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ATLAS FUNDUS OCULI

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November 1934.

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BY

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INTRODUCTION BY

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With 100 Colour Plates

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1934

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To

MY WIFE

FOREWORD

"Often," wrote Carlyle, "I have found a portrait superior in real instruction to half a dozen biographies." The Chinese express the same thought in their maxim: "One picture imparts as much information as ten thousand words."

This modest volume does not cherish any such great aspirations; yet it hopes by its earnest endeavour to approximate actual fundus conditions, to be of some service to those who use the ophthalmoscope. It must be borne in mind, however, that it is impossible to reproduce perfectly by artificial means the beauty and the brilliancy of the ever-changeful, living fundus designed by the greatest of all artists — Nature.

Atlases of the fundus oculi are not lacking. To Jaeger, Liebreich, Frost, Haab, Oeller, and others, students of the ophthalmoscope owe an unforgettable debt of gratitude. But it is growing more difficult to acquire copies of their works; students of ophthalmoscopy are increasing rapidly in numbers; and general medicine and ophthalmology are becoming more closely united. Since the appearance of these atlases, opinions concerning the causes of many fundus lesions have changed; and great improvements have been made in the ophthalmoscope itself — the illumination, the definition, and the magnification. Photography of the fundus has made great advances in recent years; but it cannot take the place of reproductions in colour by the brush. For what Haab says in regard to black and white drawings, is to some extent true of photographs: "They may reproduce the drawing and topography, but as they fail to give the important element of colour, they can be understood and utilized only by one who already possesses a fair knowledge of the conditions portrayed." Photography in colour still has its limitations, and very few ophthalmologists have found the application of this method to be successful. For fundus changes which are minute but important are not always very clearly reproduced.

The accurate printing of fundus drawings in colour is a very laborious and costly undertaking; sometimes in offset-lithography from eight to sixteen impressions (one mat for every colour) are required to produce one plate. The cheaper processes are far from satisfactory; and many of the coloured illustrations in modern textbooks are far from being true to life, although the original drawings may have been excellent.

In the chapter entitled "Ophthalmoscopic Examination," some points in the practical use of the ophthalmoscope, and a few of the factors in the ophthalmoscopic picture, are described. The plates illustrate variations in the normal eyeground, a few congenital anomalies, and some of the more common fundus lesions. Where the plates show pathologic changes, the important clinical and laboratory findings are included in the descriptive text. Fundus drawings of a few of the lower animals most frequently used in experimentation have also been included.

In making these paintings, the self-illuminating ophthalmoscope and the direct method

have been employed, and their correctness verified by the use of the Gullstrand binocular and Friedenwald ophthalmoscopes, red light, and red-free light.

With a few exceptions, the record number of the patient has been inserted in the description of the plate, so that the complete history may be available to any one who wishes to study the case in detail.

In order that the reader might have both the plate and its description before him at the same time, the treatment and course of the disease have not been given in many cases, and all surplus words have been omitted from the explanations of the drawings. The initials "B.M.R." are used in place of "basal metabolic rate," and the word "tuberculin" instead of the "intracutaneous diagnostic method of Denys."

In the retina — as in other structures — it is difficult to say from size alone where an artery ends and an arteriole begins. Many writers consider all arteries in the retina as arterioles; but the author feels that it is more in keeping with the histological structure of the central retinal artery, and more satisfactory clinically, to consider the main stems and primary divisions as arteries, and the smaller branches as arterioles.

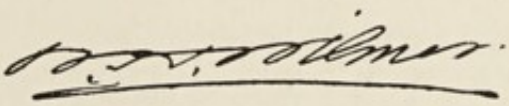
The terms "renal retinitis," "albuminuric retinitis," etc. have been sanctioned by usage. But, unfortunately, they suggest disease of the kidney or the presence of albumin in the urine, as the cause of the retinal lesion; whereas, it is probable that in most instances, both kidneys and eyes are affected by the same toxic substance, or substances, in the blood stream, or by similar vasoconstriction of their arterioles with secondary degenerative changes. Therefore, in order to connect the title of the plate with the pathologic retinal changes pictured there, the terms "arteriolosclerosis" (hyalinization of the media with lipoid deposits) and "arteriosclerosis" (connective tissue thickening of the intima with atheromatous changes) are used, although even they are not entirely satisfactory. For the characteristic changes of arteriolosclerosis may affect the larger vascular stems as well as the smaller ones. Or, in advanced cases of cardiovascular-renal disease, both arteriolosclerosis and arteriosclerosis may be present. Moreover, the term "retinitis" suggests a condition of inflammation; but in fact the inflammation is secondary to the more obvious changes of degeneration.

The originals of these paintings have been found in private and consultation cases, and in the various departments of the Johns Hopkins Hospital.

To all of his colleagues, the writer is deeply grateful, especially to Dr. Longcope for his great helpfulness and for his keen interest in ophthalmoscopy, and to Dr. MacCallum for his valuable suggestions in regard to pathologic changes. He owes a debt of gratitude to the artist, Mrs. Burgess, for her accurate and painstaking efforts to reproduce all conditions as they actually appear. The writer also wishes to express his sincere appreciation of the assistance of Dr. Woods, Dr. Jonas Friedenwald, Dr. Rand, Dr. Rones, and of the other members of his Staff. To those colleagues who have allowed interesting fundus conditions of their patients to be reproduced, acknowledgment is made in connection with the plates. In particular, thanks are due to the good friends who, by their interest and their generosity, have made this publication possible.

It was said by Heine that "No author is a genius to his publisher" — or "to his lithographer," might well be added. Therefore, the writer wishes to extend his thanks to The Macmillan Company for their forbearance, as well as for their kindly interest, and to A. Hoen & Co. for their skillful and painstaking reproductions.

So with the remembrance of Emerson's consoling words, "'Tis the good reader that makes the good book," this volume is committed to the tender mercies of the students of ophthalmoscopy.



WILMER OPHTHALMOLOGICAL INSTITUTE OF
THE JOHNS HOPKINS UNIVERSITY AND HOSPITAL
JUNE 16, 1934

ILLUSTRATIONS

NORMAL TYPES

ANIMAL FUNDI

CONGENITAL ANOMALIES

PATHOLOGIC CONDITIONS

INTRODUCTION

The permanent contributions to medicine have usually been made in one or two ways, either in the form of accurate descriptions and illustrations, or in the form of original discoveries. The first, being reproductive, is the older method of the two; the second, gaining impetus through experimentation, has flourished later in the history of science. Both methods are essential to the growth of our knowledge of all the natural sciences. The first has long been recognized as the descriptive method; the second originates most frequently through the experimental method. The lasting value of the descriptive method lies in the fact that it preserves an accurate record of an incident in Nature, while the importance of the discovery is measured by its power to propagate a new idea.

It seems scarcely necessary to recount examples in order to press these points further, but such importance is now attached to experimental science, that one is prone to overlook the contributions that have been made through the older method based on personal observation. If one wished to emphasize the value of this method, he need only recall the incomparable drawings of the 16th and 17th centuries which illuminated the structure of the human body; the brilliant and pithy pictures of disease left to us by the writers of the 17th century; and the accurate records of the morbid processes affecting the organs of the body made during the 19th century. All of these records are cherished and carefully preserved, not only on account of the value which they possess as historical records, but because they still stand as masterpieces of accurate observation, reproduced with remarkable fidelity.

The invention of instruments which allow us to look into many recesses of the body, previously hidden from view, has led, naturally, to attempts at reproducing the appearances of these structures both in health and in disease. It is due to the genius of Helmholtz, who in 1851 invented the ophthalmoscope, that we have for many years been able to inspect one of the most important of these dark recesses; namely, the fundus of the eye. Owing to the perfection in the construction of various forms of the ophthalmoscope it is now possible to examine, in the minutest detail, the beautiful and complicated structure of the retina. It is not surprising, therefore, that many attempts have been made to reproduce the appearance of the normal fundus as well as the changes that are most frequently encountered during disease. Some of these efforts have been more or less successful, but many have lacked the conviction of reality, while others, though correct in form, have failed sadly to give a correct impression of the natural colours of the fundus. This is a serious defect, for the exact reproduction of the shades of colour is essential to a correct interpretation of pathological processes.

The beautiful plates that cover the pages of this atlas have neither the one fault nor the other. They delineate with extraordinary faithfulness the appearance of the fundus in a great

variety of conditions. The drawings are accurate, and the delicate modulations of colour are reproduced with great skill. We may see in these plates, as though looking through the ophthalmoscope, the fundus of different types of human beings, of different races, and of a wide range of pathological conditions.

On this account, therefore, the reproductions of the pathological changes in the fundus are of unusual value, both to the ophthalmologist and to the clinician; for there is, perhaps, no structure in the body that reflects so frequently and so definitely such a variety of diseases that affect the body generally. One may see, in this small space, the head of the optic nerve, a meshwork of arteries and veins, as well as irregularities in the disposition of the pigment. Inflammatory reactions, secondary to infections affecting distant portions of the body, are prone to involve the highly vascularized tissues of the retina and choroid, while intoxications that may not produce a visible result elsewhere, may cause changes that can be detected in the fundus.

Since it is necessary to conceive of the fundus oculi as a tissue of the body that participates very frequently in general disease processes, it seems appropriate, in this introduction, not only to mention this well-known fact, but to develop the subject somewhat further.

The acute infectious diseases form an important group in which the fundus is not infrequently affected. During the course of the acute exanthemata, and in such protracted infections as typhoid fever, one may at times observe an optic neuritis with reddening of the disks, injection of the small vessels about the periphery and blurring of the disk margin. In rare instances an inflammatory reaction may appear in the choroid.

Much more common, however, and perhaps of greater practical significance are the changes that are often observed in the retina in general bacterial infections and as complications of septic processes. The small lenticular or round hemorrhages, which may be frequently seen in the retina during the progress of subacute bacterial endocarditis, are as significant as the petechiae which appear in the conjunctival mucosa or in the skin of the body. The retinal hemorrhages, like those in the mucous membranes and in the skin, are usually punctuated by a yellowish central dot, and are prone to make their appearance and then undergo rapid absorption. The detection of these small hemorrhages in the retina of the patient, suspected of having subacute bacterial endocarditis, adds further evidence for the diagnosis. Embolism of the central artery of the retina is a rare and more serious complication. It often explains the sudden attack of blindness from which these patients may suffer.

Suppurative processes in distant parts of the body may be accompanied by profound changes in the fundus oculi. Hemorrhages scattered through the retina, as well as optic neuritis, are not infrequent. Occasionally a pronounced neuroretinitis may be observed. The nerve head is swollen, and hemorrhages and exudates are numerous. Such extensive alterations are to be observed in suppurative pyelonephritis, in severe infections of the paranasal sinuses, or in instances of sepsis dependent upon suppurative thrombophlebitis. In the last condition infected emboli may be carried to the choroid or retina, causing the most violent forms of acute choroiditis and retinitis.

In syphilis, the eye is so frequently affected that one must regard the careful inspection of this organ as of equal importance with the examination of the skin, the heart, and the nervous system. The choroidal atrophy that occurs in congenital syphilis is quite typical. Optic neuritis is an important manifestation of the meningitis that may occur during the early stages of syphilis. It is important that the clinician should be familiar with the forms of choroiditis, or retinitis, and chorioretinitis that are characteristic of the different stages of acquired syphilis; for these affections of the eye are common, and may, if they are not recognized early and treated promptly, lead to serious impairment of the vision. Of no less importance is the detection of the first evidences of choking of the disk in gumma of the brain; for this may be an early sign of increased intracranial tension. Familiarity with the appearance of the nerve head under normal and abnormal conditions is essential; for, without such knowledge, one may overlook the early signs of choking, or miss entirely the picture of primary optic atrophy that is indicative of tabes dorsalis.

Though tuberculous lesions of the choroid and retina are, as compared to syphilis lesions, relatively rare, still their recognition by the clinician is important. Occasionally it happens that one may make the diagnosis of miliary tuberculosis by finding a few miliary tubercules scattered through the retina and choroid.

It is not necessary to dwell here upon the peculiar significance of the optic neuritis that results from intoxications of various kinds; for the unfortunate instances of blindness that have followed the therapeutic use of arsenicals such as atoxyl, or poisoning by methyl alcohol, have been made widely familiar.

Emphasis need not be placed, either, upon the varied changes that may appear in the retina in connection with diseases of the hematopoetic system. In erythremia one of the typical features of the disease is the engorgement and tortuosity of the veins of the retina. The retinal hemorrhages that are seen in pernicious anemia and in the anemia of pregnancy have been considered, for many years, as peculiar to these forms of anemia, and are of considerable significance in differentiating primary anemia from anemia such as that secondary to the loss of blood or to malignant disease. Purpura hemorrhagica is accompanied by extensive hemorrhagic retinitis; leukemia by engorged, pallid veins, hemorrhages, and edema of the disk.

The ophthalmoscope offers a remarkable opportunity to study the detailed structure of blood vessels. Nowhere else in the human body can one observe with the same clearness during life the small arteries and arterioles. Precise knowledge, therefore, of their appearance in health, as well as in disease, is as important for the clinician as for the ophthalmologist. The vascular field of the retina can only be regarded as a small fraction of a great system; and it usually happens that pathological changes which affect the arteries and arterioles of the retina and choroid also involve the arteries and arterioles of other organs of the body. It would be unwise to assume, however, that the intensity of the process is evenly distributed throughout the vascular system, or indeed that the pathological lesion affects all the vessels throughout the body of the size seen in the retina. This, as far as one can learn, is not the case. On the contrary, disease of the finer vessels is, apparently, scattered through the body in somewhat irregular fashion.

Arteriolosclerosis, one of the important features of which is a hyaline degeneration of the vessel wall, is prone to affect the minute arteries of the kidney, the pancreas, and the retina. The early recognition of arteriolosclerosis is extremely important since it is associated with the most serious forms of hypertension. On the other hand, arteriosclerosis, in which the intima of the larger arteries is thickened and, in those of the extremities, the media calcified, attacks with peculiar frequency the coronary and cerebral vessels. The involvement of arteries leading to the retina by arteriosclerosis may produce effects that can be observed in the fundus.

When one examines the diseased arteries and arterioles of the retina, therefore, some attempt must be made to differentiate, if possible, between the different forms of vascular disease; and to determine, as nearly as may be, the relationship which the abnormalities of the retinal vessels bear to possible pathological processes in the arteries or arterioles of other organs of the body. Since the vessels of the fundus oculi seem to be particularly vulnerable, and since serious arterial disease may progress in various organs of the body to an advanced stage without producing symptoms that attract unusual attention, it becomes essential for the clinician to familiarize himself with the appearance of the retinal vessels in all conditions of health and disease. The examination of the eyegrounds should be established as a routine, and the constant reference to an atlas of disease of the fundus oculi follows as a necessity. The clinician may thus be enabled to detect the earliest evidences of vascular disease, and be forewarned of an imminent danger to such vital organs as the brain, the heart, and the kidneys.

Even in early instances of essential hypertension it is possible to see the compression and nicking of the veins when they are crossed by the tense arteries. This may occur without visible disease of the wall of the artery. In arteriolosclerosis, however, it may be possible to discover the first definite signs of the disease by ophthalmoscopic examination, and to follow, step by step, the progressive alterations that involve the vessels of the fundus. One may actually see, as the disease advances, the deviations that take place in the course of the vessels, the narrowing or actual occlusion of their lumina, the appearance of the hemorrhages along the veins and arteries, and the swelling of the disk margins, as intracranial tension increases with the elevation of the blood pressure. One may watch, too, the development of the characteristic flat, scintillating exudates that radiate about the macula, and be warned of the terminal stages of the disease by the appearance of the white, fluffy exudates throughout the retina.

The appearance of uncomplicated arteriolar disease of the fundus is often modified by changes consequent upon an infection elsewhere in the body. The retina and choroid, already injured through disease of their blood vessels, and poorly nourished with blood, appear to be more susceptible than usual to the deleterious influence of infections of the nasal sinuses, or local inflammatory processes in other parts of the body. In such instances a form of toxic retinitis, or choroiditis, may be engrafted upon the arteriolar process which results in a complicated picture.

The direct relation which Bright's disease bears to changes in the fundus oculi, and the participation of arteriolosclerosis in the production of some of the lesions seen during the course of certain forms of Bright's disease, form a fascinating field for study. This subject has recently

occupied the attention of many investigators, and in spite of the excellent investigations that have been devoted to it, there still remain questions for solution. The difficulty arises largely from the fact that our knowledge of Bright's disease is incomplete. At the present time the tendency is to recognize at least three forms of the affection; namely, hemorrhagic Bright's disease, or glomerular nephritis; degenerative Bright's disease, or nephrosis; and arteriosclerotic Bright's disease, or nephrosclerosis.

The acute forms of hemorrhagic, or diffuse glomerular nephritis, such as those which follow scarlatina or tonsillitis, are not often associated with extensive changes in the retina. Occasionally hemorrhages and small exudates are observed. The margins of the optic disks are sometimes blurred; the arteries and veins often appear tortuous, and edema of the retina is seen with remarkable regularity. The origin of the acute retinitis is not altogether clear. It usually occurs in those patients who have an infection due to hemolytic streptococci, who have a sudden and marked rise in both systolic and diastolic blood pressure, and who have subcutaneous edema generally ascribed to the effect of a toxin upon the blood vessels. Any of these factors acting alone or in combination might, therefore, be held responsible. In favourable cases the retinitis disappears as the patient recovers. The edema of the retina can be interpreted as a part of the generalized edema so characteristic of this condition. It subsides as the anasarca disappears, but either the edema of the retina recedes more slowly or it may be detected more readily in the retina than elsewhere, for distinct evidence of edema of the fundus may be seen long after all signs of edema of the subcutaneous tissues have vanished. The retrogression of edema of the retina, therefore, forms a delicate index of complete recovery from this symptom in acute glomerular nephritis. If the acute glomerular nephritis progresses to the active or nephrotic stage, the edema of the retina may increase. It is interesting to recall that uncomplicated glomerular nephritis may reach the terminal stage without producing further damage to the retina or choroid than an occasional small exudate or hemorrhage; but it frequently happens, particularly in the patients who have persistent and marked hypertension, that varying degrees of choked disk are noted, and extensive hemorrhages and exudates are seen in the retina. When arteriolosclerosis complicates glomerular nephritis, the combination results in the most pronounced forms of hemorrhagic and exudative lesions in the retina with extreme grades of choked disk.

In the nephrotic forms of Bright's disease, the blood vessels are spared injury, and the blood pressure is not elevated. In the uncomplicated instances of this type of Bright's disease, there are no hemorrhages, exudates, or vascular changes in the retina; edema sometimes involving the margins of the disks may be the only alteration in the fundus.

The arteriosclerotic form of Bright's disease, or nephrosclerosis, is often accompanied, early in its course, by the most astonishing changes in the fundus. Here one sees all the phases of arteriolar disease, from the early narrowing of the vessel with compression at the arterio-venous crossing to complete occlusion of branches of retinal and choroidal vessels. Hemorrhages and exudates of all types are common, and the most extreme grades of edema of the nerve head are observed. The grave nature of the malignant form of arteriolosclerotic Bright's disease may

often be first recognized by an ophthalmoscopic examination, and the advance of the condition measured by the progress of the lesions of the retina.

It is extremely difficult to unravel the entangled causes that operate to produce these complicated pictures in the fundus in the various forms of Bright's disease. Undoubtedly arteriolosclerosis plays a predominant part. Pronounced and continued elevation of blood pressure, the tendency to edema of all the tissues of the body, and profound anemia are accessory factors. It is possible, in addition, that intoxication from infections which are common in all varieties of Bright's disease may play some part in producing the retinitis, or, at least, in exaggerating its intensity. Though it has been supposed for years that a poison formed in some way by the diseased kidneys themselves was the cause of "albuminuric retinitis," considerable doubt is now expressed as to whether this theoretical toxemia is of great significance. It seems more probable that the primary factors which cause the nephritis also affect the eye, but that in the retina, changes secondary to the nephritis, such as hypertension, edema, infection, and anemia, may in one way or another modify the pathological lesions in the fundus.

Diabetes mellitus furnishes another example of a disease in which extensive changes may occur in the fundus oculi, but it is often difficult to determine how far these alterations are due to the disease itself and how far they are due to the complications or concomitants which are so common. The optic neuritis and lipemia retinalis are undoubtedly a direct result of the disease itself. It is generally considered too, that a form of retinitis occurs which is peculiar to diabetes mellitus. It should be recognized, however, that infections as well as arteriosclerosis are frequent accompaniments of diabetes mellitus, and the question must arise, in some instances, as to whether one or both of these factors may contribute to the retinitis which is observed. A form of sclerosis of the retinal vessels, somewhat different from that observed in arteriolar disease, is not unusual in diabetes mellitus. It partakes of the character of the sclerosis involving the peripheral arteries of the extremities and may lead, as it does in some instances of diabetic gangrene, to occlusion of the lumina. It is of some moment, therefore, that one may, at times, be able to detect this form of arterial disease by direct inspection of the fundus oculi, and at least become aware of the dangers that the future may have in store for the patient.

In quite a different field of medicine, the ophthalmoscopic examination is of paramount importance, both to the physician and to the surgeon. This group of diseases includes all the conditions which lead to increased intracranial tension. Brain tumour stands first on the list, but to this must be added such serious diseases as meningitis of all forms, subdural abscess, sinus thrombosis, pachymeningitis hemorrhagica interna, cerebral hemorrhage, aneurysm of the cerebral vessels, and hydrocephalus. All of these varied conditions may produce, sooner or later, an increase in intracranial tension, which results first in swelling of the disk margin, next in edema of the nerve head, and, finally, in secondary optic atrophy and blindness. The alterations in the disk margin and in the nerve head are observed as an early sign of increased intracranial tension; and it is highly important that the physician and the surgeon should be able to recognize the first evidences of choking of the disk. He must also be able to differentiate edema of the disk margin, characteristic of the first stages of choking, from the changes

observed in optic neuritis; for optic neuritis may complicate a great number of diseases and infections, not associated with increased intracranial tension.

This brief introduction and summary may serve to emphasize the importance of a careful study of the fundus oculi for those who are engaged in the practice of medicine and of surgery; for there is a vast range of disease in which the retina, the choroid, or the optic nerve, may show abnormalities. These changes in the fundus are, at times, the first to give concrete evidence of disease; and furthermore, the alterations that they undergo may furnish valuable indications as to the favourable or unfavourable progress of the disease. Accurate information concerning the appearance of the fundus oculi in a great majority of diseased states can only be had through wide experience gained by many years of study. Few are privileged to acquire this knowledge, and only under exceptional circumstances can the knowledge be made available to others.

The *Atlas* therefore derives its value from several sources. In the first place, it may be regarded as a series of personal records, selected by Dr. Wilmer with the discretion and wisdom that comes with great experience, to illustrate the appearance of the fundus under normal conditions and in a great variety of pathological states; in the second place, it furnishes through the histories, so excellently epitomized, the information necessary for a useful correlation of the pathological lesions in the fundus with the disease from which the patient suffered; and in the third place, it unfolds before our eyes one beautiful reproduction after another, each one of which depicts the changes in the fundus with a brilliancy and accuracy that cannot be surpassed.

WARFIELD T. LONGCOPE

ATLAS FUNDUS OCULI

OPHTHALMOSCOPIC EXAMINATION

A recent small volume on affections of the eye states: "With a little practice it is not difficult to learn the appearance of a normal disk"; while a panegyric on a recently advertised ophthalmoscope closes with the naïve statement: "No skill is required to use." It is to be hoped that this statement does not include interpretation of ophthalmoscopic findings; for the serious student of ophthalmoscopy soon discovers that there is a wide difference even in normal fundi. Healthy eyegrounds differ in the colour of the optic disk, the conformation of its margins, and of the physiologic cup; also in the size, distribution, and tortuosity of the retinal vessels. There is also variation in the diffusion of pigment in the choroid and retina, and variation in the fundus colour. To complicate the picture, there are many congenital anomalies — medullated nerve-fibres, colobomata, "Gunn's Dots," pre-retinal loops, and various embryonic remains. The author recalls two recent interesting instances of congenital anomalies in young men whose ocular functions were normal, and general physical condition excellent: the tortuous retinal vessels in one case were considered the possible precursors of retinal vascular disease; and the "Gunn's Dots" (Plate 19) of the other, as a punctate retinitis. "Tyrant Time" also leaves his imprint upon the eye backgrounds. Loring[1] describes these changes very dramatically: "The aspect of the fundus of the young eye differs as much from that of the adult as the countenance, and bears all the peculiar look of freshness which youth possesses."

Before considering the even greater variations in the fundus in pathologic conditions, it is appropriate to give at this point a brief explanation of some of the factors in the changeful, normal, ophthalmoscopic picture.

The colour of the normal fundus is composite. It is produced by the sclera, which represents the artist's canvas, and by the various superimposed structures, which correspond to his pigments in the finished picture. The details of both sclera and choroid, like the canvas of the artist, grow less visible in proportion to the density of the overlying pigment. The colouration of the normal fundus corresponds somewhat to that of the hair and skin; and it is determined largely by the amount of pigment in the retinal epithelial layer and in the three pigmented layers of the choroid. It is also influenced to a lesser degree by the three vascular layers of the choroid, by the blood vessels of the retina, and possibly by the rhodopsin contained in the rods.

There is an infinite variety of hue, saturation, and brightness of colour in the fundus of the normal eye — ranging from the brilliantly reflecting, chocolate coloured fundus of the pure-blooded negro, to the washed out, yellowish red eyeground of the albino. The so-called

[1] Loring, E. G. "Text Book of Ophthalmoscopy." Vol. 1. New York. D. Appleton & Co. p. 84. 1886.

"transparent" retina, even apart from its pigment layer, contributes its share to the composite ophthalmoscopic picture and its colour scheme; the larger retinal vessels are prominent features in the fundus; and even the arterioles and capillaries add to the tinge of red. In youth, and in the dark-skinned races, the beautiful, dancing reflections from the lamina interna of the retina, and the more stable ones from the blood vessels, are very entrancing additions to the ophthalmoscopic view of the background. The nerve-fibre layer of the retina around the disk gives a pretty appearance of minute, white, radiating lines, which are especially well seen in youth, in the dark-skinned races, and with red-free light. A great many of the pathologic fundus changes involve the retina.

The chocolate coloured fundus is found in the black races and in the higher orders of monkeys. In this type of eyeground, the deposit of pigment in the retinal pigment epithelium is so dense that it obscures all details of the underlying tissues. However, the red colour of the choroidal vessels does show through slightly. This pigment deposit is the chief factor in this colouration. (Plate 1). In an eyeground of this type — as well as in some other deeply pigmented fundi — the observer frequently receives the impression of an ethereal, intangible, dark green sheen, which is especially marked in youth. This appearance is probably the subjective green quality which is always seen when yellow or orange is darkened, and it is produced in this instance by the overlaying of the red choroid by the retinal pigment epithelium. The phenomenon is especially well seen in Plate 4.

The chocolate-red fundus is seen in the brown mulatto and in other persons of similar tint in whom the pigment in the retinal epithelial layer is less dense than in the chocolate coloured fundus. Therefore, the vascular layers of the choroid become more important factors in the general fundus colouration. A relatively slight admixture of Caucasian blood is sufficient to change the smooth chocolate coloured eyeground of the pure-blooded negro to a reddish tint, often with a rather coarse, granular effect. (Plate 2).

The stippled or granular fundus is found in the North American Indian, the Hindu, the Chinese, and other Asiatic peoples; but the general colour scheme varies greatly in the different races. For instance, the fundamental colour of the Hindu eyeground is brown with a slight over-tint of red; in the North American Indian, the general colouration is somewhat similar; but the fundus of the Chinese is yellow. In the stippled or granular eyeground, the pigment in the retinal epithelial cells is deposited less evenly and less densely than in the chocolate coloured fundi. But the pigment is still sufficiently profuse to hide all of the deeper details. (Plates 3, 4, and 5).

In the tessellated or tigroid fundus of the dark-haired Caucasian, the pigment in the retinal epithelium is lessened, while it is still profuse in the choroid. Therefore, the pigment and the flat, ribbon-shaped vessels of the choroid become more visible, and form the most prominent features in the pattern and in the colour scheme. The granular, choroidal pigment appears as dark islets between the broad, red, vascular channels. The general hue is orange-red. (Plate 6).

The light orange-red fundus occurs in pronounced blonds. In these eyegrounds, there is

still less retinal and choroidal pigment. Therefore, the reflecting sclera and the blood vessels of the choroid become more important factors in the production of the rather even light orange-red colour. (Plate 7).

The albinotic fundus lacks pigment in the retina and choroid. Therefore, the sclera appears as a yellowish red background for the darker red, arborescent choroidal vessels. These blood vessels are more pronounced toward the periphery. The pale pigment granules of the epithelium of the retina are more numerous,[2] and the retinal capillaries more abundant in the posterior pole of the eye; so that this portion of the fundus is a darker red than the periphery. (Plate 8).

The optic disk, with its central depression, is on a general plane with the rest of the fundus. It does not correspond to the posterior pole of the eye; it lies to the nasal side and above. However, it is the most noticeable object in the fundus on account of its contrasting colour and its branching blood vessels. The optic nerve is insensitive to light; therefore the disk corresponds to the "blind spot" discovered by Mariotte in 1668. The disk, or papilla, is formed by a mass of arching nerve-fibres (some half a million in number). These fibres usually lose their medullary sheaths just back of the lamina cribrosa; and the non-medullated fibres spread out to form the nerve-fibre layer of the retina. Histologists separate these fibres into four groups: (*a*) nasal, (*b*) supero-temporal, (*c*) infero-temporal, (*d*) papillo-macular. The papillo-macular fibres are of such great importance in acute central vision, that they comprise about one-third of all those radiating from the disk — in spite of the limited area they supply.

Even in health, the colour of the disk varies somewhat; but it is usually a reddish white. This colour is produced by the nerve-fibres and their capillaries, with the reflecting lamina cribrosa as a background. Owing to the greater number of nerve-fibres and capillaries distributed over the nasal side, this portion of the disk is redder, more prominent, and the margins more indistinct, than the temporal side.

The disk is nearly circular in form. Sometimes it is slightly oval, in which case its long axis is usually vertical — though occasionally, the axis may be oblique. The actual diameter of the disk averages about 1.5 mm. In emmetropia, its apparent diameter, with the ophthalmoscope, is about 6 to 7 mm. by the indirect method, and about 21 mm. by the direct method.

The ophthalmoscopic size of the disk varies somewhat with the personal equation of the observer — just as the full moon appears to some persons as small as a dinner plate, and to others as large as a cartwheel. The magnification is less in aphakia and in hyperopia, and greater in myopia.

In high degrees of hyperopia with astigmatism, the disk sometimes has the appearance of a beginning optic neuritis, or of a papilledema (pseudo-neuritis optica). Not infrequently such a condition in children has suggested the possibility of some serious cerebral lesion, such as a tumour, because the margins of the disk in one axis are always blurred.

The physiologic cup is formed by the separation of the non-medullated nerve-fibres in their distribution to their respective portions of the retina. This depression varies a great deal in

[2] v. Hippel, E. "Albinism." Handb. d. Spez. Pathol. Anat. u. Hist. Vol. II. Berlin. Julius Springer. p. 110. 1931.

normal eyes. Sometimes a bridge of connective tissue between the vessels entirely obscures the cup; again, the disk may be so nearly flat that the retinal vessels seem to come from only a slightly curved surface; or, the cup may be in contour like the flower of the morning glory; or, it may be so large, and so crater-like in appearance, that it simulates a glaucomatous excavation. When optic nerve atrophy occurs in a disk of the last type, the simulation of glaucoma is still more marked. (Plate 22). Should glaucoma actually ensue when the cupping is very great normally, the excavation becomes especially deep and extensive. The physiologic cup is whiter than the rest of the disk; and at the bottom of the excavation, greyish spots are sometimes visible. This mottled appearance is due to the meshes of the lamina cribrosa and to the endings of the medullary nerve-sheaths. The depression of the temporal portion of the disk is due to the fact that the nerve-fibres on this side are fewer in number. This portion of the nerve is the first to appear pale in axial neuritis, and to yield to increased intraocular tension in glaucoma.

Scleral ring. — Around the optic nerve entrance (especially on the temporal side), there is often a white, crescentic ring lying close to the border of the nerve. It is called the scleral ring, or connective tissue border. It is due to the fact that the layers of retina and choroid (except the lamina vitrea) stop short of the optic nerve itself, and the sclera thus becomes visible. This appearance is often influenced by the form of the optic canal — an opening in the choroid and sclera about 0.5 mm. long and 1.5 mm. wide — through which the non-medullated optic nerve-fibres and retinal vessels pass. The shape of this canal varies a great deal in normal eyes. Its sides may be practically parallel; or, one side may be straight and the opposite one oblique; or, the anterior and posterior apertures may be smaller than the middle, which gives a barrel-shaped appearance. The anterior opening is usually narrower than the posterior. The general axis of the canal may be oblique in its relation to the surface of the globe. If the nasal angle is acute (commonly the case), the observer is able to look directly upon the whitish, temporal wall of the canal. In this way, the canal may play a part in the formation of the scleral ring. This ring is apt to increase with age.

The choroidal, or pigment, ring appears as a dark crescent around the temporal margin of the disk. At times, it entirely surrounds the disk. It is caused by an accumulation of pigment granules, or by the remains of choroidal tissue upon that portion of the sclera that separates the red fundus from the reddish white nerve. Often there is a bizarre accumulation of pigment masses around a portion of the disk. Occasionally, there are small pigment granules on the disk itself; and — very rarely — these granules collect into larger masses (congenital pigmentation of disk). Both scleral and choroidal rings may exist at the same time. When this occurs, the scleral is within the choroidal ring. In myopia, the scleral ring may be so exaggerated that it becomes a myopic crescent, or conus. (Plate 5). The increase, or non-increase, in extent of this conus indicates the tendency of the myopia to progress, or to remain stationary.

The central retinal vessels. — The central retinal artery is the first branch to be given off by the ophthalmic artery (a division of the internal carotid) after it emerges from the optic foramen in company with the optic nerve. It usually enters the nerve from its lower, medial aspect. The average point of entrance of the artery is from 7 mm. to 12 mm. back of the globe. Oc-

casionally, the artery enters the optic nerve as near to the globe as 4.5 mm.;[3] but a distance as great as 20 mm. has been noted. The vein emerges from the nerve at, or near, the point of entrance of the artery, but usually slightly nearer the globe. The vein has a longer course in the subarachnoid space of the optic nerve than the artery. Therefore, in cases of increased intracranial pressure, it is more subject to engorgement from compression. In the nerve, the vessels are contained in a connective tissue strand, which itself is covered by a tubular continuation of the pial sheath. The vessels are accompanied by sympathetic nerves derived from the carotid plexus. While in the nerve, the artery gives off small nutrient branches. These anastamose with vessels of the pial sheath and — through the circle of Zinn — with branches of the posterior ciliary arteries. (Piersol [4]). Up to the point of the first main division, the calibre of the artery is not appreciably diminished.

After leaving the nerve, the central vein empties, as a rule, directly into the cavernous sinus; sometimes it joins the superior or, more rarely, the inferior ophthalmic vein. According to Whitnall,[5] it always has a side connection, but usually with the superior vein. This collateral connection explains the fact that, in thrombosis of the cavernous sinus, engorgement of the retinal veins does not always occur. The writer has noted several such instances. In fact, in some cases he has found that the changes in the optic disk were very slight.

The retinal vessels usually emerge from the disk at its centre or a trifle to its nasal side, with the vein temporal to the artery, which is the relative position in the optic nerve trunk. But the vessels may appear to the temporal side, above, or below the centre of the disk. The relative positions of the artery and vein may be reversed. The artery usually divides — either in the porus opticus or on the disk — into two main branches, upper and lower; and these in turn subdivide into a superior temporal and superior nasal branch, and into an inferior temporal and inferior nasal branch. But at times, the artery delays its bifurcation for one to two disk-diameters from the margin of the disk. On the other hand, when the vessels divide within the nerve, they appear on the surface of the disk in the form of several branches. In the case of a very deep, gun-barrel shaped porus opticus, the vessels often pierce the thin overhanging edge of the cup, and each branch has its own point of exit.

The central retinal artery is a terminal artery; and after it appears on the disk, it does not normally anastamose with any other arterial system — a very important fact in vascular lesions of the retina. But the central retinal artery may anastamose with a short posterior ciliary artery to form a cilioretinal vessel. (Whitnall [6]). From the optic nerve entrance to the periphery of the retina, the branches of the artery grow progressively smaller, in form like the branches of a young elm tree. The arterial branches on the temporal side of the retina bend in broad, graceful curves above and below, towards the macular region, and send to it many small

[3] Yashida, Yashihara. "A Few Comments on the Point of Entry of the Arteria Centralis in the Optic Nerve." Act. Soc. Jap. XXXIV. No. 10. 1930.
[4] Piersol, G. A. "Human Anatomy." Ninth Ed. Revised. Phila. J. B. Lippincott Co. p. 1470. 1930.
[5] Whitnall, E. S. "Anatomy of the Human Orbit and Accessory Organs of Vision." Second Ed. London. Ox. Med. Pubs. p. 315. 1932.
[6] Whitnall, E. S. Vide No. 5. p. 30.

twigs. In addition, a few minute vessels on the temporal side of the disk run a rather straight course to this region. The veins in the retina follow a similar plan of division. From the retinal arterioles, capillaries carry nutrition to the cerebral portion of the retina as far as the outer border of the inner nuclear layer. The outer, neuro-epithelial layers derive their nutrition from the very vascular choriocapillaris of the choroid.

The retinal arteries have three coats: intima, media, and adventitia. J. Friedenwald has studied carefully the retinal blood vessels in health and in disease; and in a personal communication he has written as follows:

"(*a*) *Intima*, consists, in the primary branches of the retinal artery, of endothelial cells which rest on a very delicate elastic lamella. There is no subendothelial areolar tissue as in the larger arteries elsewhere. Beyond the first branchings of the retinal artery the elastic lamella also disappears, and only the endothelial cells remain to constitute the intima.

"(*b*) *Media*, consists of a single layer of smooth muscle-fibres which, except in the primary branches, do not constitute a continuous coat, but are separated from one another by gaps partially filled in by connective tissue. There is no elastic tissue in the media of the retinal vessels.

"(*c*) *Adventitia*, consists of loose connective tissue which is, in turn, surrounded by a mantle of glial fibres and cells."

In view of the divergent opinions concerning classification of the retinal vessels — whether they should be termed "arteries" or "arterioles" — the author quotes from Lewis H. Weed:[7] "I think that the consensus of belief among histologists is that we should restrict the term 'arteriole' to those branches of arteries which have no complete covering of smooth muscle. Such arterioles of course lie between the true artery, having a complete investment of smooth muscle, and the capillary bed." Therefore, according to Weed's[7] definition, and to J. Friedenwald's[8] findings, one must conclude that the primary branches of the central retinal arteries are true arteries, and that the smaller branches are true arterioles. In fact, Weed[7] further states: "I am quite sure that it is wholly correct and logical to regard the main branches as true arteries."

According to Pines (following Krückmann's histological investigations), the central retinal vessels are surrounded by a definite structure — the perivascularis, which is composed of lymphatics and delicate connective tissue. These structures are encompassed by a glial mantle which forms a practically impervious membrane. Pines states that "sclerosis of this perivascularis explains all modifications of arter ovenous compression." This view would seem correct if one judged only from the ophthalmoscopic appearance of the white lines bordering the sclerosed arteries where they cross the veins. But careful observers, like Wagener[8] and J. Friedenwald,[9] do not entirely accept Pines' view of a definite perivascularis. While Friedenwald agrees to the presence of a potential space between the ad-

[7] Weed, Lewis H. Personal Communication.
[8] Wagener, H. P. "Sclerosis of the Retinal Vessels." Arch. Oph. p. 335. March, 1930.
[9] Friedenwald, J. Personal Communication.

ventitia and the glial covering, he feels that the latter tissue is sieve-like in structure, and that the subglial space is connected with the general tissue space of the retina. Therefore, stasis in this space could not compress the veins at isolated points. Friedenwald further considers that the changes in arteriosclerosis can be accounted for by sclerosis of the walls of both arteries and veins.

The histological structure of the veins is similar to that of the arteries; but the arterial middle coat (muscularis) is absent in the veins. Ophthalmoscopically, the arteries are straighter, narrower, and a brighter red, than the veins.

The student must constantly bear in mind the fact that the tortuosity of the retinal vessels varies greatly even in healthy eyes.

While there are no true lymphatic vessels in the eye, there are numerous lymph spaces such as the vitreous, aqueous, subarachnoid, etc.; and lymph is diffused throughout the various layers of the retina.

Light-streak on retinal vessels. — The cause of this phenomenon has been the subject of divergent interpretations. While space will not allow its full discussion, it is necessary to state briefly why the smaller and more rigid artery should have a more brilliant and a wider light-streak than the larger and more flabby vein. The author [10] feels that the light-streak on the artery is caused by reflections at the anterior surface of the *media* (*muscularis*), and from the anterior surface of the *blood column;* and that the light-streak on the veins is produced by reflection at the anterior surface of the *blood column*. The diameter of the muscularis of the artery is greater than that of the blood column of the vein. Therefore the light-streak on the artery is wider and more brilliant. The light-streak is of great practical interest because of its alteration in pathologic conditions.

Pulsation of the retinal vessels. — From the standpoint of vascular dynamics, this phenomenon is a very interesting one. The percentage of recognizable instances of pulsation of the veins in normal eyes, varies with the magnification, the brilliancy of illumination, and the slit-like effect of the instrument. Additional factors are the steadiness with which the patient is able to hold the eye, the size of the pupil, and the patience of the observer. The parallax movement of the vessel from a slight nystagmoid oscillation of the eye often gives the effect of pulsation where none exists. On the other hand, with small pupils, slight pulsation may easily escape detection. In examining a large group of persons, whose ages varied from seven to seventy years, the author found venous pulsation in 70.5 per cent of healthy eyes. It was slight in 47.5 per cent; moderate in 8.5 per cent; marked in 14.5 per cent. It occurred eleven times as often bilaterally as unilaterally. It is seen best where the veins bend to enter the porus opticus. Venous pulsation is diastolic and physiologic. But it does occur also pathologically in pressure upon the globe, in ocular hypertension, venous congestion, aortic insufficiency, and in similar conditions. J. Friedenwald [11] makes the interesting statement that "so far as the local factors

[10] Wilmer, W. H., Pierce, H. F., Friedenwald, J. "The Light-streaks on the Retinal Vessels." Arch. Oph. Vol. 9. p. 368. March, 1933.

[11] Friedenwald, J. "Retinal Vascular Dynamics." (In Press).

are concerned, the absence of visible venous pulsation presents more of a problem than its presence."

Arterial pulsation is more complicated. Coccius, in 1853, and many later observers have concluded that pulsation of the retinal artery is not physiologic. In fact, it is usually stated that pulsation of the central retinal artery is systolic and pathologic. But, in 1913 Onishi[12] observed that although the pulsation of the retinal artery is slight, it is always visible by greater magnification; and that it is possible to see this pulsation entoptically upon an illuminated surface. Friedenwald points out that, with sufficient magnification and brilliancy of illumination, a faint arterial pulsation can be observed in nearly every eye, if the vessels have not lost their tone from age or disease. Ballantyne[13] concludes that arterial pulsation could be observed with the ophthalmoscope in 36 per cent of patients with healthy eyes; but that the locomotor pulse is more common than the expansile. However, arterial pulsation is more easily recognizable in aortic insufficiency, hyperthyroidism, increased intraocular tension, orbital tumours, optic neuritis, etc.

Capillary pulsation is usually not visible as a change in the capillaries themselves; but occasionally it is recognizable as a recurrent diastolic blanching of the disk in aortic regurgitation. While the permeability of the capillary walls has received thoughtful consideration, the active contractile and expansive power of this most important part of the vascular tree has not been sufficiently recognized.

The cilioretinal artery is an anomalous branch from the scleral circle of Zinn which surrounds the optic nerve entrance. Its source is seen especially well in some cases of optic nerve atrophy. This vessel may rise from the upper, the lower, the nasal, or the temporal, side of the disk. The point of origin may be on the disk itself just beyond the edge of the optic cup, or at the margin of the disk, or in the adjacent retina. (Plate 15). But it usually emerges at a point near the lower, temporal margin of the disk. (Plate 4). There is also great variation in the size of the vessel. Sometimes it is so minute that it may easily be overlooked. Occasionally it is so large that it is actually a substitute for a branch of the central retinal artery. (Plate 38). In the examination of a large group of persons whose eyes were normal, and whose ages ranged from seven to seventy years, the writer found that a cilioretinal vessel was present in 22 per cent. Of this percentage, the vessel was small in 8 per cent; medium size in 6 per cent; comparatively large in 8 per cent; and it occurred unilaterally 2.4 times as often as bilaterally. Plates 26 and 90 show a small cilioretinal vessel; Plate 4 shows a large one. In cases of embolism of the central retinal artery, the presence of this anomaly renders the prognosis much more favourable.

The presence of an *opticociliary vein* is extremely rare.

The area centralis retinae. — According to Salzmann,[14] this is a circular area 7 mm. in diameter with the fovea as its centre, and its nasal periphery tangent to the temporal margin of the

[12] Onishi. Nippon Gankakai Zashi. XIII, 1913. Abstract: Klin. Monats. f. Aug. 52. p. 562. 1914.

[13] Ballantyne, A. J. "Pulsation of the Retinal Arteries." Amer. Encyclopedia and Dictionary of Oph. Vol. XV. p. 11301. 1919.

[14] Salzmann, M. "Anatomie und Histologie die Menschlichen Augenapfels." Leipzig und Wien. Franz. Deuticke. p. 83. 1912.

disk. Frequently descriptions of this very important part of the fundus confuse the macula lutea with the fovea centralis. Therefore, careful distinction should be made between the larger macular region proper and its centre, the fovea. The central area contains the macula lutea, the fovea centralis, the fundus foveae, and (at the bottom) the minute foveola.

The macula lutea, next to the optic disk and its blood vessels, is the most noticeable feature of the fundus. Its centre corresponds closely to the posterior pole of the eye. It comprises a space about 1.7 mm. in diameter (Dimmer [15]), but sometimes it may measure 2 mm. or more. Its shape varies from a nearly perfect circle to an ellipse, with its greater diameter usually horizontal. It is a darker shade than the colour of the rest of the fundus; and often the irregular distribution of pigment in this region gives it a granular appearance. In youth, it is surrounded by pretty light-reflexes. This area is particularly well seen by the indirect method of ophthalmoscopy; with the Gullstrand binocular ophthalmoscope; by red-free light; and when the pupil is dilated. The macular region is very rich in blood vessels, and the periphery is thicker than its avascular centre. The vascular details of this very important area are particularly well seen with the Friedenwald ophthalmoscope, as shown by the accompanying drawings from the normal eye of a brunette youth 14 years old. Fig. 1. Large drawing on the left as seen with the ordinary ophthalmoscope. Fig. 2. Small drawing on the right as seen with the Friedenwald ophthalmoscope.

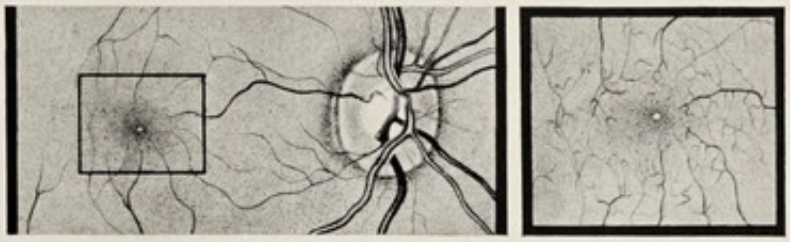


FIG. 1 FIG. 2

The fovea centralis occupies very nearly the centre of the macular region, and corresponds closely to the optical axis of the eye. It is an elliptical, funnel-shaped depression with its long axis horizontal. It is about 3.5 mm. from the temporal side of the disk, and a trifle less than 1.0 mm. below its centre. The thicker margin of the fovea is spoken of as the limbus; the sloping walls of the fovea, as the clivus; and the bottom, as the fundus foveae. According to Salzmann [15] (quoting Dimmer), an actual fundus foveae occurs only when the fovea is rather large and flat. The funnel-shaped depression of the fovea is caused by the separation of the cerebral retinal layers. Adler [16] and others have determined, entoptically, that the avascular fovea is from 0.4 mm. to 0.6 mm. in width, which agrees with histological investigations.

The fundus foveae represents the thinnest portion of the retina (0.075 mm.–0.12 mm., Salzmann, quoting Dimmer). According to Schieck and Bruckner,[17] it has a width and a radius of curvature, of 40 mu.

[15] Dimmer, F. "Der Augenspiegel und die Ophthalmoskopische Diagnostik." Leipzig und Wien. Franz. Deuticke. p. 101. 1921.

[16] Adler, F. H. "Circulation in Retina." Arch. of Ophth. p. 91. Jan. 1929.

[17] Schieck, F. and Bruckner, A. "Kurzes Handbuch der Ophthalmologie." Vol. I. Berlin. Julius Springer. p. 128. 1930.

The minute foveola, which occupies the centre of the fundus foveae, varies with the general contour of the many kinds of foveae. Owing to the increased length of cones, and to the thickened choriocapillaris in this area, the external limiting membrane usually assumes a slight anterior convexity; but the internal limiting membrane retains its general concave form.

A full discussion of the histology of this important region is impossible here. But, in brief, the cerebral layers of the retina are reduced to just those layers that are essential to acute vision in bright light; and the neuro-epithelium undergoes highly specialized alterations to comply with the visual requirements. The visual cells are represented entirely by the slender elongated cones, each of which is connected with a single bipolar, and a single ganglion cell. Therefore, the visual centre of the brain is connected more directly and perfectly with the fovea than with any other portion of the retina.

The darker colour of the macula proper is due to the finer capillary network in the choriocapillaris; to the thickening of the retina at the macular periphery; and to the amount and irregular distribution of the pigment in the retinal epithelial layer. The perifoveal colour depends upon the yellow pigment in the cerebral layers of the retina, the thinning of the retina, and the increased vascularity of the choroid.

Retinal light-reflexes. — The macular region is surrounded by beautiful, silvery, evanescent reflections. These light-reflexes are more pronounced in youth and in dark-skinned people. In the pure-blooded negro, the whole fundus is so masked by dancing reflections from the lamina interna of the retina and from the blood vessels, that it is sometimes difficult to detect slight pathologic changes. The nerve-fibres that converge from the entire retina to the disk produce a thickening of the nerve-fibre layer in this region. Therefore, the reflections around the disk are radiating in character, and very pronounced. These reflections are well shown in Plate 1. In the albino, the retinal reflections are insignificant; but the portion of the fundus around the disk and in the central area is a slightly darker shade of red than the rest of the fundus. (Plate 8). The foveal light reflection varies with the conformation of the walls and bottom of the fovea. The reflection may be from the walls, or from the minute mirror-like foveola. The foveolar reflection is a reduced, inverted image from a portion of the ophthalmoscopic mirror. While this small light-reflex is brilliant, and relatively stable, it does change its shape with every movement of the patient's eye, or of the observer's mirror. When very minute lesions occur in the foveal region, the foveal reflex is often linear in shape, and it has a definite parallax movement in front of these choroido-retinal changes. The foveal reflex is absent in albinos. Changes in the macular and foveal reflexes are among the earliest objective signs of edema, inflammation, or degeneration in this spot — so precious to vision. The macula, so marked in man, is absent in mammals lower than monkeys.

The periphery of the retina. — The visual part of the anterior extremity of the retina terminates at the ora serrata. The tooth-like jagged ora serrata lies just back of the posterior extremity (orbiculus ciliaris) of the ciliary body. In emmetropia, it is approximately 8.50 mm. behind the corneal limbus. The distance is slightly greater on the temporal, than on the nasal side; and in myopia, than in hyperopia.

In regard to Donders' statement that the anterior portion of the retina is blind, Salzmann[18] says: "The fact that the outermost portion of the retina is blind should cause a high degree of astonishment, because the histological structure of the retina does not justify this observation." However, in this region the retina becomes thinner; the outer members of the rods contain no visual purple for a zone of 3 or 4 mm.; they decrease in number relatively more than the cones; and the cones become smaller. From 0.5 mm. to 1.0 mm. behind the ora serrata, the nerve-fibres and ganglion cells disappear; and only scattered neuroglial cells remain (Salzmann[19]). The extreme anterior part of the visual retina is inaccessible to the rays of light. According to Scullica, quoted by Schieck and Bruckner,[20] in emmetropia there is a zone of about 7 mm. back of the ora serrata on the temporal side, which light cannot reach. This is a little greater in myopia than in hyperopia; in aphakia, however, this limit is reduced to 3.5 mm.

The fundus becomes more and more difficult to see as one approaches the ora serrata; ordinarily, its extreme anterior portion is inaccessible to ophthalmoscopic examination. Therefore, it is impossible to correlate the microscopic findings in this region with previous ophthalmoscopic appearances. For instance, a cystoid condition of the retina near the ora serrata — invisible with the ophthalmoscope — has often been found microscopically even in the eyes of comparatively youthful people.

In spite of the inaccessibility of the extreme periphery of the fundus to ophthalmoscopic examination, every effort should be made to see as far anteriorly as possible. This can be aided very much by a full dilatation of the pupil, and by good co-operation upon the part of the patient. The efforts of the examiner may be rewarded by the discovery of a small tumour springing from the ciliary region; of an inflammatory mass; or of a beginning retinal detachment. The importance of localizing tears in retinal detachment renders it desirable in these cases to make a very accurate ophthalmoscopic examination of this region. The periphery is best seen in cases of complete coloboma of the iris, and where there has been a cataract extraction with broad iridectomy.

Practical points in the use of the ophthalmoscope. — If the patient is able to sit up, it is best to place him in a comfortable revolving chair, a trifle lower than the stool of the observer. For the right eye, the examiner should sit upon the patient's right side, and upon the left side for the left eye. The student from the beginning should accustom himself to this position. It is a curious fact that the beginner is apt to sit "straddling" the patient's knees, which is very awkward and inefficient. In making the examination, the observer's own refraction error should be corrected.

To examine the media, the student (on the patient's right side) should place a + 8.0 D. lens as a magnifying glass in the aperture of the ophthalmoscope, which should be held in the right hand. With the aperture before the right eye, the examiner should approach the patient until the red-reflex through the pupil and the details of the iris are clearly defined. By having the

[18] Salzmann, M. Vide No. 15. p. 85.
[19] Salzmann, M. Vide No. 15. p. 86.
[20] Schieck, F. and Bruckner, A. — Vide No. 18.

patient look in different directions, it can be determined whether there is an opacity in the cornea, or in the lens, or in the vitreous. If the opacity is in the anterior part of the eye (in front of the pupillary plane), it will appear to move in the same direction as the eye of the patient. If it is situated in the posterior portion of the eye, it will move in a reverse direction. The farther it is away from the pupillary plane, the more marked is the apparent motion of the opacity. Opacities of the vitreous and aqueous are the only ones that move spontaneously. One should be careful not to confuse particles of mucous on the cornea with small vitreous or lenticular opacities. A general view of the media in each eye may be obtained without change of position. But for a careful localization of an opacity in the left eye, the observer should be on the patient's left side; and he should use his left eye in making the examination. Small lesions may be studied by increasing the strength of the ophthalmoscopic lens gradually to a + 20.0 D., while the observer comes correspondingly closer to the patient. Or a lens weaker than + 8.0 D. may be used while the observer carries his ophthalmoscope farther away from the patient. Opacities sufficient to interrupt the returning light rays from the fundus will appear as dark spots against the red background. These opacities, as a rule, are best seen when the pupil is widely dilated and the illumination very brilliant. But, at times, very faint and diffuse opacities become more visible when the brilliancy of the light is reduced.

The indirect method should be used after the inspection of the media. With the advent of the self-illuminating ophthalmoscope, there has been a tendency on the part of the students of ophthalmoscopy to abandon entirely the indirect method of examination. This is to be deplored, because this method is very useful in obtaining a quick, general view of the fundus. In some instances, one can see the background better and with more ease by this method than by direct ophthalmoscopy; for example, where there are slight opacities in the refractive media, high degrees of myopia and astigmatism, nystagmus, etc. Occasionally, from the point of personal hygiene and comfort, it may be more pleasant for the observer to be a little farther away from the patient when making the examination. In spite of the disuse of the old reflecting ophthalmoscope and sources of illumination, one may still employ the indirect method with the aid of a + 18.0 D. converging lens, and the modern self-illuminating ophthalmoscope with a + 4.0 D. to + 8.0 D. lens (as an eye-piece) in the ophthalmoscopic aperture. For the right eye, the patient is instructed to look off in the distance on a level with the eye of the examiner; the converging lens is held between the left forefinger and thumb of the observer while his hand is steadied by resting the other fingers on the patient's forehead. With the ophthalmoscope in the right hand, the examiner approaches the patient until the optic disk and blood vessels are clearly-defined. By moving the converging lens back and forth, a clear focus of the fundus may be obtained. By tilting the lens slightly, one may get rid of annoying light-reflexes, and bring portions of the adjacent fundus into view. The field of examination can be still more extended by having the patient look in any desired direction. Without change of position, the disk of the left eye can be seen by having the patient look towards the tip of the observer's left ear. In emmetropia, the stronger the converging lens, the closer must the examiner and the lens approach the patient. By the use of a + 20.0 D. condensing lens, a great deal of the

fundus can be seen at one time; but the details are too small for the study of minute changes. On the other hand, a + 13.0 D. lens will give a large image of the fundus. In brief, the magnification varies with the refraction of the eye under examination, and with the strength of the converging lens, and of the lens in the aperture of the ophthalmoscope. In emmetropia, the magnification is about 3–5 diameters. In all cases, the fundus picture is inverted.

There have been great improvements in the ophthalmoscope since the author first taught ophthalmoscopy. In those days, gas and oil were used as the light source for the reflecting ophthalmoscope. Now there are many very satisfactory self-illuminating instruments in common use, such as the May, Morton, etc.

The Gullstrand monocular hand ophthalmoscope is not used as much for the indirect examination of the fundus as it deserves. This instrument is connected with the ordinary electric current. The ophthalmoscope itself has a slit effect, and the condensing lens has a slit stop. By increasing the strength of the lens in the ophthalmoscopic aperture, the magnification of the fundus can be correspondingly enlarged. For instance, with the stop lens furnished with this instrument, and a + 6.0 D. lens in the ophthalmoscopic aperture, the magnification is 4.25 x; with + 8.0 D., it is 7 x. This instrument gives a very clear field of view, free from light-reflexes. With this ophthalmoscope also, the image is inverted.

In the direct method of examining ambulant patients, the relative positions of patient and observer should be similar to those already described. To examine the disk of the right eye, the patient should be told to look off in the distance on a level with his own eye, and close to the observer's head. On the wall opposite the examination chair in the author's dark room, there is a white circle about 2 inches in diameter, with a black centre. This target enables the patient to look in the proper direction for the first step in the ophthalmoscopic examination. In the case of hyperopia, the strongest convex glass that gives the best definition should be used in the ophthalmoscopic aperture; but in myopia, the examiner should use the weakest concave lens. At first, the student finds it difficult to relax his accommodation, and he is prone to use a concave lens of 3 to 4 dioptres, even in emmetropic patients. Only practice will enable him to avoid this. During the examination, the student should keep both eyes open, and endeavour to feel as though he were looking into the far distance. The ophthalmoscope should be held as close as possible to the patient's eye. In this method of examination, the fundus image of an emmetropic eye is magnified about 14 times. The image is upright.

The Friedenwald ophthalmoscope affords an unusually clear view of the fundus. The instrument is connected with the ordinary electric current; it has a slit-like effect, brilliancy of illumination, fine definition, increased magnification, and three monochromatic light filters. It enables one to see the fundus quite well through an undilated pupil. Small macular twigs, invisible with the ordinary ophthalmoscope, are clearly seen with this instrument. It is possible to study early arteriosclerotic and arteriolosclerotic changes in the walls of the retinal vessels, and to see even small varicosities of the capillaries. Recently a binocular attachment has been devised.

The large Gullstrand ophthalmoscope has the advantage of allowing one to make a stereo-

scopic examination in relief of the inverted fundus image. With its stereoscopic eyepiece, it is possible to study the fundus with a magnification up to twenty-fold without any confusing light-reflexes. By changing the ophthalmoscopic eyepiece, one may obtain a monocular, upright view of the fundus with a magnification of from 5 x to 49 x. Of course, the greater the magnification, the smaller the field of view, and the less the illumination. Up to a magnification of 29 x, the illumination and field of view are satisfactory. The stereoscopic examination by this instrument is especially helpful in studying congenital anomalies of the disk, early glaucoma, beginning papilledema, vessel pulsation, etc. There is an attachment to the monocular eyepiece which enables two observers to see the fundus image at the same time.

The polyophthalmoscope is useful in undergraduate teaching, for, in addition to the instructor, eight students can observe a fundus simultaneously. A pointer attached to the apparatus can be used for indicating anything of special importance in the fundus image.

The Keeler ophthalmoscope with graticule is useful in recording accurately the site and size of a fundus lesion. The image of the squares of the fine screen is thrown upon the retina. In emmetropic patients, each one of these small divisions is equal to .186 mm. The elevation is measured by a rotating marker which is placed upon the posterior surface of the ophthalmoscope.

In addition to the examination of the fundus by the ordinary illumination, the use of coloured light filters is very helpful. For instance, with the *red-free* light, which Vogt introduced, the fundus has a greenish yellow tint; vessels and hemorrhages appear black; the nerve-fibre layer of the retina around the disk has a very striated appearance; and the light-reflexes from the lamina interna of the retina, and from the blood vessels, are much increased in definition and brilliancy.

With the *yellow light*, there is very little loss of brilliancy of illumination, and relatively very little change in the colour values of the fundus. The details of the small vascular twigs, and of the nerve-fibre layer of the retina, are especially well-defined.

With the *red light*, there is very little colour contrast between the general red-reflex of the fundus, the retinal vessels, small hemorrhages, and exudates. However, with this illumination, minute pigment changes are very readily seen — particularly by proximal illumination. In using this latter method, the beam of light from the ophthalmoscopic mirror is directed on a portion of the fundus a little above, below, or to one side of the lesion. And by this method of retro-illumination, a slight pathologic alteration will often stand out prominently against the reddish background, though it might be invisible in direct lighting. The red light has been of great value in determining early pigment changes in juvenile and senile macular degeneration. Owing to the absorption of light by these coloured filters, the illuminating source must be very brilliant, or the advantage will be limited. Without the use of any filter, frequently minute changes in the macula may be seen better by simply reducing the illumination.

In making a careful ophthalmoscopic examination, it is best to follow a definite routine. One should begin with the optic disk and study carefully its colour, contour, margins, physiological cup, and blood vessels. The colour, calibre, conformation, and light-streaks of the vessels

should be noted. In the macular region, the colour, pigment changes, light-reflexes, and arterioles should be examined with great care.

The student will find it very helpful to divide the fundus into quadrants; to investigate each section in detail; and to make drawings — however crude — of all abnormalities. Finally, the periphery should be searched to the limit of ophthalmoscopic visibility.

These simple suggestions, of course, apply to the examination in the dark room. However, some of the most interesting and instructive patients that the student will see, are confined to bed. The examiner, under these circumstances, will find it very convenient to have a black cloth, similar to that used by photographers in focussing the camera, to throw over his head and over the head of the patient. In this way, even in a very bright sunshiny ward, the examiner may have the advantage of a small dark room.

The careful examination of the eyes of young children is very much facilitated by the use of a general anesthetic, and of fixation forceps for placing the eye in any desired position.

In the case of painful eyes, the instillation of a few drops of a ½% solution of pantocain will render the examination more comfortable for the patient and more satisfactory for the physician.

Mydriatics. — In ophthalmoscopic examinations in old people — with whom there is always danger of glaucoma — a 5% solution of ephedrin is a safe mydriatic if followed after the examination by the instillation of a 1% solution of pilocarpin. In younger people, where a quickly acting mydriatic is desired, a few drops of a 5% solution of euphthalmin may be used in addition to the ephedrin. In the case of the black-skinned races, nothing less strong than a 2% solution of homatropin is effective. Frequently even this solution has to be repeated several times. In all cases, a 1% solution of pilocarpin should be employed after the completion of the examination. Older people should not pass from observation until the examiner is sure that the pupil is normal again, and that the eye remains soft.

In no branch of medical investigation is the fruit of infinite patience more sweet than in ophthalmoscopy.

PLATES

PLATE 1

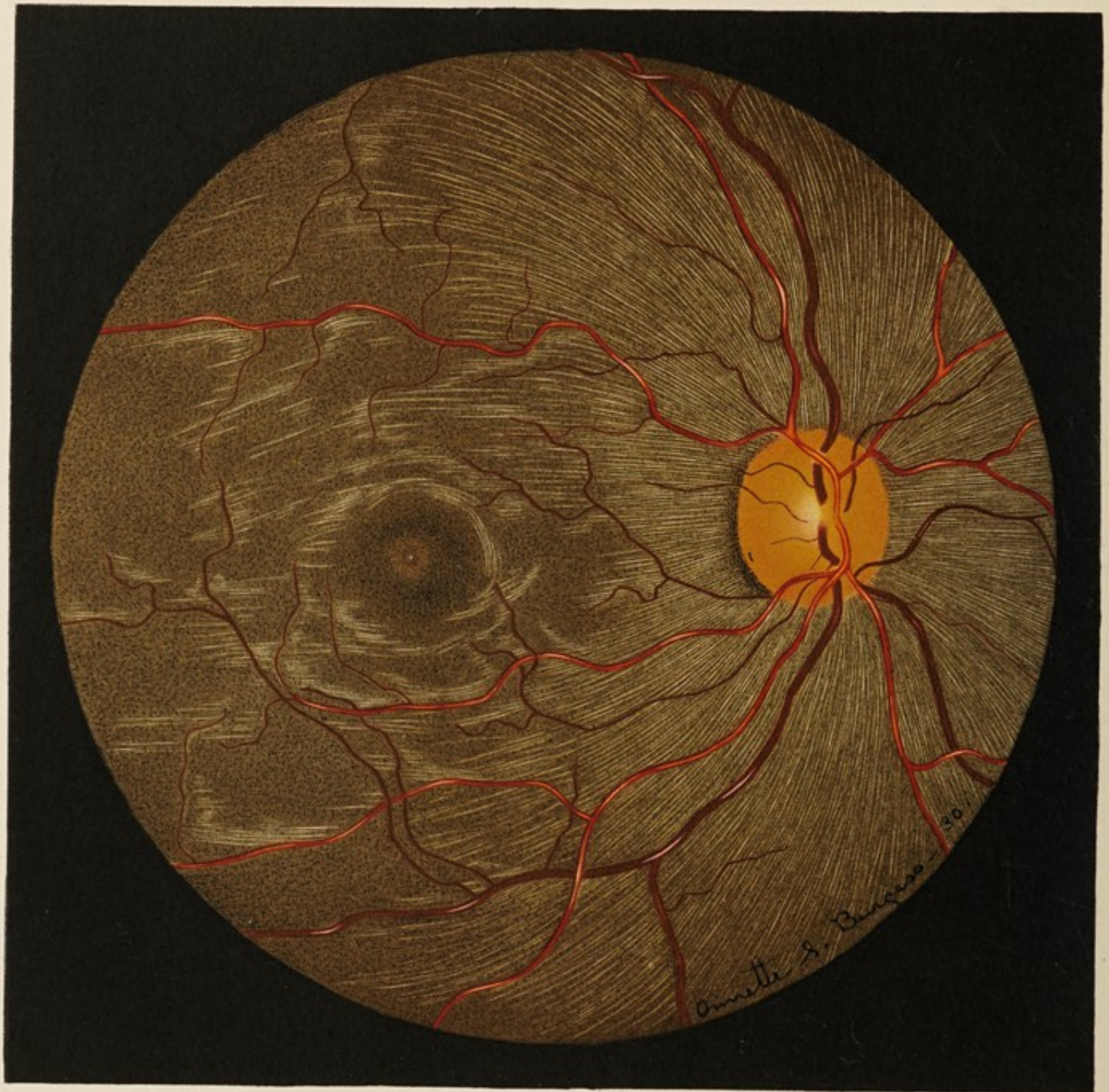


PLATE 1

Normal, Chocolate Coloured Fundus, right eye of pure-blooded negro* man 22 years of age. Both eyes are normal in all respects.

The yellowish red disk stands out with unusual clearness of outline against the very dark background with its shimmering, white reflections; and the margins are as cleanly-defined as though the disk had been cut out and pasted on the background. An accumulation of pigment forms a narrow, black crescent on the temporal side of the disk. There is a very small mass of pigment on the lower temporal part of the disk itself. The physiological excavation is not marked.

The retinal arteries are a dark red-brick, and the veins deep carmine. In some places the vessel light-streaks are marked. There is a particularly dense deposit of pigment in the macular region, but the foveal area appears a trifle more red. Around the disk, light reflections are white and radiating, and they practically obscure the underlying tissues. The foveal reflection is minute and silvery. The reflections surrounding the macula are crescentic; near the blood vessels, they become irregular and linear. In both situations, however, they are quite fleeting in their appearance.

The pigment of the retina and choroid, and the shimmering light reflections are the chief factors in the colour of this fundus. In addition to the general chocolate colour, there is an indefinite greenish sheen which is explained in the chapter on Ophthalmoscopic Examination.

In an eyeground of this type the brilliant, silvery white, dazzling reflections are most impressive; and they make it very difficult to detect early pathologic changes. The variations which occur in both the normal and pathologic eyegrounds of the negro race, are most interesting.

* The eyes of many negroes were examined before a good illustration of this type of eyeground was found.

PLATE 2

Normal, Chocolate-red Fundus, right eye of a mulatto woman, 29 years of age. Both eyes are normal in all respects.

The disk has a uniformly light orange-red colour. Its margins are clearly-defined; and at the lower temporal border, there is a very slight accumulation of pigment. The physiological excavation is small and funnel-shaped.

The arteries have the solid appearance, the red-brick colour, and the marked light-streaks, characteristic of the very deeply pigmented fundus. The veins are very dark, and the light-streaks on their anterior arches are quite pronounced.

Around the disk, and in the macular region, the pigment is particularly dense. It is irregularly deposited, but it is sufficiently profuse throughout the whole eyeground to give a distinctly granular appearance, and to obscure the details of the underlying tissues.

Around the disk, the light reflections corresponding to the distribution of the nerve-fibres are radiating. Where they encompass the macular region, they are crescentic, silvery, and evanescent in appearance. The foveal reflection is small, brilliant, and fairly stable. The light-reflexes around the vessels are irregularly linear, and changeable in appearance.

This fundus lacks the even chocolate colour shown in Plate 1, because the greater visibility of the vascular layers of the choroid adds a tinge of red.

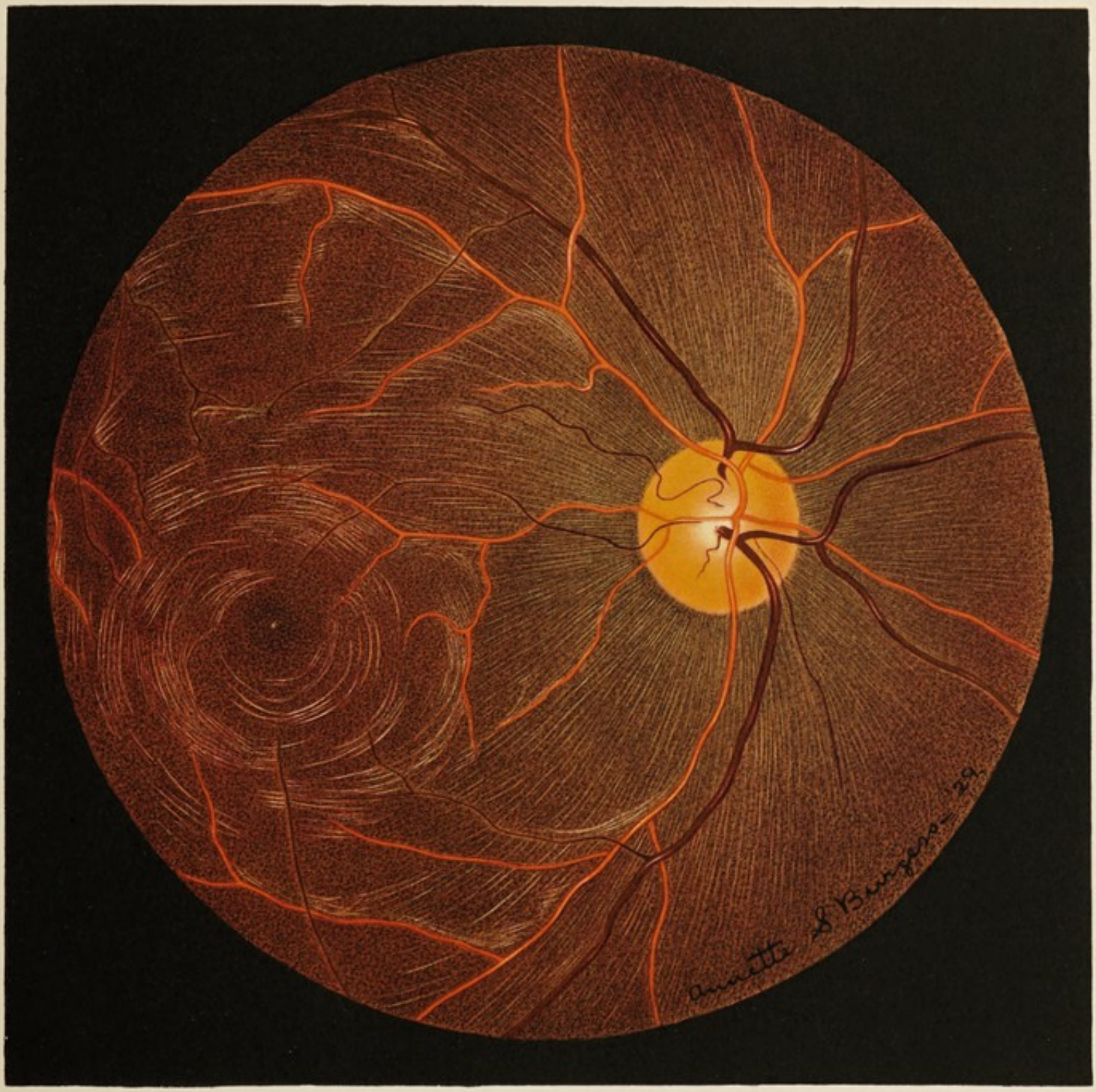


PLATE 3

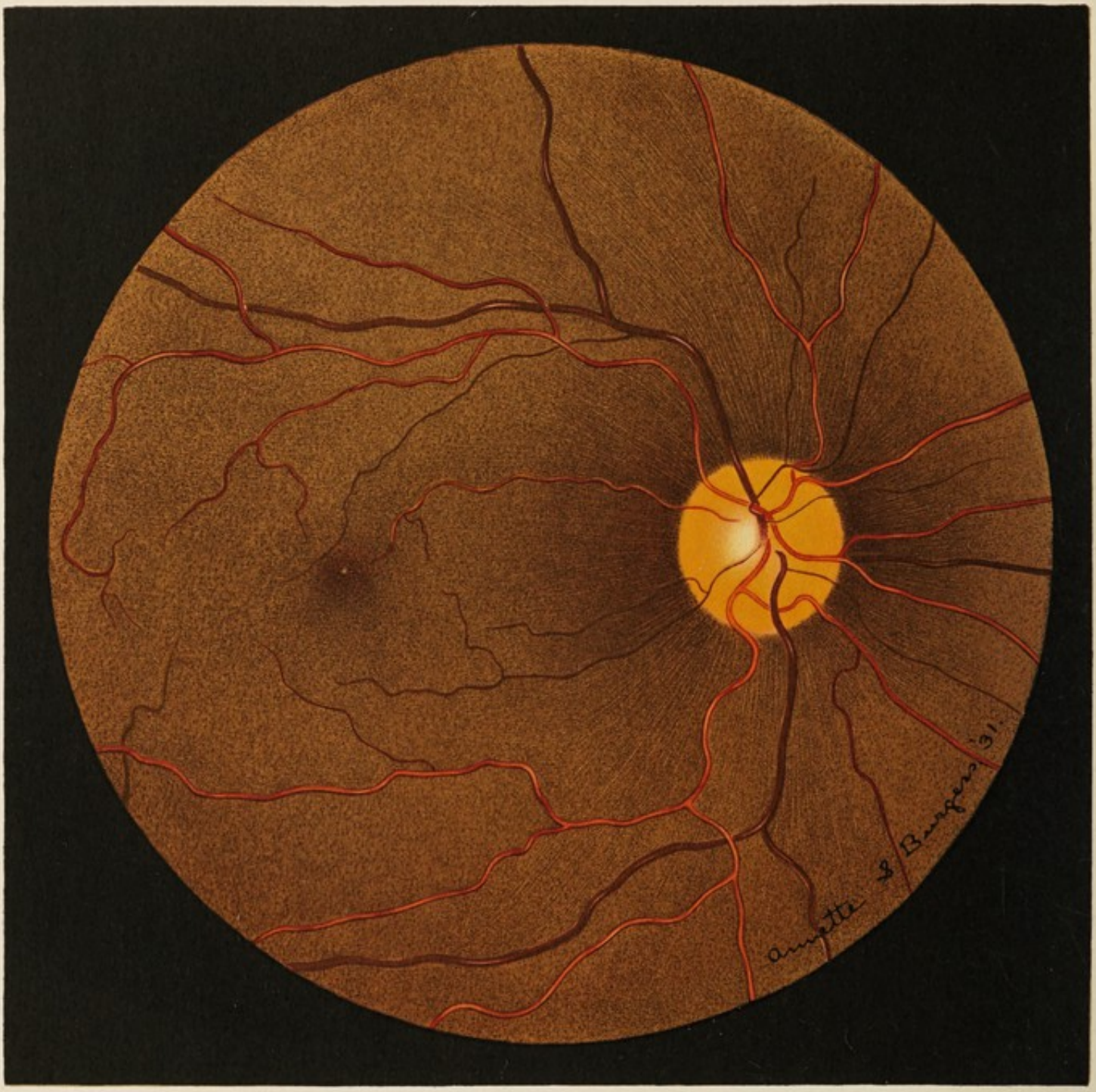


PLATE 3

Normal, Reddish Brown, Granular or Stippled Fundus, right eye of a Hindu, 40 years old. Both eyes are normal throughout.

The light orange-red colour of the disk is more brilliant than in Plate 2. The disk margins are well-defined. The physiological excavation is insignificant in size; but it is a trifle lighter in colour than the other portions of the disk. The vessels appear to emerge from a very slightly curved surface, and they are more tortuous than usual. The arteries are a red-brick colour, but they are not as solid in appearance as those in Plate 2. The veins are very dark, almost a claret colour. The light-streaks of the vessels are pronounced.

The pigment distribution around the optic disk and in the macular region is denser than in the periphery. The fovea is a lighter red than the surrounding macular region.

The light reflections around the disk are very fine, ethereal, and radial. The foveal reflection is minute, relatively stable, and of a yellowish white colour. The macular reflections are entirely lacking. On the whole, the fundus reflections are rather insignificant.

The colour of this fundus is lighter in tint than in Plates 1 and 2. But in this eyeground (as in the fundi in the two preceding plates) the retinal and choroidal pigments are the chief factors in the production of the general colouration.

PLATE 4

Normal, Reddish Brown, Granular or Stippled Fundus, right eye of a 10 year old North American Indian girl of the Menominee tribe. Both eyes are normal. It is impossible to reproduce perfectly the beauty and the living quality of this eyeground.

The disk is slightly elliptical in shape, with its long axis vertical. It is reddish yellow in colour, and the margins are very clearly-defined. The physiological excavation is small. The retinal vessels are quite tortuous, and they stand out with great vividness. Their dark colour is the usual hue of the deeply pigmented races. An unusually large cilioretinal artery leaves the disk at the lower temporal margin, takes its course below the macula, and sends a number of branches upward to this region, and one branch downward.

The macular area is darker in colour than the rest of the fundus. This is due to the irregular deposition of pigment, which gives a granular, chocolate appearance.

The fundus as a whole has a reddish hue, overlaid with a chocolate coloured, stippled pattern. In addition, there is a brownish, olive-green sheen over the whole fundus, as though the red-brown background were seen through an overlaying of dark green. This phenomenon is explained in the chapter on Ophthalmoscopic Examination. In the pure-blooded negro, one gets a similar, though less marked, impression. (Plate 1).

Around the disk, the light reflections are radiating; around the macula, they are broken, fleecy, and changeable. The foveal reflection is brilliant and silvery. Near the vessels, the light-reflexes are irregularly linear — as usual in the deeply pigmented fundus.

The colour of this fundus is due chiefly to the pigment of the choroid and retina, and to the influence of both retinal reflections and the choroidal vessels. In addition to these factors, the contrasting red colour of the retinal circulation plays a part in producing the complicated, composite picture.

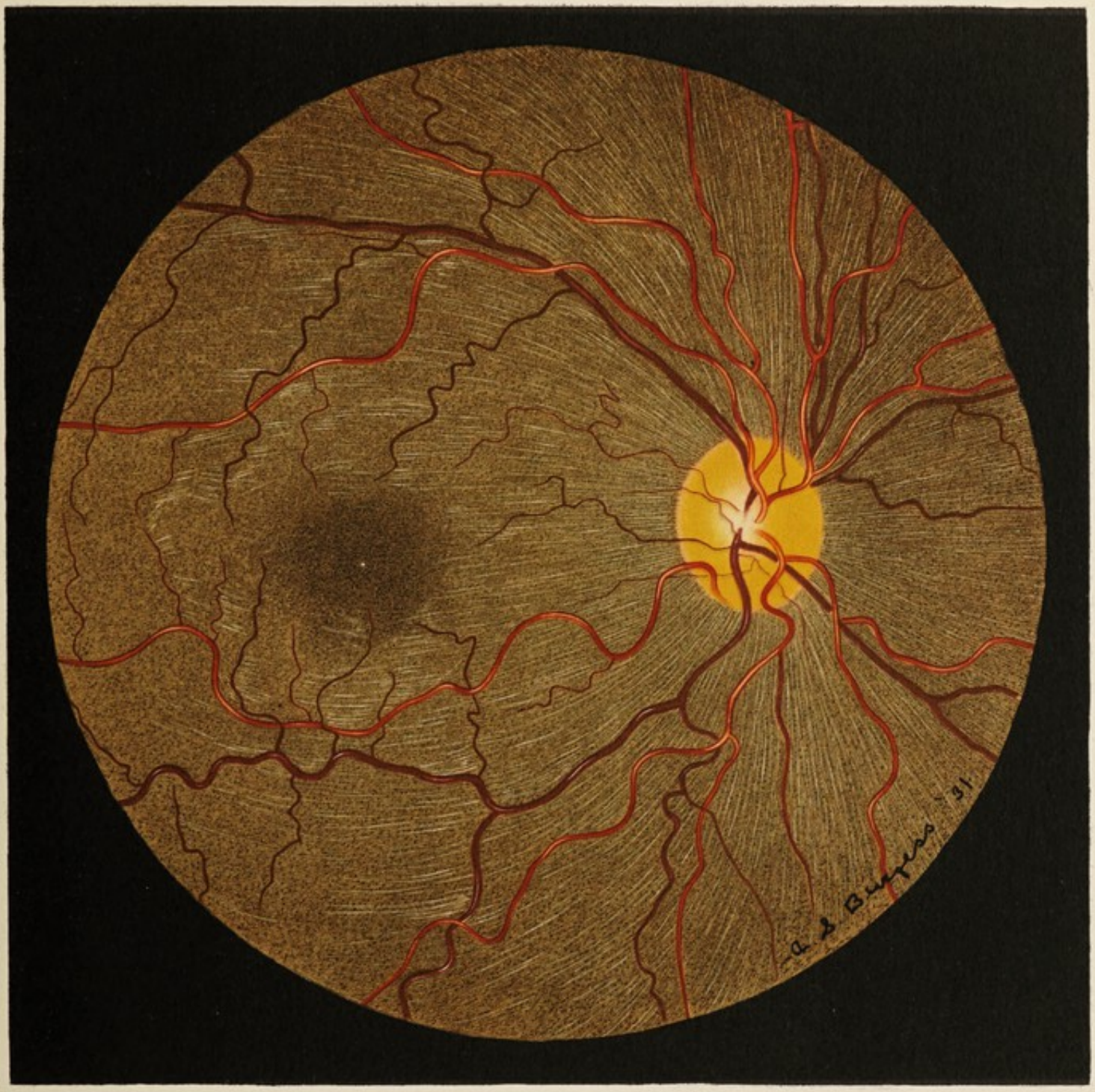

A. S. Burgess '31

PLATE 5

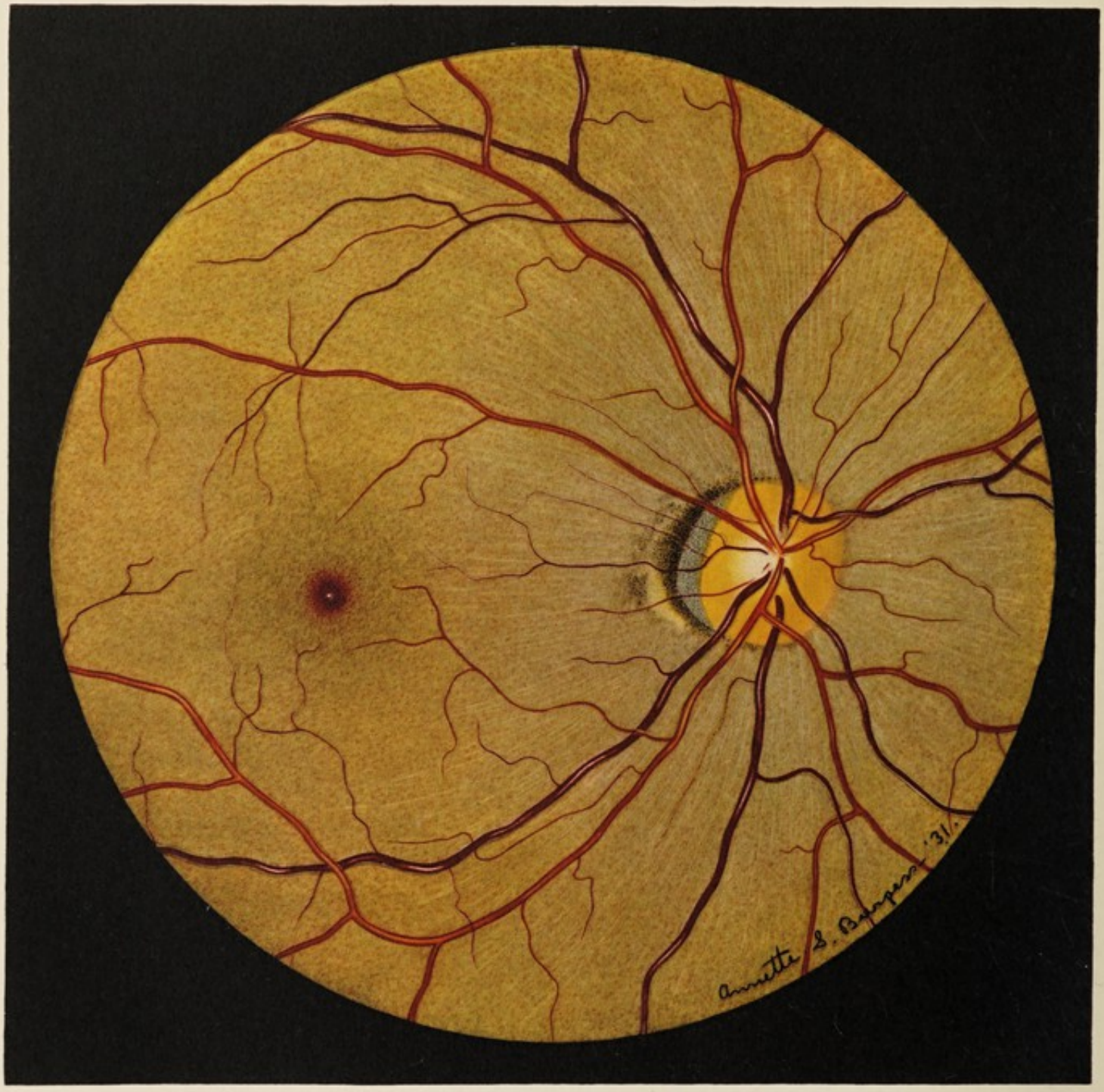


PLATE 5

Yellow, Granular or Stippled Fundus, right eye of male Chinese, 30 years of age. Both eyes have a slight myopia with astigmatism; but otherwise they are normal.

The disk is irregular in outline, the margins well-defined, and the colour a light orange. The physiological excavation is insignificant. On the temporal side of the disk, there is a greyish white scleral crescent, which is bordered by an accumulation of pigment. Still farther towards the macula, there is a slight atrophy of both retina and choroid. This condition, due to the stretching of the retina and choroid, is secondary to the myopia, and is known as a myopic crescent.

The retinal vessels are lighter in colour, and the arteries appear more translucent, and less solid-looking than in the preceding plates. The veins are a dark claret colour. The light-streaks of the vessels are quite normal, but as usual in dark-skinned individuals, the light-streaks on the veins are more pronounced where they bend forward.

Around the disk, and especially in the macular area, the colour is a trifle darker than in the periphery. The deep, cherry-red fovea stands out in sharp contrast with the yellow background.

The faint light reflections around the disk are radial, but near the macular region they are fleeting — impossible to reproduce. The foveal reflex is larger than usual and of a yellowish white colour.

This fundus is of the yellow, granular type; but there is sufficient pigment in the retina and choroid to obscure the details of the deeper tissues.

The fundi of the Chinese vary in colour with the general pigmentation of the body, and many of them are darker than the one here illustrated.

PLATE 6

Normal, Tessellated, or Tigroid Fundus, right eye of a brunette Italian woman, 36 years of age. Both eyes are normal throughout.

The disk is clear-cut in outline and normal in colour. The physiological excavation is paler and more marked than in the preceding plates; and its contour is of the general "morning glory" type.

The vessels are more tortuous than usual, but they show no pathologic changes. The light-streaks are not especially pronounced.

The pigment is denser around the disk than in the periphery, and it forms an irregular, dark, crescentic line on the temporal side of the disk. The macular region is of a deeper red than the rest of the fundus, and it has a distinctly granular appearance.

The foveal reflection is greyish white and fairly stable. There are no marked light reflections in the other portions of the fundus.

The tessellated appearance is especially marked in the periphery of the fundus where the choroidal vessels appear as flat, ribbon-shaped, light red streaks; while the pigment of the choroid appears as darker islands in the intervascular spaces. Students are sometimes puzzled by the appearance of the tessellated fundus, and confuse it with a beginning choroiditis.

In contrast with the preceding plates, the details of the deeper structures of this fundus are not hidden by the diffusion of pigment in the retina and choroid. Therefore, the choroid itself plays a most important part in producing the general colour and pattern of this fundus.

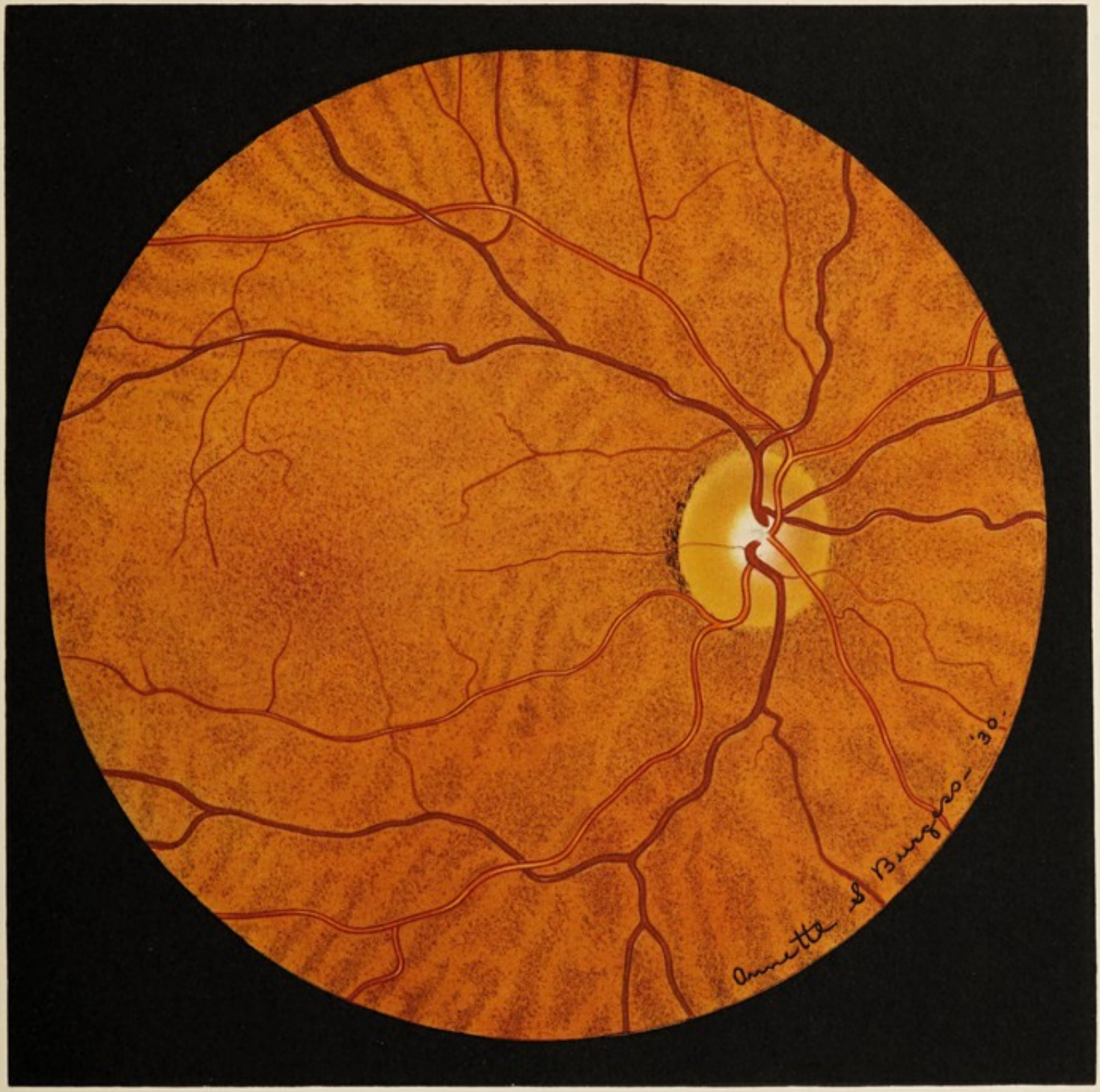

Annetta S Burgess '30.

PLATE 7

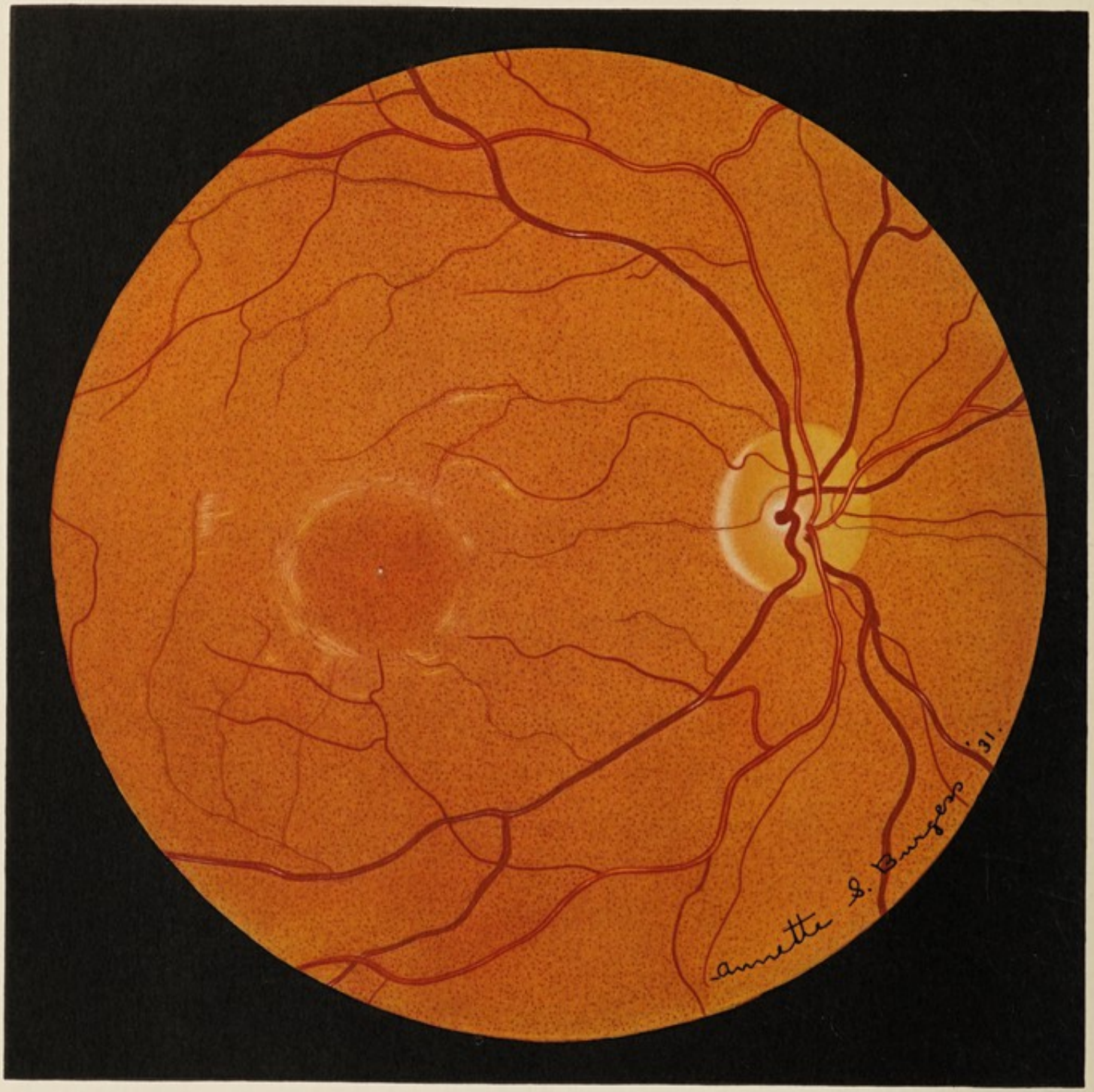


PLATE 7

Normal, Light Orange-red Fundus, right eye of a very blond man, 23 years of age. The eyes are free from disease, but somewhat sensitive to light. The ocular functions are normal.

The reddish disk shows very little contrast in colour with the rest of the fundus. There is a small scleral crescent at the temporal side of the disk. It is somewhat indefinite, and hazy in outline. The physiological excavation is insignificant. There is a small bridge of connective tissue between the central retinal artery and vein where they emerge from the physiological cup. There is likewise a somewhat curious branching of the arteries and veins on the disk itself. The vessels are more translucent in appearance than those of very dark-skinned individuals. The light-streaks are not especially prominent, but they are more pronounced where the veins bend forward. The macular region is a darker red than the other parts of the fundus.

There are no definite light-reflexes around the disk itself. But the macular region, which is circular in outline, is surrounded by light reflections that are beautiful, faint, and fleeting. There are also some faint linear light reflections along the macular vessels.

There is much less pigment in the retinal epithelium and in the choroid than in the fundi shown in the preceding plates. However, no details of the choroidal structures are visible.

In the eyes of very blond persons, where the retinal and choroidal pigment is somewhat scanty, the sclera acts as a reflecting surface and influences the colour of the fundus. In its general light tones, this eyeground approaches in appearance the fundus of the albino.

PLATE 8

Fundus of Albino, right eye of a woman, aged 34. The eyes are very sensitive to light. There is a high degree of hyperopia with astigmatism. The corrected vision in each eye is 6/20. There is a marked nystagmus such as is commonly present in albinos. The visual fields are essentially normal.

The margins of the disk are poorly-defined. This is due to the high refraction error, to the lack of marked contrast between the disk and the adjacent fundus, and to the rapid nystagmoid movements of the eyes. The physiological excavation appears as a shallow depression on the temporal side of the disk. The retinal vessels show no striking peculiarity, other than a slightly attenuated appearance.

Around the disk, and in the macular region, the eyeground has somewhat the colour of the very blond fundus. There is no foveal or fundus reflex. Seefelder [22] calls attention to the fact, noted by others, that the fovea is absent in the albino. The periphery is very much lighter than this central area. The sclera appears as yellowish islands between the red of the large, ribbon-shaped choroidal vessels. On account of the absence of the uveal and retinal pigment, the sclera and the choroidal vessels are the most important factors in producing this composite picture.

In general, the accurate ophthalmoscopic examination of the eyes of albinos is difficult, by reason of the high degree of refraction error, nystagmus, and the sensitiveness of the eyes to light.

Though the usual illustrations of the fundi of albinos do not show it, the author finds that in these cases, the posterior pole (including the fundus around the disk) is generally darker than the peripheral portion of the eyeground because the altered pigment granules are more plentiful, and the retinal capillaries finer and more profuse, in this region. According to Von Hippel,[23] " the pigment epithelium of the retina contains many, but very pale, pigment granules, more numerous in the macular region."

[22] Seefelder, R. "Albinism." Kurzes Handb. Vol. 1. Berlin. Julius Springer. p. 575. 1930.
[23] V. Hippel, E. — Vide No. 2.

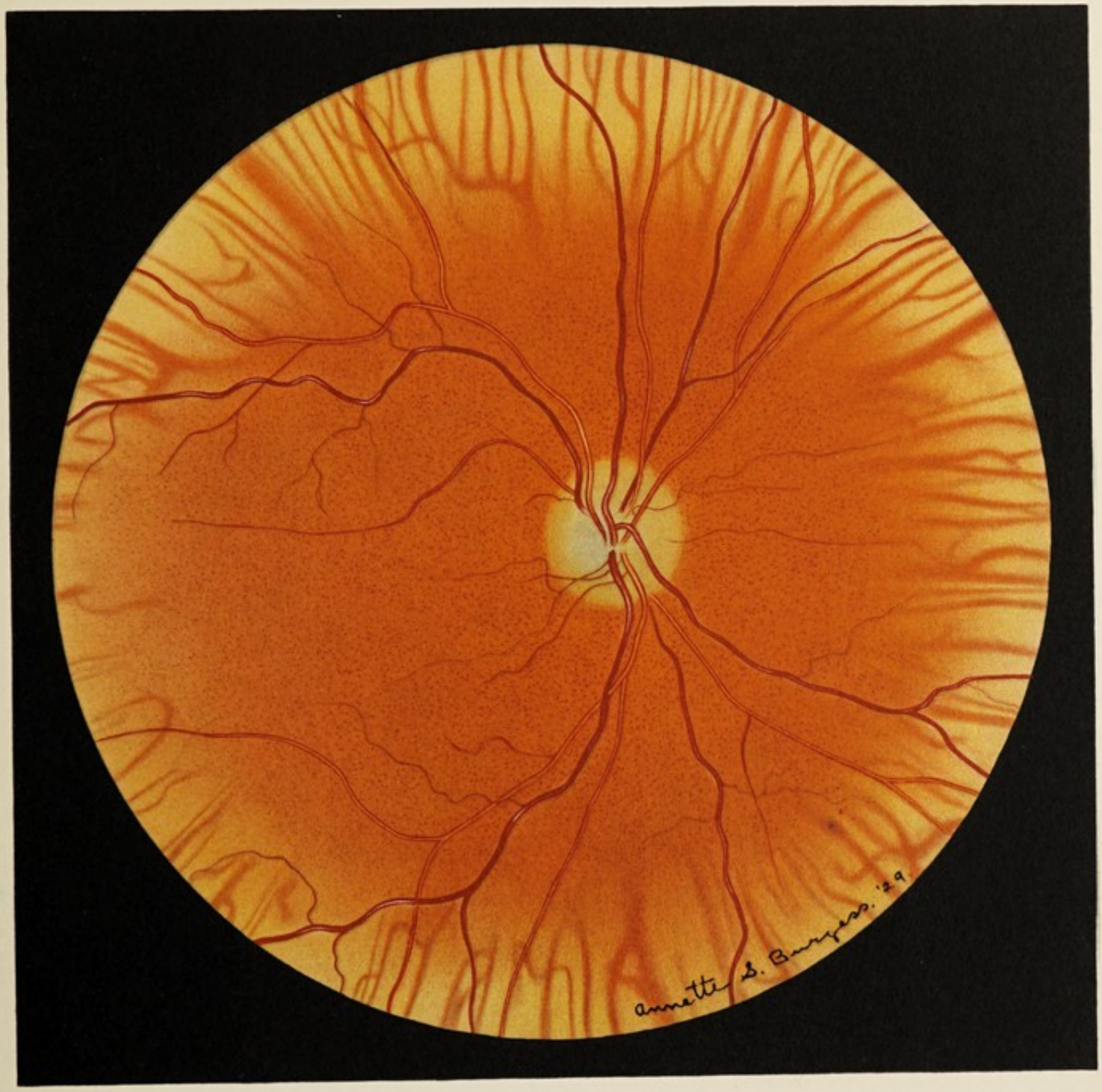

Annette S. Burgess, '29

PLATE 9

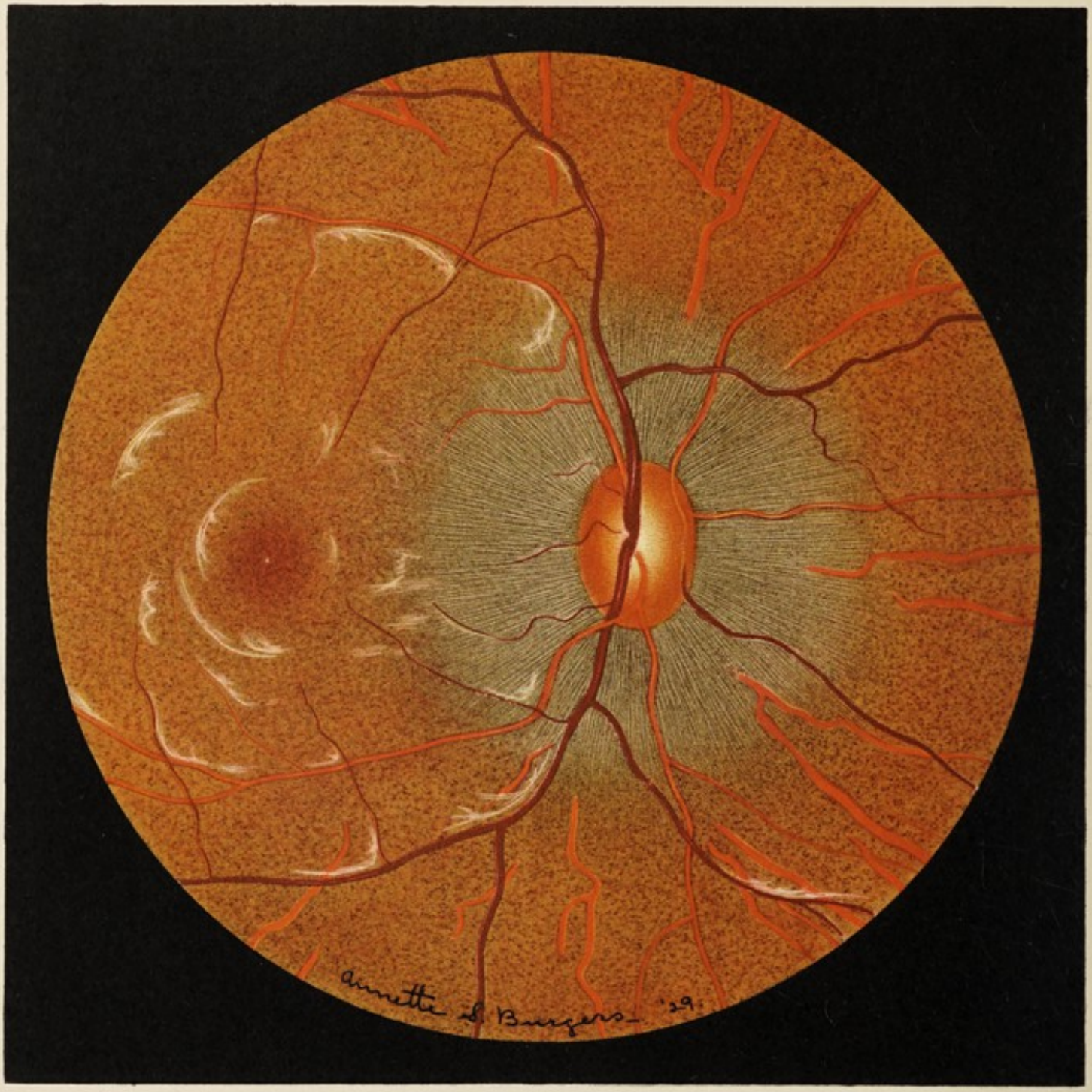


PLATE 9

Normal Fundus of Monkey (macacus rhesus), right eye.

The dark, orange-red disk is oval, with the long axis vertical. The margins are well-defined. The physiological excavation is small and paler than the rest of the disk.

The central retinal artery emerges from the physiological cup and divides into an upper and lower branch. The arteries are somewhat obscured by the very large divisions of the central retinal vein. In addition to these central vessels, an artery and a vein are seen on the nasal side of the disk. The arteries are comparatively small, fairly translucent, and red-brick in colour, with well-marked light-streaks. The veins are very large, of a dark red, almost claret, colour, and their light-streaks are not very pronounced.

The region around the disk is more deeply pigmented than the rest of the eyeground, and it resembles that area in the fundus of the negro. The macular area is a darker red than the pheripheral fundus, and presents an appearance similar to that of the stippled macula in man. The fundus has a general yellowish red hue. The choroidal vessels are few in number but well-defined, especially towards the periphery. The light reflections around the disk are radial, stable, and beautifully marked against the darker background. The foveal reflection is minute, silvery, and relatively stable. The light-reflexes in the macular area are crescentic and very changeable. Along the vessels, they are linear, feathery, evanescent, yet seemingly tangible — like thin shreds of cotton wool.

On the whole, the fundus between the vascular spaces has a granular appearance. The chief factors in the general colour of the fundus are the light-reflexes around the disk, the pigment epithelium of the retina, the pigment cells in the choroid, and the sharply-outlined details of the choroidal vessels.

NOTE: In primary optic atrophy in the macacus rhesus, the white disk, with its clearly-cut margins and its brilliant blood vessels, makes a striking picture against the reddish grey reflecting background.

PLATE 10

Normal Fundus of Dog (mongrel), right eye.

The disk is prominent, irregular, with feathery margins. Its colour is a pale reddish yellow, almost salmon. The physiological excavation is central but insignificant. There is no difference in the appearance of the temporal and nasal sides of the disk. If one is not familiar with the appearance of the dog's disk, the normal disk might be mistaken for beginning papilledema.

Nine minute arteries emerge from the margin of the disk in the same manner as the cilioretinal artery in man. The arteries are red-brick in colour with poorly-defined light-streaks. The principal veins enter the disk at four points around the edge of the optic cup, somewhat like a miniature "Circle of Willis." They are large, carmine coloured, with broad, red light-streaks. There are also two smaller veins on the margin of the disk.

There is no macular region. The lower part of the fundus, and a narrow strip above the disk, are reddish brown in colour, with a stippled appearance. The lower portion of the dog's fundus is known as the "tapetum nigrum," and has much the appearance of the ordinary negroid fundus. It extends higher up on the nasal than on the temporal side. The colour is due to the translucent retinal pigment cells and to the pigment and vessels of the choroid.

It is impossible to describe or depict the beautiful, crystal-like, kaleidoscopic colours of the upper portion of the fundus (tapetum lucidum), with its lemon and orange yellows, many tints of green, and a narrow strip of small blue plaques.

Space will not allow a full description of the histological characteristics of the tapetum lucidum, or the various theories advanced to explain the brilliant reflections. Briefly, the pigment epithelial cells are devoid of pigment. The choroid contains a non-pigmented structure (tapetum lucidum choroidale), cellular in character, and lying between the choriocapillaris and the larger choroidal vessels.

"In no other case," says Lindsay Johnson,[24] "have I found such an enormous difference in the colour and appearance of the fundus, as in the Dog's."

[24] Johnson, G. L. "Contributions to the Comparative Anatomy of the Mammalian Eye, Chiefly Based on Ophthalmoscopic Examination." Phil. Trans. Roy. Soc. 194, London. Harrison & Sons. p. 19. 1901.

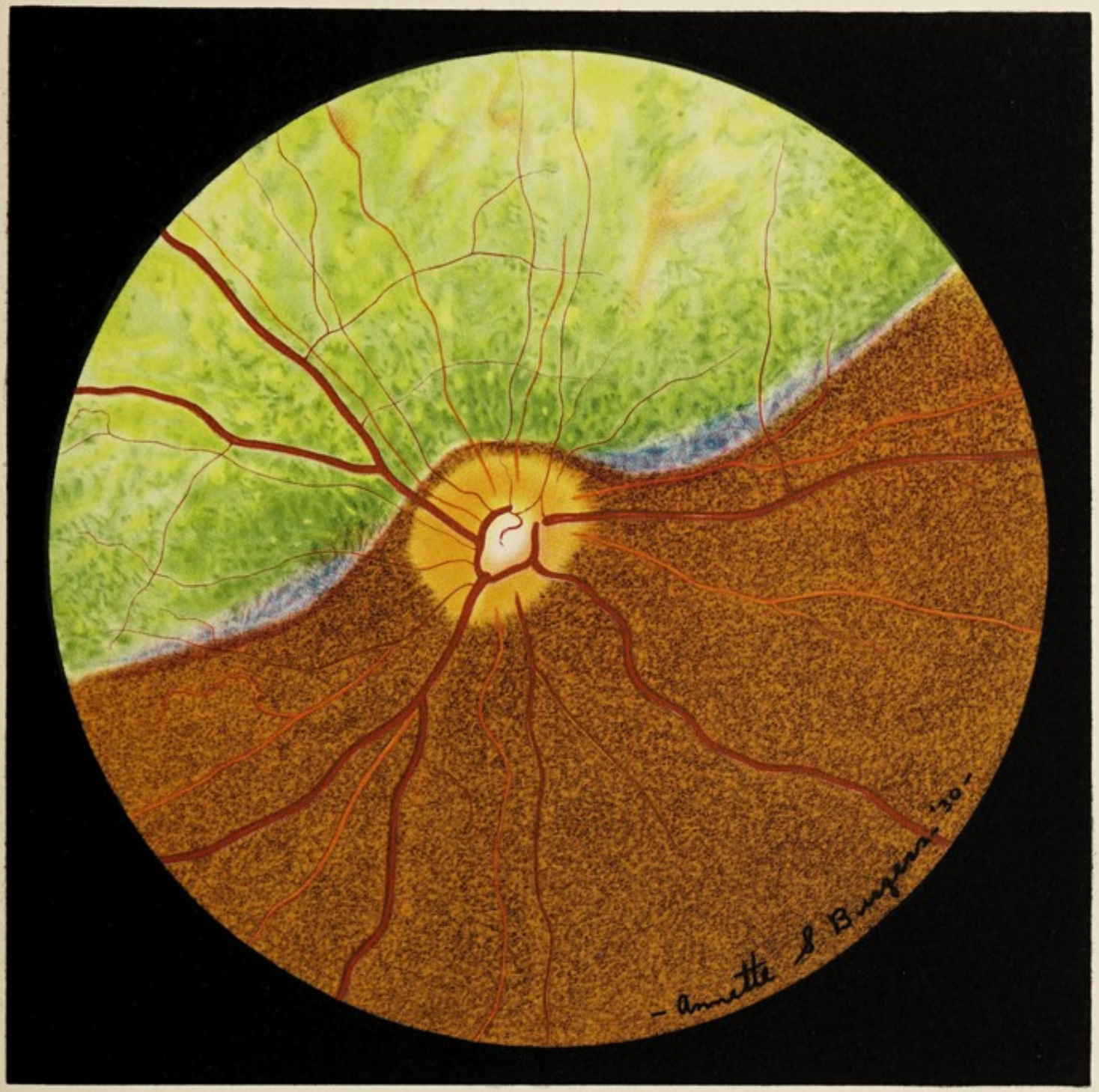

- Annette S Burgess '30

PLATE 11

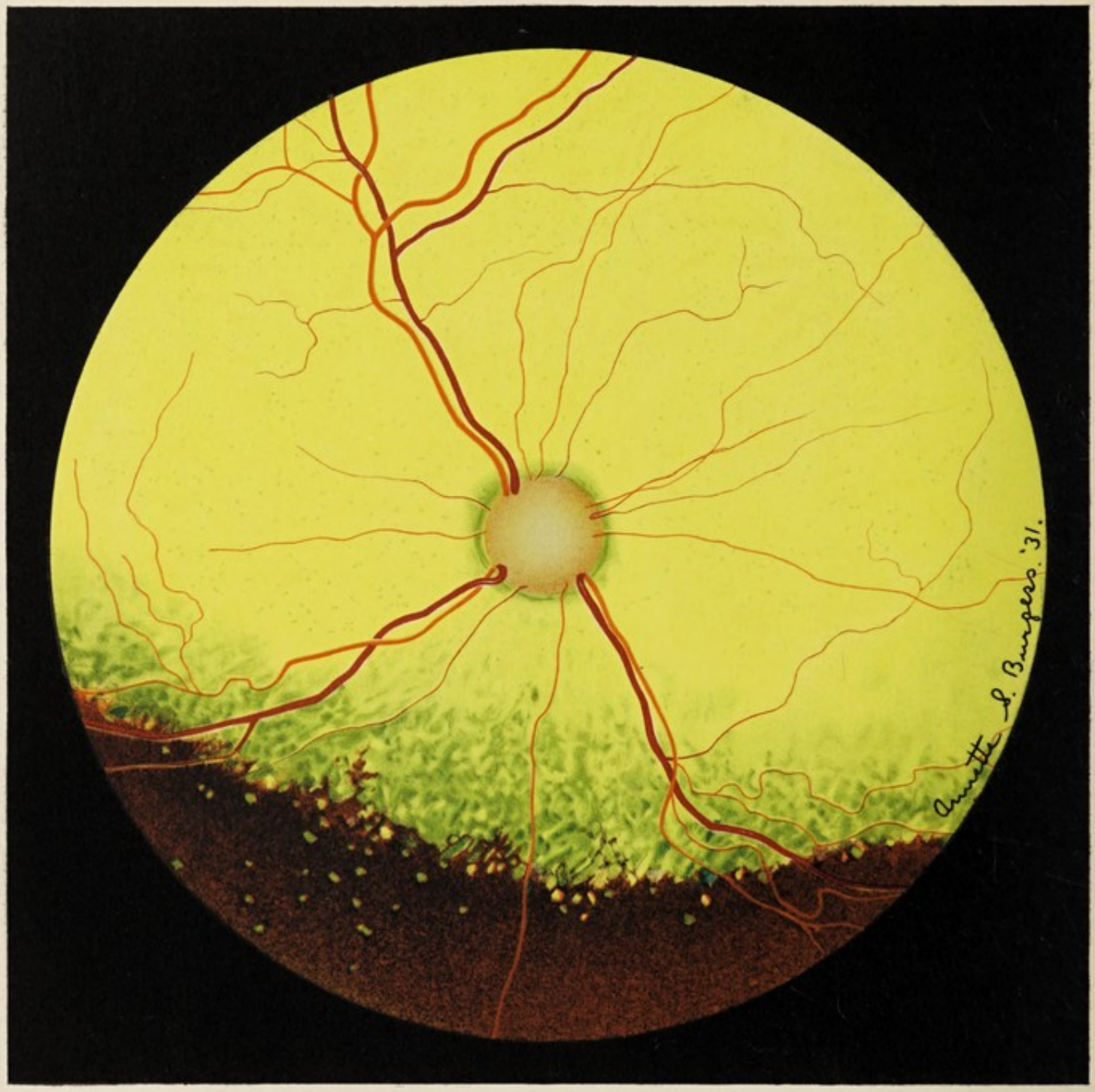


PLATE 11

Normal Fundus of Cat (grey), left eye. There is a hyperopia of 2 dioptres.

