temporal and at the nasal side. Dose : 1-1.5 milliampères, 1-2 minutes each site. The treatment can be repeated every day, in severe cases twice a day. If there is any reaction every second or third day. If there is extensive oedema warn the patient, because it lasts sometimes 5-10 hours. If there is a little haemorrhage in the conjunctiva, it does not disturb the therapeutic reaction. Dionin (1 : 500) has similar reactions, but histamine is of surer effect.

The technique of acetylcholin-ionization (1 : 200) has been modified. We can use the capsule, filled up with cotton-wool and with the solution of acetylcholin; dose : 2 milliampères, 5-10 minutes. To mobilize acetylcholin in the tissue itself and to increase its effect when introduced into the tissue by ionization it has proved best to use the capsule with a solution of calcium chloride (1 : 300) to which are added two drops of eserine salicylate (0.5 per cent.); dose : 1-2 milliampères, 5-8 minutes, from the positive pole. Eserine has the quality even in the highest dilutions of preventing the splitting up of acetylcholin by destroying the

enterase (Feldberg). After having introduced the eserine with the capsule we take the tube with cotton-wool and acetylcholin (1:200) and treat the sclera, the temporal and the nasal side, as far as possible from the limbus. Dose: 1-2 milliampères, 1-1.5 minutes each side. This treatment must be done in the beginning every day, then three times a week and after having got a result, once every week for a long time.

Generally, it may be said that in every kind of choroido-retinitis, be it of arteriosclerotic, diabetic or any other constitutional origin, the method should be systematically carried out. It is always possible to produce a better circulation, perhaps of the effect of the activated means, an effect, which consists first in

FIG. 9.

FIG. 10.

relieving the spasm of the small arteries. At the very moment of influencing the spasm the circulation is improving and the retina is functioning better. One of the most remarkable signs of improvement is the disappearing of central scotomata for colours. The central vision is improving gradually, as well for distance as for near. That also in the course of such a treatment exudates in the retina are resorbed, can be proved by pictures of the fundus, photographed by the Zeiss-Nordenson camera. (See Figs. 9 and 10.) It was a case of arteriosclerotic retinitis. In the macular region a big pigmented patch was to be seen. The vessels from the optic nerve to the macular region disappeared behind an exudate. The vision was $1/25-1/20$. Large paramacular scotomata could be demonstrated. After a treatment of more than two months the picture has changed in every way. You see, instead of the patch, a small haemorrhage, the previously curved vessels are stretched and well filled up, the veins and the arteries which had disappeared behind the exudate, are distinctly to be seen. The vision has improved to $1/3$, with a weak convex-cylinder even to $1/2$.

To illustrate the therapeutic effect of the new technique let us cite some other interesting cases:—

Thrombosis of the central vein. After 10 treatments improvement of vision from 1/50-1/35 to 5/35. Man, aged 63 years. Deep excavation, optic nerve temporal paleness. Vision from 1/35-1/25 with -8.0 D. Sph. excentrically seen, within four weeks to 5/20. Reading was improved from recognising big letters to recognising the smallest letters. Lady, aged 35 years, burning of the macula, after wandering over a glacier without protective glasses. Vision improved from 1/3 to 5/5, for near from Snellen 3.5 to Snellen 1.5 within 10 days (treatment every day). A central scotoma for red and green disappeared after the second treatment. High myopia is without any doubt a good field for this treatment. There are remarkable improvements of vision for distance and near.

That in all these cases the constitutional treatment must be taken in consideration is natural. At home, the patients have to instil every night a drop of pilocarpine (0.01/20) for months and months.

In cases of retinitis pigmentosa we combine the ionization with a diathermic treatment before, 10-15 minutes, 200-500 milliampères. There is no doubt that in some cases a therapeutic reaction is possible. Central scotomata for colours disappear. In one case we saw the field of vision enlarging in a high degree, instead of the narrow field of vision an annular scotoma had developed. As I have been told by Dr. Henry A. Barrett, New York, he has seen remarkable improvement of retinitis pigmentosa by the diathermic treatment. In combining the two methods we see a new possibility of helping in this serious disease.

Of many cases of retrobulbar optic neuritis which we have treated we have to report that a certain shortening of the course of the disease is possible if we introduce adrenaline from the nasal side into the globe. We take calcium chloride 1:300 with 3-5 drops of adrenaline (1:1,000) and put the tube far from the limbus into the orbit; dose 1-2 milliampères, 1.5-2 minutes every day. The optic nerve recovers from one sitting to another. In most of the cases after a week there was normal vision and operative interference like opening of the sinuses was unnecessary.

Résumé

The systematic study of the method of ionization reveals many interesting and new observations, of theoretical as well as practical therapeutic character. By introducing certain drugs, all being electrolytes, we are enabled to increase their pharmacodynamic effect and thereby obtain better therapeutic results. The method

of ionization is simple, its technique having been improved by new apparatus and new practical electrodes. Every practitioner in eye work may employ it with ease. We repeat once more: The method is of great therapeutic value in most of the common diseases and changes of the eyes and, when used in the uncommon and rare cases, sometimes produces astonishing and very impressive therapeutic results. If used in the early stage of a disease the restoration of the function is complete. But even in chronic cases the method should be tried since it stops the progress of inflammations and is a mighty factor in accelerating the resorptive power of the tissues.

LITERATURE

- Arruga.—*Verein mitteldeutscher Augenärzte*, Halle, 1929.
 Bos.—*Dissert.*, Groningen, 1929.
 Erlanger.—*Zeitschr. f. Augenheilk.*, 1922; *Tierärztliche Rundschau*, 1926; *Klin. Wochenschr.*, 1928; International Congress of Ophthalmology, Amsterdam, 1929; *Jahreskurse für ärztliche Fortbildung*, 1932.
 Erlanger, G., and Erlanger, Alice.—*Deutsch. med. Wochenschr.*, 1931; *Klin. Monatsbl. f. Augenheilk.*, 1932.
 Feldberg.—*Zeitschr. f. d. ges. Exp. Med.*, 1931.
 Feldberg and Schilf.—*Histamin*. Berlin. Julius Springer, 1930.
 Korrenjewitsch.—*Zeitschr. f. Augenheilk.*, 1929. Ref.
 Nümi.—*Klin. Monatsbl. f. Augenheilk.*, Ref., April, 1935.
 Malkin.—*Klin. Monatsbl. f. Augenheilk.*, 1932.
 Rochat.—International Congress of Ophthalmology, Amsterdam, 1929.
 Schnyder.—*Klin. Monatsbl. f. Augenheilk.*, 1919.
 Wirtz.—*Klin. Monatsbl. f. Augenheilk.*, 1908.
 Cantonnet.—*L'ionisation dans l'ophtalmologie*. Paris, 1927.
 Rousseau et Nyer.—*La pratique de l'ionisation*. Doin et Co., Paris, 1931.

SCLERECTOMY WITH IRIDENCLEISIS.—A MODIFIED GLAUCOMA OPERATION

BY

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JAVA

SEEING that there have been described so many good operations for glaucoma, I have been in doubt, whether I should publish the method which I have used during the last ten years. Still, as it has given good results, it might perhaps be of some use to describe it.

My idea has been to find a method that will combine perfect safety with great efficiency. It is in reality to a certain degree a combination of Herbert's wedge-isolation-operation and iridencleisis; but there are differences which prevent me from calling the operation after Herbert. These differences are the following: