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OPHTHALMOLOGIST TO THE ORTHOPÆDIC HOSPITAL
AND INFIRMARY FOR NERVOUS DISEASES.

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THE OCULAR COMPLICATIONS OF MALARIA.¹

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FÖRSTER,² writing in 1877 concerning the ocular changes in malaria, says:

"If we take into consideration that protracted pernicious malaria may originate the severest disturbances in the entire organism—melanæmia, decided cerebral symptoms, probably dependent upon circulatory disturbance in the central organ of the nervous system, profuse diarrhœa and intestinal hæmorrhage, albuminuria and hæmaturia, irremediable cachexia, hæmorrhagic diathesis, fatty degeneration of the glandular organs of the abdomen, etc.,—then, in some measure, it is remarkable that little is reported concerning the disturbances of the eye, the result of malarial poisoning."

It is the object of the present paper to record the various diseases of the eyes which have been studied either as the direct result of the malarial poison, or which have appeared in association with malarial toxæmia.

Diseases of the Conjunctiva. Intermittent Ophthalmia.—W. F. Norris³ writes:

¹ Read by title in the Section of Medicine, of the American Medical Association, Nashville, 1890.

² Graefe u. Saemisch, Handbuch der gesammten Augenheilkunde, Bd. vii. p. 176.

³ Pepper's Encyclopædia of Medicine, vol. iv.

" Intermittent ophthalmia is but rarely encountered in countries where only a mild form of intermittent fever is present; in fact, it was so rare in Scotland, that Mackenzie, in the earlier editions of his work, denied its existence, but a larger experience enabled him (in 1854) to give three cases. In 1828 and 1829 it was so infrequent in Marburg that Hueter (*Jahrbücher für Chirurgie u. Augenheilkunde*, Berlin, 1828, xii. 271-279) devoted two papers to its study—one of a case of the quotidian type, and the second, of the septan form of the ophthalmia."

Between the years 1838 and 1868 the files of the *Annales d'Oculistique* contain references to ten papers upon this subject. In 1843 J. E. F. Schaezman wrote his thesis¹ upon intermittent ophthalmia, and described three varieties: 1. Those which appear under the mask of intermittent fever; 2. Those which are only one symptom of intermittent fever; and 3. Those which result from the change in the form of an intermittent fever.

In countries where malaria is prevalent intermittent ophthalmia is common, and may appear simply as a vascular irritability of the eye, without true inflammation (phlegmasia dolens oculi or ophthalmia nervosa of the older writers); in association with ordinary trigeminal neuralgia, which—as is the case with all neuralgias—may assume a periodic type; as a congestion of the conjunctival vessels, with photophobia and lachrymation, together with malarial neuralgia—incurable until the true nature of the disorder is discovered; or, as Griesenger² has said, it may terminate in stationary chronic conjunctivitis, opacity of the cornea, and even atrophy of the bulb.

¹ For a review see *Annales d'Oculistique*, t. x. p. 46.

² *Infectionskrankheiten*, 2 Aufl., 1864, p. 48.

Wehle¹ describes among intermittent cases in Hungary a form of ophthalmia characterized by erysipelatous swelling of the lids, studding of conjunctiva with red dots, tumefaction of the ocular conjunctiva, and occasional involvement of the cornea and destruction of vision.

Eulenberg and Landois,² in a discussion on vasomotor neurosis, refer to intermittent ophthalmia, giving the important literature from Edmonstone's treatise in 1816 to Derby's article in 1865, as a circumscribed affection of the trigeminal filaments supplying the conjunctival vessels arising under the influence of malaria—a vasomotor infection-neurosis.

In the cases reported by Pagenstecher conjunctivitis, sometimes accompanied with paresis of accommodation, was the only symptom of malaria, and formerly was called "febris intermittens larvata."

Finally, an ophthalmia may arise to which, when it is already advanced, intermittent fever may be added. To the latter class, perhaps, should be referred those epidemics of ophthalmia between which and malaria an affinity has been traced. An example of this character is furnished by the study of the epidemic ophthalmia which pervaded South Carolina in the summer and fall of 1882, and which E. Miller ascribed to the influence³ of malaria—a position in which he was supported by Rhett, Kollock, of Cheraw, and Munroe, of Marion; but unsupported by Howe, of Columbia; Cowles, of Johnson's, and F. L. Parker, of Charleston.

¹ Oesterreichische medizinische Wochenschrift, 1846, No. 16, quoted in *Annales d'Oculistique*, t. xviii. p. 174.

² Wiener medizinische Wochenschrift, No. 72, p. 1140, 1867.

³ Louisville Medical News, vol. xv.-xvi. p. 177.

Diseases of the Cornea. Malarial Keratitis.—The cornea may be involved in a form of inflammation specially dependent upon the malarial poisoning, or become inflamed in a subject of intermittent fever as an associated disease. Thus, long ago, Bürhrlen¹ while discussing intermittent ophthalmia pointed out that keratitis may occur in a malarial individual during the course of the disease, and should be described as “intermittens cum keratite.” A vascular keratitis is recorded as an illustration. This influence of the malarial impression upon the course of a keratitis, either because the patient resides in paludal regions or himself is the subject of malaria, is a matter of common observation and stock knowledge, and to such an influence should be accredited the cases of herpes febrilis corneæ observed by Godo,² one-third of which he traced to malaria. Chronic interstitial keratitis, either directly malarial or occurring in malarial subjects, has been observed in a number of instances. Arlt³ has recorded eight cases; Levrier⁴ another; more recently the influence of this cachexia in the production of this type of corneal disease has been dwelt upon by Landolt, Poncet, Javal, and others, while Sedan, of Toulon,⁵ among thirty-four cases found malaria in twenty-seven instances.

Keratitis the direct result of malaria, and exist-

¹ Medicinische Correspondenzblatt des Würtemb. Aerzt. Vereins, Bd. xxx. No. 35, p. 293.

² Recueil d' Ophthalmologie, March, April, and May, 1880.

³ Klinische Darstellung der Krankheiten des Auges, 1881.

⁴ Thesis, Paris, 1879.

⁵ Recueil d' Ophthalmologie, September, 1887.

ing in the form of a superficial lesion, has been known for a long period. Becker¹ referring to a variety of keratitis after cataract extraction, describes its appearance as identical with that of the painful keratitis following malaria, mentioned by the older writers, but not mentioned in the more modern literature. In this country we are indebted especially to Kipp, of Newark, for a masterly study of malarial keratitis. His first publication appeared in 1880,² and in the *Transactions* of the American Ophthalmological Society for 1889 he gives his most recent results based upon one hundred and twenty observations. In 90 per cent. of the cases the lesion consisted in a "peculiar narrow, serpiginous, superficial ulcer, with lateral offshoots," like the skeleton of veins in a lanceolate leaf, usually accompanied with photophobia and lachrymation, and sometimes ushered in with severe supraorbital neuralgia. This appearance Dr. Kipp formerly considered characteristic, but in five instances it was replaced by a large superficial abrasion of the cornea, while the peculiar appearance just described he has observed in non-malarial subjects. Cases appeared in every month of the year—69 per cent. during June, July, August, September, and October. Dr. Kipp's observations have been repeated and confirmed by Hotz,³ H. G. Miller,⁴ and Sutphen.⁵ Noyes, whose

¹ Graefe u. Saemisch, Handbuch, vol. v. p. 350.

² Transactions American Ophthalmological Society, 1880.

³ Chicago Medical Journal and Examiner, vol. xliii. p. 598, 1881.

⁴ Transactions Rhode Island Medical Society, 1882, p. 381.

⁵ Transactions American Ophthalmological Society, 1889, p. 338.

cases were reported by Minor,¹ for years has been accustomed to observe a form of superficial keratitis as the result of malaria; the characteristic symptoms were exaggerated tenderness of the supraorbital nerve and anæsthesia of the cornea. Van Milligen,² in 1888, described a peculiar form of keratitis, resembling the keratitis dendritica mycotica of Grut, Hock,³ and Emmert, as the result of malaria, and characterized by the appearance of a superficial erosion on the temporal border of the cornea or a fungus-like lesion in some other point; local pain, ciliary neuralgia, and anæsthesia of the cornea were associated symptoms. Keratitis bullosa, a disease in which large vesicles form, filled with clear serum and of uncertain origin, in some instances has appeared to have its source in malaria, and Tangeman, of Cincinnati, suspecting this, cured his cases by the administration of quinine.

The practical deduction from these observations evidently is the importance of remembering the possible influence of malaria in corneal inflammation, and in the absence of the characteristic clinical symptoms described by Kipp, Noyes, and Van Milligen, the need of examination of the blood for the corpuscles of Laveran. The remedies indicated in addition to local measures are quinine, arsenic, and eucalyptus.

¹ American Journal of the Medical Sciences, 1881.

² Centralblatt f. praktische Augenheilkunde, January, 1888.

³ For a discussion of these types of keratitis and their etiology see an article entitled "Beitrag zur Kenntniss der furchen Keratitis," by Dr. F. Makrocki, Klin. Monatsbl. f. Augenheilkunde, March, 1890, p. 39.

Diseases of the Iris. Iritis.—The development of iritis under the influence of syphilis, rheumatism, gout, gonorrhœa, and in association with tuberculosis and diabetes, would seem to indicate malarial toxæmia as a possible and even likely cause for the same inflammation. Staub¹ described intermittent iritis, passing on in some instances to intermitting and periodic hypopyon, cured by the influence of quinine. Peunoff,² in an investigation of a large variety of ocular troubles the result of malaria, in rare instances found iritis. Mackenzie³ and Quaglino⁴ refer to periodic iritis; and modern writers, like Noyes, include malaria among its constitutional causes. It is to be remembered, however, as Gowers⁵ has pointed out, that pyæmia closely simulates intermittent fever, and purulent affections of the eyes (purulent iritis and choroiditis) may arise under its influence and be ascribed inaccurately to malaria.

Scleritis and episcleritis—relapsing affections—no doubt appear in malarial subjects as associated disorders. Some of the reported examples of intermittent ophthalmia appear to have been of their character.

Amblyopia and Amaurosis.—Disturbances of vision during the course of intermittent fever have been observed from the earliest days, many of the recorded

¹ Von Ammon's Zeitschr. f. Ophthalmologie, Heidelberg und Leipzig, 1835; quoted by Wiener medizinische Wochenschrift, No. 72, p. 1140, 1867.

² Centralblatt f. praktische Augenheilkunde, 1879.

³ Diseases of the Eye.

⁴ Annales d' Oculistique, t. 65, p. 129.

⁵ Medical Ophthalmoscopy, 2d ed. p. 248.

cases having been reported in the pre-ophthalmoscopic period. Leber¹ divides the amauroses of malaria into two varieties: typical or intermittent, and stationary amaurosis. In temporary amaurosis the fever usually is of the tertian type, and may be associated with severe nervous symptoms—delirium, coma, aphasia—or the loss of vision begins with the chill, lasts through the fever and subsides with the sweat, as was shown years ago by Kühlbrand and Tott.² Thus Deval³ mentions a case of tertian intermittent with amblyopia after disappearance of the fever which only slowly and partially subsided, and Dutzmann,⁴ a young man with tertian intermittent, violent convulsions, unconsciousness and complete amblyopia without fundus lesions, who was cured with quinine. In larvate intermittents, when the fever is slight or concealed, the amaurosis, according to Himley (quoted by Leber), more usually is monolateral—a point observed by von Störck as long ago as 1759.

Stationary amaurosis from larvate intermittents is more unusual, and may be an amblyopia with exacerbations, either unilateral or bilateral in character. (Leber.) Periodical amblyopia may be associated with spasm of the retinal vessels, as in the cases recorded by Ramorius,⁵ pale disks, shrunken veins and

¹ Graefe u. Sæmisch, Handbuch, vol. v. p. 950

² Casper's Wochenschrift f. des gesammten Heilkunde, 1833, II. Nr. 35, and Ibid., 1835, quoted by Leber.

³ *Traité de l'Amaurose*, Paris, 1851, quoted by Bull in *St. Louis Courier of Medicine*, vol. 3, 1880, p. 453.

⁴ *Weiner medizinische Presse*, 1870.

⁵ *Annales d'Oculistique*, vol. lxxxii. p. 200.

arteries, and simultaneous congestion of the face and ears.

The result of numerous observations is that amblyopia not infrequently complicates malaria and appears in the form of a transient loss of vision, or as complete blindness. Its duration varies from a few moments to several hours, days, or even months, and it disappears under antiperiodic treatment, as Teillais¹ has said, "with the same quickness with which it came without leaving a single trace of its passage at the bottom of the eye." In most of the amblyopias just referred to, the ophthalmoscopic findings were negative, or the descriptions are included in the vague terms applied to the retina or optic nerve—"congestion," "hyperæmia," "redder than normal." In the monolateral cases these terms have been at times limited to the affected side, while the other was described as "normal."

Two questions of differential diagnosis are of importance in the consideration of malarial amblyopia—amaurosis from associated kidney disease, and blindness the result of large doses of quinine; examination of the urine should exclude the one, and the peculiarities of the retinal arteries and the behavior of the color-fields the other. Adopting a classification given by Teillais² we may say in regard to malarial amblyopia that it is of three varieties:

1. Amblyopia without lesion due to a special action of the malarial poison on the optic nerve and the retina.

¹ *Annales d'Oculistique*, xcvi., xcvi. 1886, p. 234.

² *Loc. cit*

2. Amblyopia in which the lesions are not appreciable with the ordinary means of investigation.

3. Amblyopia with lesions apparent at the bottom of the eye-ground.

It is to the lesions of the latter group to which I now wish to call attention. These consist in œdema of the end of the optic nerve and optic neuritis, optic atrophy, retino-choroiditis, hæmorrhages into the retina and into the vitreous humor.

Malarial Neuritis and Neuro-retinitis.—In 1866 McNamara referred to instances of intermittent hemicrania with neuritis in connection with malaria, and several years later reported¹ a case of neuro-retinitis, the result of malarial toxæmia in a native Indian, cured by quinine. These cases he believed to be common in that region. Noël Gueneau de Mussy² relates a case of double optic neuritis and hæmorrhages into the retina alleviated by quinine. Galezowski³ refers to neuritis; Poncet,⁴ who observed changes in 10 per cent. of the cases of malarial cachexia in Algeria, beside hæmorrhages found peri-papillary œdema and neuro-retinitis. Jacobi⁵ describes œdema of the papilla in a woman of thirty-four years of age, with quotidian ague and enlarged spleen, who was cured by quinine and iron, and in Peunoff's⁶ extensive list of ocular disorders attributed to malaria, several cases of neuro-retinitis

¹ Indian Medical Gazette, 5 and 6, 1870-71, p. 28.

² Journal d' Ophthalmologie, 1872.

³ Traité Iconographie, p. 190.

⁴ Annales d' Oculistique, May, 1878.

⁵ Von Graefe's Archiv f. Ophthalmologie, Bd. xiv. 1. 154.

⁶ Loc. cit.

are detailed. Hammond¹ saw two cases of malaria with optic neuritis and remarkable collections of stellate pigment in the retina. In a recent communication McNamara² reports three cases of neuritis due to malarial poisoning.