The disk is circular and slightly cupped. The edges are sharply-defined and surrounded by a bright green halo. The centre of the disk is a light brownish grey, which becomes darker towards the periphery. There is no difference in the appearance of the temporal and nasal sides.

Nine small arteries emerge from the margin of the disk and bend over its edge as in glaucomatous cupping. Seven veins likewise bend to enter the disk. This curving of the vessels over the margin of the disk increases the effect of excavation. The appearance of the arteries and veins resembles that of the cilioretinal vessels in man. The light-streaks on the vessels are insignificant.

There is no macula. The portion of the fundus which corresponds to the macular region in man is situated in the tapetum lucidem which is more extensive in the cat than in the dog. (Plate 10). It occupies all of the fundus above the disk and a broad strip beneath it. It is more extensive on the temporal than on the nasal side. The colour is a very translucent lemon-yellow, with faint flecks of golden yellow, and some minute, bright green specks scattered through it. Below this yellow area, there is a beautiful border with many tones of crystal-like green. The lowest portion of the eyeground (tapetum nigrum) is a reddish brown with a few scattered plaques of brilliant green. On the upper border of the tapetum nigrum, there are some orange coloured spots with bright green centres.

In 1792 John Hunter [25] described the tapetum lucidum in the cat and other animals.

[25] Hunter, J. "Observations on Certain Parts of the Animal Oeconomy." 2nd Ed. London. G. Nical and J. Johnson. p. 249. 1792.

PLATE 12

Normal Fundus of Rabbit (dark grey). There is a hyperopia of 1.5 dioptres.

The disk, with its medullated nerve-fibres on either side — like the "wings" of an aviator — makes a most dramatic appearance in the upper part of the fundus. It is irregular, oval, white, cupped, with its long axis horizontal. Its lower portion appears slightly greenish grey because the rays of light are reflected away from the eye of the observer. The margins are indistinct; but especially blurred above, and on the sides.

The band of opaque nerve-fibres, which resembles a strip of long-haired, white fur, tapers horizontally from the margins of the disk to a point near the equator. The medullated fibres extend a short way above and below this strip, also above and below the disk. This myelin structure appears about two weeks after birth. Berliner [26] attributes its presence to the secretion of oligodendroglia cells, which occur only in this portion of the rabbit's retina.

The retinal vessels consist of four arteries and three veins. The main artery emerges from the disk slightly below its centre, and divides into four branches — two nasal and two temporal. All veins enter the disk nearer the margin than the centre. The small blood vessel at the lower border of the disk is too minute to determine whether it is an artery or a vein. The vessels extend laterally in front of the strip of opaque nerve-fibres where they appear very vividly on a plane anterior to this band. The light-streaks are insignificant. The rest of the retina is avascular.

There is no macula in the rabbit. But there is a sensitive strip of retina 3 to 4 mm. wide below the disk which extends horizontally on a plane with the posterior pole of the eye. According to Davis,[27] in this area "the rods and cones are longer, the external and internal nuclear layers are thicker, and the ganglion cells are more numerous."

In the periphery, the choroidal vessels appear as ill-defined, light red streamers between the pigment cells of the choroid. (In the white rabbit, the intervascular spaces are yellowish red). Except for the absence of retinal vessels, the lower part of this picture suggests the tessellated human fundus.

The disk, the opaque nerve-fibres, and the retinal vessels are placed well above the plane of acute vision — a satisfactory arrangement for the rabbit, whose visual requirements are simple.

[26] Berliner, M. L. "Cytologic Studies of the Retina." Arch. Oph. 6. p. 740. Nov. 1931.

[27] Davis, F. A. "The Anatomy and Histology of the Eye and Orbit of the Rabbit." Trans. Am. Ophth. Soc. Vol. XXVII. p. 401. 1929.

PLATE 12

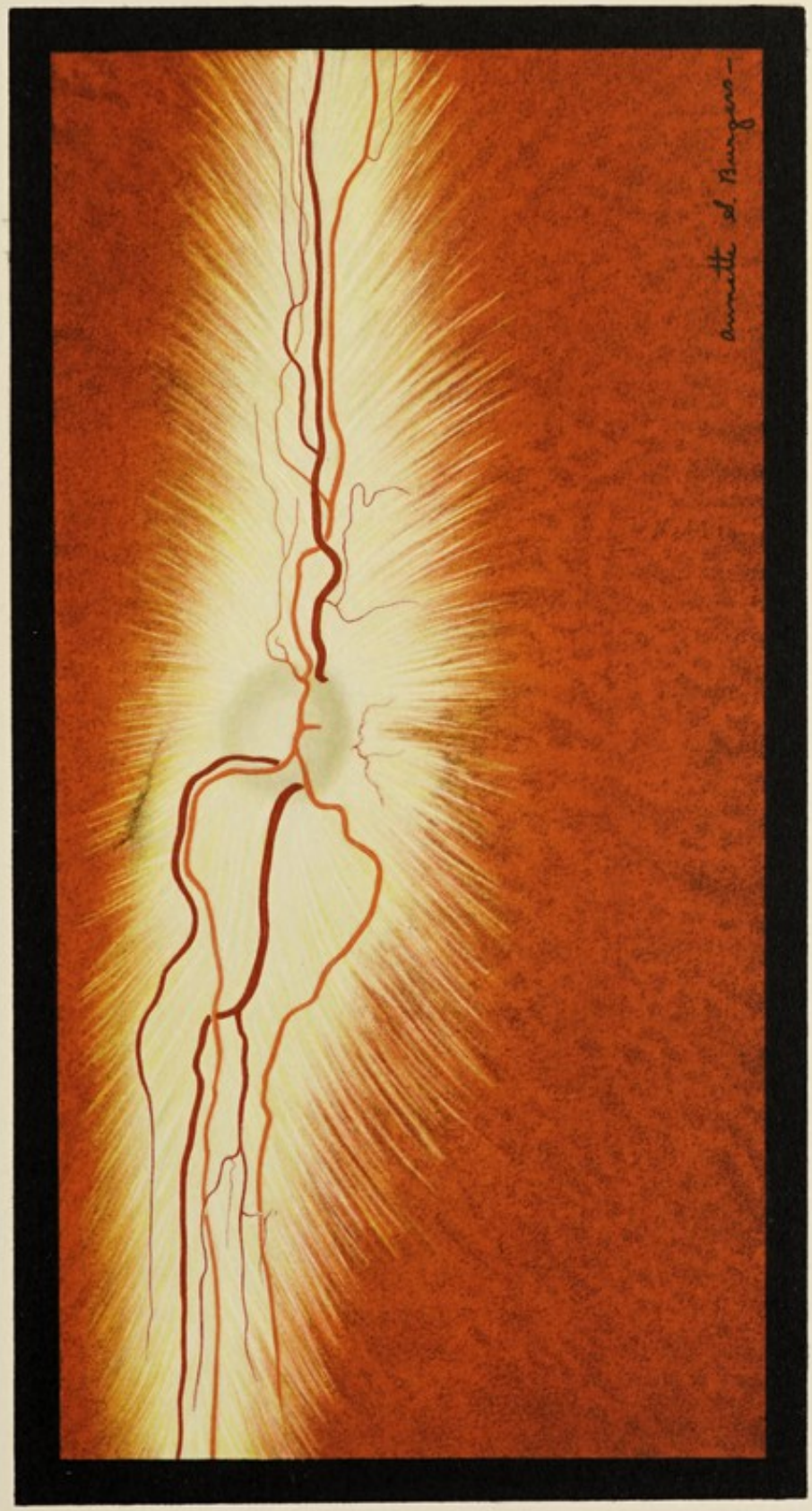


PLATE 13

PLATE 13

Normal Fundus of Guinea-pig (black), right eye. The refraction error consists of a small amount of hyperopia with a slight astigmatism.

In guinea-pigs the eyes are small, and the refraction error is usually insignificant. Corneal opacities are rather common, and the corneal epithelium is easily disturbed by the use of mydriatics. A clear view of the fundus is therefore difficult to obtain. The corneal disturbance is probably caused by their mode of life in the dust and straw; for the cornea in the young animal is much clearer than in the mature guinea-pig.

The disk is a pale yellowish white, with round, poorly-defined edges. The vascular supply consists of an irregular projection of blood vessels in the centre of the disk and a few minute twigs around the margin. These twigs are extremely small, and it is difficult to depict them accurately in a drawing.

Around the disk there is an accumulation of pigment which forms a dark ring apparently 8 mm. in width. This deposit gradually fades away towards the outer margin. Over this pigmented area there are faint, radiating reflections which extend some distance out from the disk.

No retinal vessels are visible. The fundus in general presents an irregular, mottled appearance. In the posterior part of the fundus there are black islands of pigment surrounded by larger reddish areas; these seem to represent choroidal vessels. There is less pigmentation towards the periphery. Here the white sclera is visible through the intervascular spaces.

The great variation in the fundi of these animals ranges all the way from the darker pigmented eyeground here illustrated to the pale fundus of a white guinea-pig. In the white guinea-pig, the intervascular spaces are yellowish white in colour — similar to the human albinotic fundus.

PLATE 14

Medullated (Opaque) Nerve-fibres, right eye of a 23 year old woman.

This condition, which is anomalous in the human eye, is normal in the eye of the rabbit. (Plate 12). The ocular functions are normal, with the exception of a slight enlargement of the blind spot in the right eye. The fundus of the left eye is normal.

At a distance of 33 cm., the blind spot of the right eye is 3 × 5 cm. in size, while in the normal left eye it is 2.5 × 4 cm. The disk is normal in colour, and its margins are well-defined. On its temporal side, there is a narrow crescent of choroidal pigment. The physiological cup is small.

Above the disk, lying slightly to the nasal side, there is a patch of medullated nerve-fibres about two-thirds the size of the disk. These medullated nerve-fibres cover the superior temporal vein, although two small superior arterial branches lie on its anterior surface.

These myelinated fibres are often very extensive. They may reach far out into the retina and assume all kinds of bizarre shapes. Occasionally, an interval of normal retina may be seen between the disk and the medullated nerve-fibres.

Opaque nerve-fibres may be mistaken for retinal exudations; and occasionally they complicate the picture when either a papilledema or a mild neuroretinitis is actually present. (Plates 31 and 32).

The fibres of the optic nerve usually lose their myelin sheaths as they pass through the lamina cribrosa. Occasionally they persist for a short distance in the retina (or they recur) and appear in the fundus as shown in this illustration. Berliner [28] has suggested that they are "due to the abnormal presence of myelin-forming elements, the oligodendroglia, in the layer of nerve-fibres."

[28] Berliner, M. L. "Medullated Nerve-Fibres Associated with Choroiditis." Arch. of Ophth. 6. p. 404. Sept. 1931.

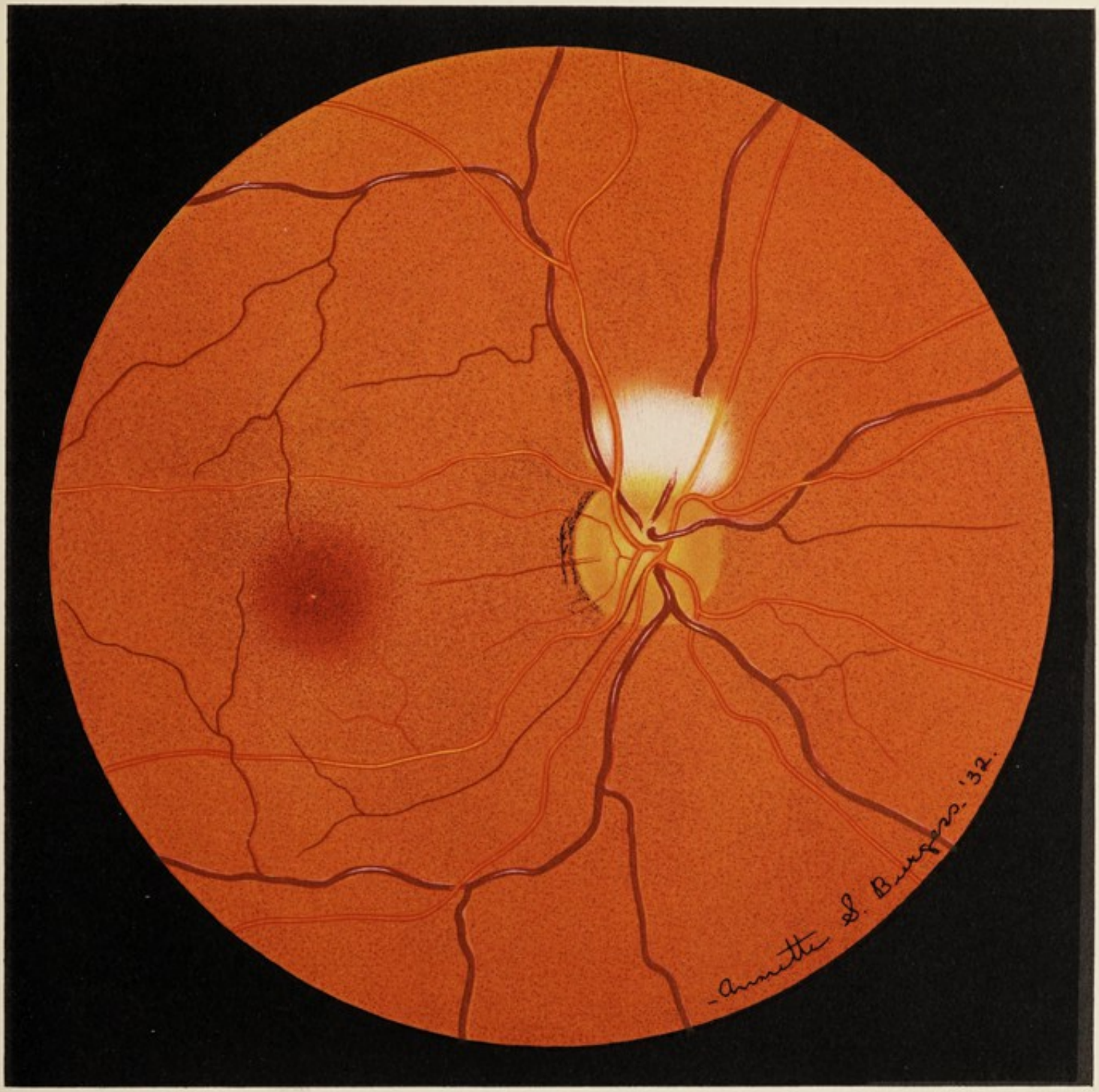

Annette L. Burgess '32.

PLATE 15

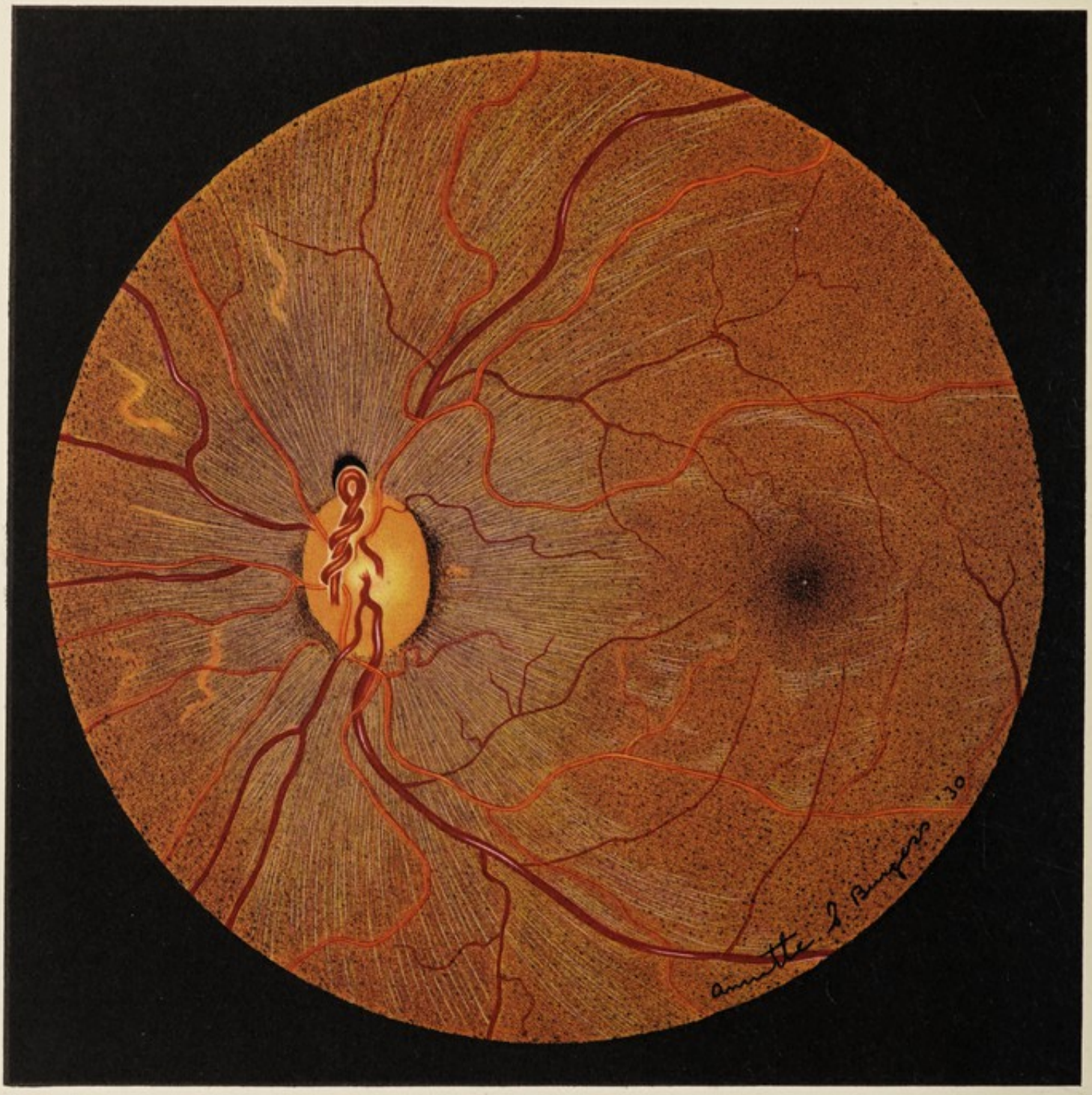


PLATE 15

Prepapillary Arterial Loop, left eye of a mulatto girl, 11 years old. Dispensary No. 44,256.

Family History. — Negative. *Past History.* — Apart from congenital deaf-mutism, patient's health has been good. *Present Illness.* — The child complained of inability to see blackboard at school.

Eye Examination. — Externally, the eyes are normal. Refraction: R. E. V. S. + 3.5 D. ⌒ C. + 1.0 D. × 90° = 6/6. L. E. V. S. + 2.75 D. ⌒ C. + 2.0 D. × 90° = 6/6. *Ophthalmoscopic Examination.* — Left eye. Media, clear. The disk is best seen with + 4.0 D. lens. It is somewhat oval in shape, with the long axis vertical, and it has a rather dusky red colour. The margins are well-defined, with pigment deposits on both sides.