Hæmorrhages into the retina may occur with neuritis or without other changes. Numerous reports have appeared, prominent among which are those by Peunoff,³ Fernandez (quoted by Poncet⁴), Poncet, Karpinsky,⁵ whose cases happened in southern Russia, in some instances associated with marked fever; and Stephen Mackenzie,⁶ who found in three examples the hæmorrhages especially along the course of the large vessels, and when they faded away shiny white spots marked their position. In our own country a number of communications upon this topic have been published. Thus Edward W. Jones,⁷ of New Orleans, reports five cases of retinal hæmorrhage. In one, a man aged thirty-four, the fever was of the remittent type, and in another there was also unilateral optic neuritis. J. Dickson Bruns,⁸ of New Orleans, describes two examples of hæmorrhages into the retina—the one with fever of the tertian type, and the other in which the chills occurred at first daily, and later every other day. Usually the hæmorrhages are found near the disk,

¹ Transactions American Neurological Society, 1875, p. 142.

² British Medical Journal, May 8, 1890.

³ Loc. cit.

⁴ Loc. cit.

⁵ Aertz. Blatter, No. 373, 1879; Centralblatt f. praktische Augenheilkunde, 1880, p. 84.

⁶ Medical Times and Gazette, 1877.

⁷ Medical Record, June 27, 1885.

⁸ New Orleans Medical and Surgical Journal, vol. x. p. 455.

along the course of the larger vessels, as in Mackenzie's cases, sometimes on the disks in the form of fine specks of blood, and occasionally in the macular region assuming unusual shapes; Bruns examined one formed like a "meat-chopper." Amenitsky¹ reports blindness attributed to embolism of the central artery of the retina in a girl of seventeen, the subject of tertiary intermittent fever; the diagnosis is open to doubt.

Optic Atrophy. — Galezowski² describes optic atrophy with the pernicious forms of malaria; it is rare in the intermittents of temperate climates. Instructive cases have been recorded by McNamara, and in our country by Bull.³ (The influence of quinine was excluded.) Edward Jones⁴ among twelve cases of retinal disease, the results of malaria, saw only one go on to atrophy. Even when the atrophy is advanced marked improvement under treatment (strychnine and potassium iodide) may take place, as in a remarkable case of recovery of vision after atrophy of the optic nerves consecutive to malaria, reported by Brudenell Carter.⁵

The *pathology of the retinal and optic nerve changes* in these cases is not settled. The hæmorrhages have been ascribed to pigmentary embolism, although, as Gowers points out, this may be present, according to Mackenzie, in the absence of melanæmia. Poncet⁶ believes the vessels of the choroid may be the seat

¹ Nagel's Jahresbericht, 1886, p. 252.

² Loc. cit.

³ American Journal of the Medical Sciences, 1877, p. 413.

⁴ Loc. cit.

⁵ British Medical Journal, January 3, 1886.

⁶ Annales d' Oculistique, 95-96, 1886.

of emboli of leucocytes, and attributes the hæmorrhages to this condition. According to Lopez y Veitia,¹ the immediate cause of the extravasations of blood is an augmentation of the blood tension, and he believes the hæmorrhages are increased by fresh accessions of fever. H. D. Brunt² thinks the smaller hæmorrhages due to diapedesis, the larger ones to rupture of the finer bloodvessels of the retina. Concerning retinal hæmorrhage and its frequency Brunt³ writes that during the years 1882-1886, 192 cases of malarial fever were treated in the wards of the Charity Hospital in New Orleans, but during the same time only six indubitable cases of malarial hæmorrhage are recorded in the books of the Eye-clinic.

Jacobi⁴ believes a neuritis, not itself intermittent in character, bears no direct relation to malaria. According to him, this depends upon severe recurring hyperæmias of the opticus and retina, separated by such short intervals that the dilated bloodvessels cause œdema and incarceration of the intraocular end of the optic nerve within the scleral ring (according to von Graefe).

McNamara⁵ "inclines to the idea that the inflamed state of the optic papilla is due to something of the nature of a microbe which becomes planted in the affected tissue, and growing there produces ptomaines, which in their turn cause irritation of the tissues, engorgement of the vessels, and the transudation of serum and leucocytes into the retina and optic papilla."

¹ Thèse de la Havane, Recueil d' Ophthal., 12, 1888.

² New York Medical Record, July 14, 1888.

³ Loc. cit.

⁴ Loc. cit.

⁵ Loc. cit., British Medical Journal.

In some instances optic neuritis is secondary to meningitis. Galezowski ascribed the atrophy to pigimentary embolism; in the majority of cases it is consecutive to a neuritis.

It is of prime importance to exclude chronic kidney and hepatic disease before attributing these retinal and optic nerve lesions to miasmatic poison, and in the atrophies the influence of quinine must be eliminated. Bull¹ has examined 150 cases of malaria, and omitting the instances in which co-existing hepatic and renal disease existed, believes the examples of "degeneration or inflammation of the optic nerve due directly to miasmatic influence" to be infrequent, a position in which he is supported by Kipp.² McNamara, on the contrary, writing of England, thinks the instances more common where malaria prevails than is generally supposed. The writer has examined numerous malarial subjects in Pennsylvania and found only rarely coarse retinal changes.

Lesions in the Vitreous and Choroid.—The lesion of the vitreous which most usually has been recorded is hæmorrhage. In one case related by von Kries³ this occurred in a patient who suffered from ague on the first day after the paroxysm had been arrested by quinine. Levrier⁴ quotes Galezowski as relating an example of periorbital neuralgia with atrophic choroiditis and flocculi in the vitreous, and Peunoff reports choroiditis and vitreous opacities. In this

¹ St. Louis Courier of Medicine, vol. iii., 1880, p. 543.

² Transactions Medical Society of New Jersey, 1881.

³ Archiv f. Ophthalmologie, vol. xxiv, I., p. 159.

⁴ Loc. cit.

country hæmorrhage into the vitreous has been noted by E. W. Jones,¹ and W. W. Seely² records two examples of serous effusion into the vitreous due probably to malaria. In the first case the vitreous was filled with an "impenetrable mist" which gradually cleared in two months. The patient had one severe chill, and the urine was normal. In the second case there was only a gray reflex from the fundus; supra-orbital neuralgia was associated. Brunt³ has seen one similar case. The most important communication on vitreous hæmorrhage in cases assumed to be malarial, is from the pen of C. S. Bull.⁴ Seventeen cases are reported in which the hæmorrhages occurred almost always in one, though they also occurred in both eyes, but never simultaneously. All of the patients were over forty years of age, and all the subjects of pronounced malaria contracted in markedly miasmatic regions. Valvular disease of the heart, chronic renal change, rheumatism and gout were excluded. In the majority of the cases the blood was extravasated generally through the vitreous; in a few it was in the posterior part. The hæmorrhages appear to have been due to rupture of choroidal or ciliary vessels, and possibly the vessels of the sheath of the optic nerve during the congestive stage of the malarial attack. After absorption of the blood, which was slow and left behind membranous opacities, areas of atrophic

¹ Loc. cit.

² Transactions American Ophthalmological Society, 1882, p. 345. Ibid. 1885, p. 64.

³ Loc. cit.

⁴ New York Medical Record, vol. xxx. p. 617.

choroiditis were seen in the periphery of the eyeground.

Changes in the Field of Vision.—Malarial amblyopia is always accompanied with more or less restriction of the visual field. A central scotoma may exist, small at first, or large enough to invade the whole field and produce the blindness (Teillais), or contraction of field and amblyopia with each paroxysm. In case of atrophy there is marked contraction, color scotoma (Bull), and color blindness (Peunoff). A remarkable phenomenon is hemianopsia. Peunoff¹ describes lateral hemianopsia with the approach of fever. Reich² himself had right lateral hemianopsia while suffering from the fever, and I refer by permission to a case under the care of Dr. Joseph Leidy, Jr., in the wards of the Pennsylvania Hospital in which there was bi-temporal hemianopsia. The corpuscles of Laveran led to a correct diagnosis, and the condition was cured by quinine.

The Pupils and Accommodation.—In some of Pagenstecher's cases of intermittent ophthalmia, paresis of accommodation was an associated symptom, and according to Bull the intermittent forms of visual disturbance probably are due to paralysis of accommodation. Mannhardt³ reports three examples of paralysis of accommodation in subjects of stubborn quotidian and tertian intermittent (quinine produced a cure), and Stellwag⁴ on the authority of

¹ Nagel's Jahresbericht, 1883, p. 301.

² Centralblatt f. praktische Augenheilkunde, 1879.

³ Klinische Monatsblatt f. Augenheilkunde, 1865.

⁴ Diseases of the Eye, 4th edition, p. 748.

this author places malaria among the causes of this derangement of the functions of the ciliary muscle. Stilling¹ reports larvate intermittent fever under the form of supra-orbital and ciliary neuralgia which reflexly brought forth spasm of accommodation.

Various authors have described the pupils as dilated and inactive, or unaffected; the latter when there has been complete blindness, a condition which is analogous to that which is seen in uræmic amaurosis.

Finally, as a functional disturbance, night blindness has been reported by C. Zimmerman² and by Pöncet, who says it may be associated with peripapillary œdema.

Paralysis of the external eye muscles has been recorded in a few instances, but must be a rare manifestation. It is not mentioned in Mauthner's *Diagnostik und Therapie der Augenmuskellähmungen*, Wiesbaden, 1889.

Illustrative Cases.—During the last year the writer has examined a large number of cases of acute intermittent fever and chronic malaria without discovering, except in a few instances, serious ocular changes. Practically all of these cases had contracted their intermittents in the climate around Philadelphia—in other words, in regions not noted for types of pernicious fever. In the Eye Dispensary of the University Hospital, and in the wards of the Philadelphia Hospital, a number of cases of keratitis have appeared in malarial subjects, but they did not present the characteristic lesions noted by Kipp, Noyes

¹ Klinische Monatsblatt f. Augenheilkunde, xiii. p. 530.

² Archiv f. Augenheilkunde, Bd. xiv., H. 1.

and Van Milligen. In short, they should be described as "intermittents with keratitis," and not as examples of true malarial keratitis. In two cases there were multiple retinal hæmorrhages, and in one superficial optic neuritis with a single hæmorrhage.

CASE I. *Retinal hæmorrhages*.—A man, aged thirty-five, a laborer, working on an embankment and subject to much night exposure, was admitted to the hospital, and without any thorough examination classed as "general debility." An ophthalmoscopic examination revealed in each eye large oval hæmorrhages at the outer side of each disk. The spleen was enlarged. Under anti-malarial treatment the case improved, but disappeared from observation before a cure was obtained. The urine and heart were normal.¹

This case was in all probability an example of true malarial hæmorrhage occurring in a man who had contracted his disease in a miasmatic neighborhood, and in whom the disease had become chronic with associated anæmia.

CASE II. *Multiple retinal hæmorrhages, probably malarial in origin*.—This patient, a man, aged forty-eight, living in Maryland, was seen in consultation with Dr. J. Madison Taylor, in May, 1888. He had suffered from intermittent fever of the tertian type for ten years, and three times contracted remittent fever. The spleen was enlarged. Two blood-counts made in 1888, at short intervals, yielded 2,800,000 red blood-corpuscles to the cubic millimetre, and later 3,200,000, the hæmoglobin being respectively 28 per cent. and 30 per cent. Subsequent examina-

¹ Transactions County Medical Society of Philadelphia, April, 1890.

tions showed improvement in corpuscular richness and corresponding rise in the percentage of hæmoglobin. The heart presented no organic disease; repeated examinations of the urine, the absence of any indications of chronic Bright's disease. In the right eye the cornea was conical; the disk gray, containing a sharp central cup, and on its surface a flame-shaped hemorrhage, while above and to the nasal side there were three round hæmorrhages. In the left eye the disk was also very gray, and up and out from its margin, and down and in likewise, there were two small, round hæmorrhages. The macula contained numerous fine yellowish dots, and several small dot-like hæmorrhages.

This case at first sight led to the suspicion of pernicious anæmia; the gradual improvement, however, under the influence of iron and arsenic disproved this theory, and the anæmia was attributed to the malaria. This patient died subsequently of pneumonia, although before his death there had been marked improvement in the general condition.

CASE III. *Superficial optic neuritis; one small retinal hæmorrhage; probable influence of malaria.*—This case, a child, aged twelve years, was brought for constant frontal headache and some habit-chorea of the orbicularis. He lives in a malarious district on the banks of a river, and every summer for three years has had chills and fever. His last chill occurred on January 1st of this year. Since this date there have been no chills but numerous attacks of headache. Each optic disk was swollen slightly above the level of the eye-ground (+ 1.5 D.). All edges of the disks were veiled, the nasal sides hidden. The central lymph sheaths were full, white lines extending some distance along the vessels. In the

right eye on the nasal side of the disk along the course of the nasal artery there was an oval, partially absorbed hæmorrhage. The urine was normal, the heart normal, the spleen slightly enlarged, the hæmoglobin 75 per cent., the blood-corpuscles 4,262,500, or, in other words, for the amount of red blood-corpuscles enumerated there was a deficiency of 10 per cent. in hæmoglobin. Repeated examinations of the blood failed to demonstrate the corpuscles of Laveran. This is probably explained by the fact that the child had always been given large doses of quinine up to the date of his first visit, January 23d.

In this case the presence of hypermetropia lent some doubt in regard to the etiology of the headache. The correction of this refraction-error did not control the headaches, which, however, disappeared under the influence of ascending doses of arsenic. The same is also true of the neuritis, which at his last visit, in the latter part of April, was well-nigh dissipated. The neuritis and hæmorrhage probably were due, in spite of the absence of the corpuscles of Laveran, to malaria. The history is perfectly clear; all organs were normal, and anti-malarial treatment effected an improvement. It is, however, equally true that hypermetropia is capable of producing superficial neuritis and congestion of the end of the optic nerve, and, furthermore, as this was corrected, it may have aided in the subsidence of the neuritis, as it also may have been the cause of its appearance.

In conclusion malaria may originate:

1. An ophthalmia of the intermittent type, which

sometimes replaces the ordinary manifestations of the disease.

2. A form of keratitis, properly described as "malarial keratitis," and quite distinct from those types of corneal inflammation which are simply associated with intermittent fever.

3. Various functional ocular disturbances, amblyopia, paresis of accommodation, changes in the field of vision, even hemianopsia and night blindness.

4. Gross changes in the interior of the eye, optic neuritis, optic atrophy, retinal hæmorrhages, and hæmorrhage into the vitreous.

In the event of the appearance of any of the disorders of the fourth class it is necessary before ascribing it to malaria to eliminate rheumatism, syphilis, chronic Bright's disease, and chronic hepatitis; and, in so far as atrophies are concerned, the influence of quinine. In any doubtful case, especially in larvate forms of intermittents, and, indeed, in all cases a careful examination of the blood should be made with the hope of determining the presence or absence of the corpuscles of Laveran. It remains to be shown what relation the character and number of these bodies bear to ocular diseases attributed to malaria.

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