The inferior nasal artery twists around itself as the snake in the caduceus twines around the staff. The straight portion is efferent; the twisted portion is afferent. The circulation is quite free in this loop, and there is a marked arterial pulsation. The loop bobs up and down with every heart beat. It seems to be a substitute for the inferior nasal branch of the central retinal artery, although it extends upwards a short distance above the superior margin of the disk, and forward into the vitreous. Above the loop, there is a dark shadow due to the reflection of the light away from the observer. The apex of the loop is best seen with a + 8.0 D. lens.

A delicate, greyish tissue surrounds the spiral. It suggests either a so-called perivascularis, or that the internal limiting (or hyaloid) membrane has been pushed forward in front of the loop. Its extreme delicacy renders its detection in section very difficult. Goldstein and Wexler [29] recently studied such a case microscopically. They were unable to discover any membrane or supporting structure in connection with the loop.

A small arterial twig crosses the nasal side of the disk. Near its lower nasal margin, but entirely separate from the disk, there is a well-developed cilioretinal vessel. Five arterial branches and three main venous stems emerge from the disk.

The pigmentation of the fundus, with its changing light reflections and erratic choroidal vessels, are of the negroid type.

There is a similar arterial coil in the right eye, but the pulsation is less marked.

[29] Goldstein, I. and Wexler, David. "Preretinal Artery. An Anatomic Study." Arch. Ophth. 1. p. 324. March 1929.

PLATE 16

Congenital Epipapillary Membrane, right eye of a man 26 years of age. W. O. I. No. 6,432.

Family History and Past History. — Unimportant. *Present Illness.* — The patient did not complain of his eyes, and the membrane was found during a routine examination.

Eye Examination. — The left eye is entirely normal. Externally, the right eye is normal. Vision corrected = 6/5. Visual Field: periphery normal. Blind spot normal for white, but a slight enlargement for red, as shown in the accompanying diagram.

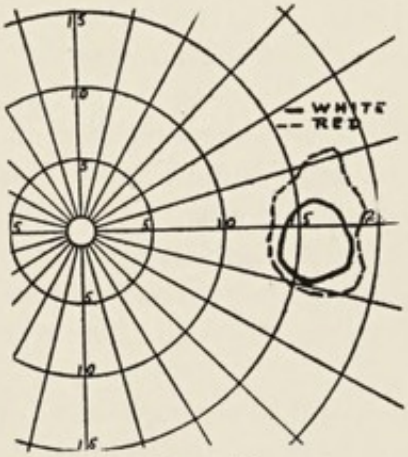


PLATE 16
BLIND SPOT ENLARGED FOR RED

The fundus of the right eye is interesting because of the presence of a congenital anomaly. This consists of a delicate, semi-transparent membrane which covers the whole of the nasal side of the disk, and projects beyond its borders at the upper and lower nasal quadrants. The membrane seems to spring from the physiological excavation, and it has the appearance of a delicate gauze veil. Its translucency renders its reproduction very difficult. The margin of the membrane curves forward and appears to be opaque. It suggests the curled edges of a La France rose petal. The black shadow around its upper nasal margin is due to the reflection of light away from the eye of the observer. The membrane does not exhibit any evidence that would indicate a previous inflammatory condition; therefore it is likely of neuroglial origin.

Epipapillary tissues of this nature have been described by a number of observers. Recently, Samuels[30] presented a very interesting paper on the subject before the American Ophthalmological Society.

[30] Samuels, Bernard. "Epipapillary Tissues." Trans. Am. Ophth. Soc. 29. p. 242. 1931.

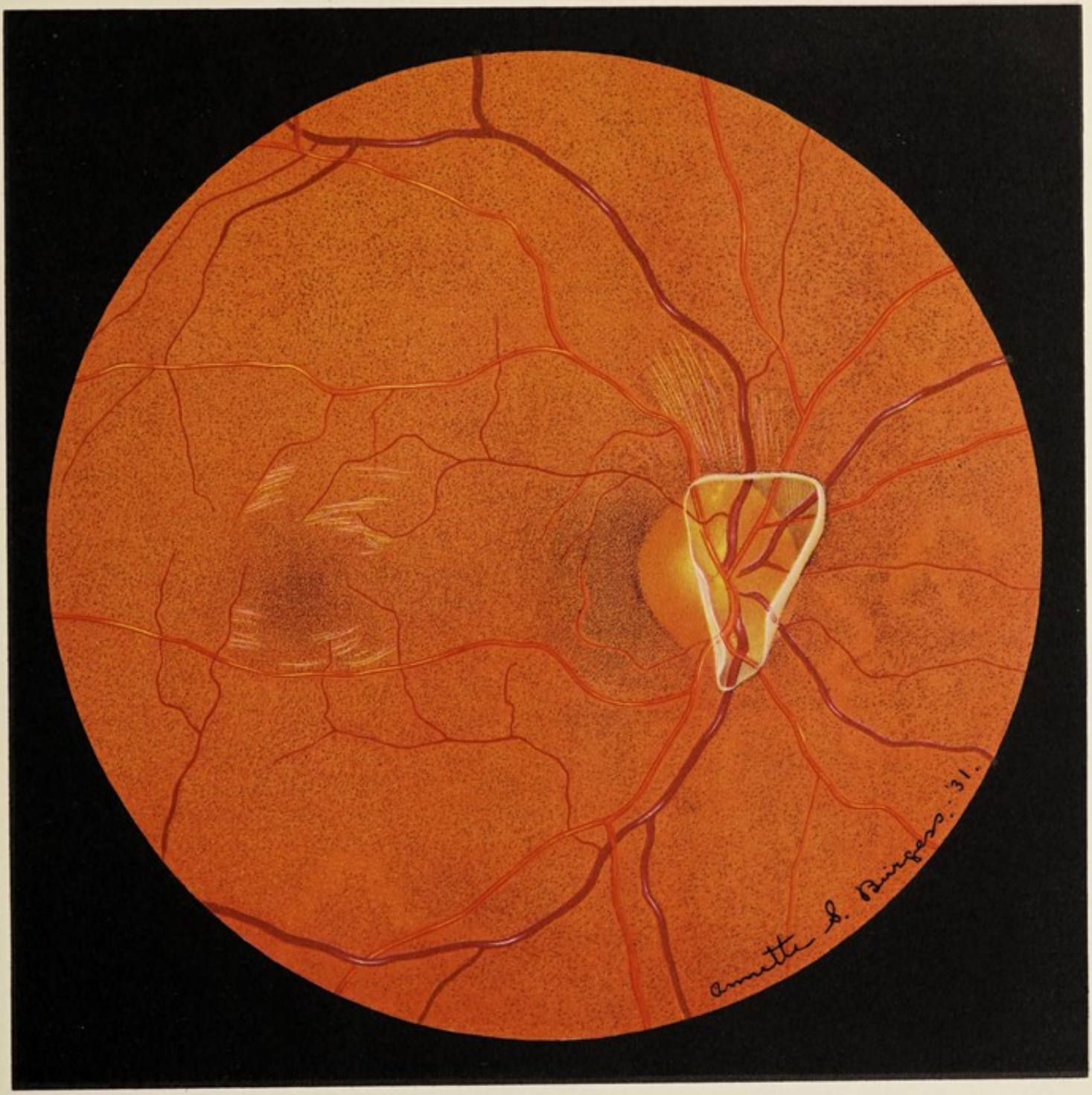

Annette S. Burgess. 31.

PLATE 17

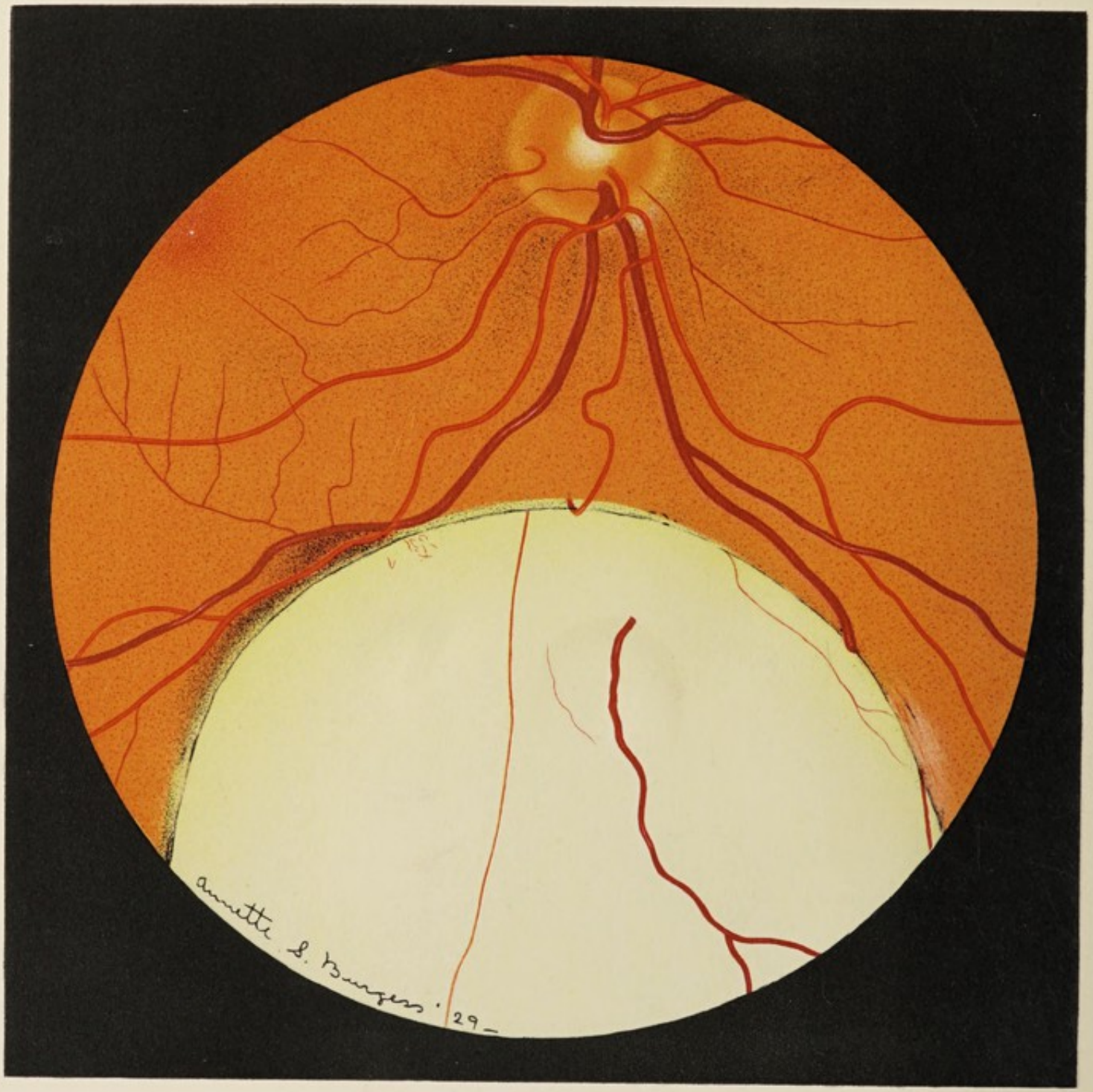


PLATE 17

Coloboma of Choroid, right eye of a man 36 years of age. Dispensary No. 34,383.

Family History, Past History, and Present Illness. — Unimportant.

Eye Examination. — Externally, the left eye is normal. Vision corrected = 6/6. Visual Field: upper defect as shown in chart. *Ophthalmoscopic Examination.* — The disk has a rather curious, distorted appearance. It is a dusky reddish colour. The margins are blurred. The physiological excavation is insignificant.

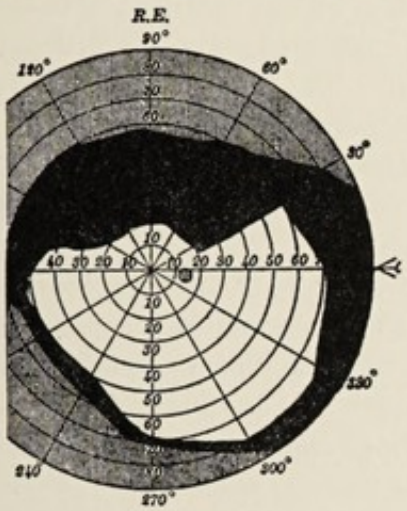


PLATE 17
UPPER FIELD DEFECT, RIGHT EYE

The central retinal vessels are eccentrically placed, and the exit of the upper venous branch is completely obscured by the vessel itself. The veins are large and ribbon-shaped. There is a moderate sized cilioretinal vessel at the outer margin of the disk.

The coloboma is below. Over the ivory-white, glistening sclera, there are no remains of retinal or choroidal tissue except at the margins. The surface of the coloboma is depressed — the ectatic type. There is an accumulation of pigment on the temporal side. For two disk-diameters between the disk and the coloboma, the tissues are normal. A branch of the inferior nasal artery curves under the upper margin of the coloboma, and, as far as the examiner can see, reappears after a short space, to continue its course. A larger, darker red vessel appears on the upper edge of the coloboma at the point of its greatest depression, and runs downward and slightly inward, to branch and continue its course below. In addition to these larger vessels, two minute arterial twigs are visible on the coloboma.

This anomaly is attributed to faulty closure of the foetal cleft, or to the adhesion of the retina to mesoblastic tissue during the embryonic development of the eye. Mann[31] states that congenital defects are more common in the newer, less stable, lower part of the eye than in the portion above the disk.

[31] Mann, I. C. "The Regional Differentiation of the Vertebrate Retina." Am. Jour. Oph. Vol. II. No. 7. p. 515. July 1928.

PLATE 18

Coloboma of Choroid and Optic Nerve, right eye of a 15 year old boy. W. O. I. No. 3,483.

Family History, Past History and Present Illness. — Unimportant.

Eye Examination. — The left eye is entirely normal. Externally, right eye, coloboma of the iris. Vision corrected = 6/15. Visual Field: upper defect shown in chart. The blind spot (not shown) is enlarged. *Ophthalmoscopic Examination.* — The disk is reddish white, irregular in shape, with deposits of pigment around the margin, more marked at the upper nasal quadrant. The physiological cup is insignificant. There is a small coloboma in the lower portion of the disk. It is markedly excavated, and apparently 9 × 11 mm. in size. A branch of the inferior nasal artery runs downward and inward across this defect, and divides into three branches. The two upper branches continue their course across the normal disk, while the inferior branch disappears at the lower nasal margin of the coloboma to reappear at the border of the disk. The inferior temporal vein dips downward into the disk at the lower portion of the coloboma. At the lower temporal margin of the disk, there is an unusually large cilioretinal artery which sends one branch above, and one below, the macular region.

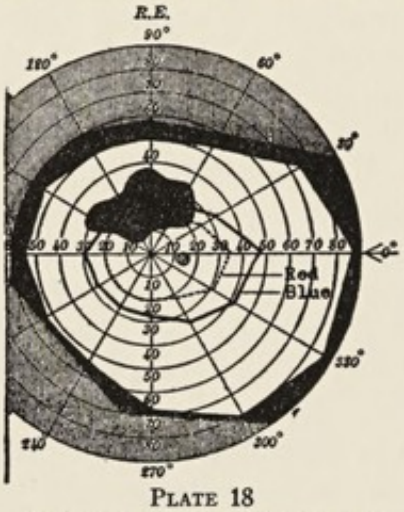


PLATE 18

ABSOLUTE SCOTOMA, RIGHT EYE

There is a coloboma of the choroid and retina in the lower portion of the fundus. While the periphery of the coloboma is not shown in the plate, there is actually a rim of normal tissue between it and the ora serrata. The upper portion of this coloboma is two disk-diameters from the lower margin of the disk. This defect has not the ivory-white, glistening appearance, nor the depression, seen in Plate 17. It is a greyish yellow, with marked pigment deposits along its border. It is crossed by several branches of the inferior nasal artery. On the nasal side, there is one large choroidal vessel.

Many varieties of colobomata of the retina and choroid are seen. Plates 17 and 18 illustrate two of the common forms.

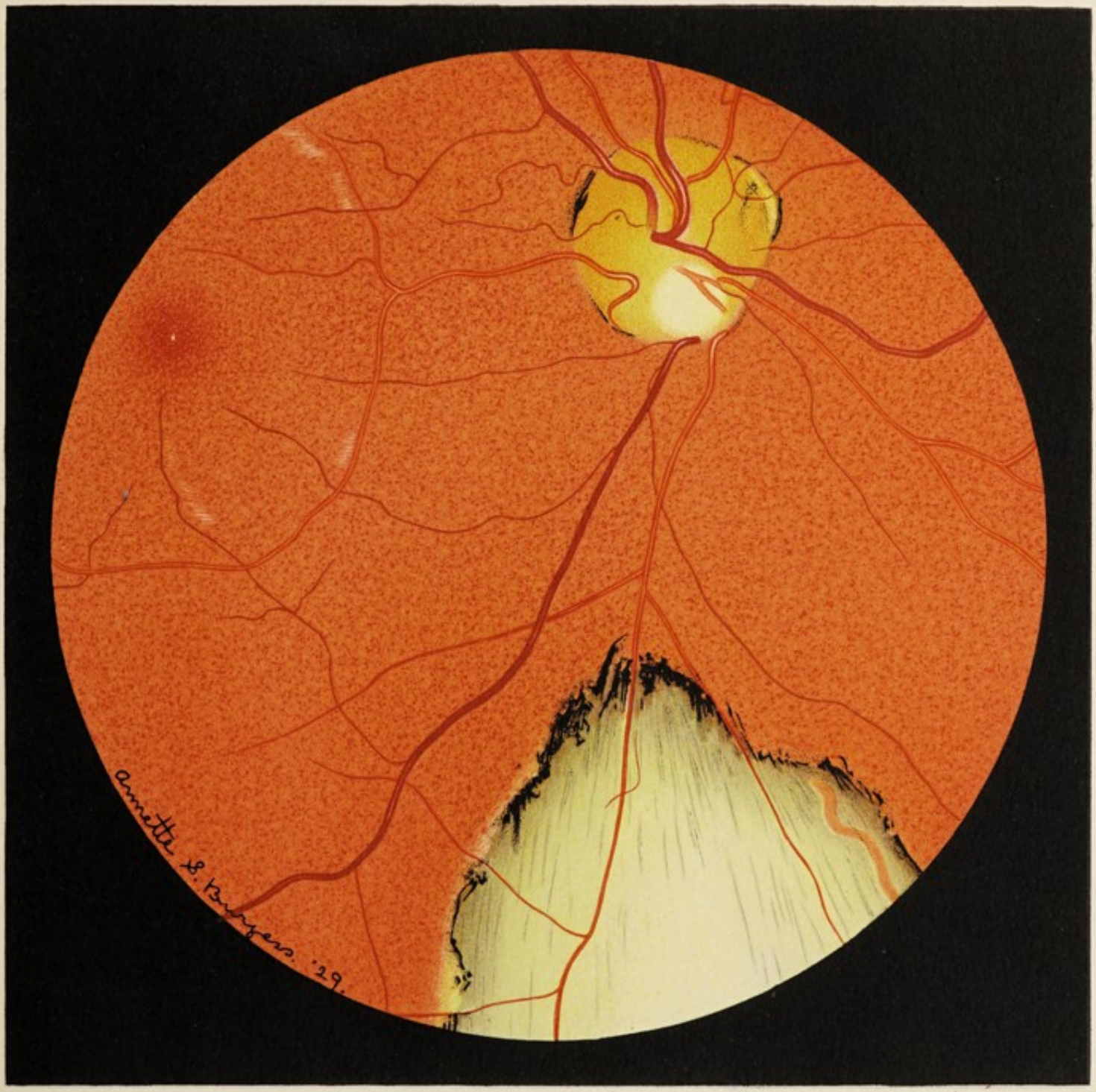

Annette S. Burgess. '29.

PLATE 19

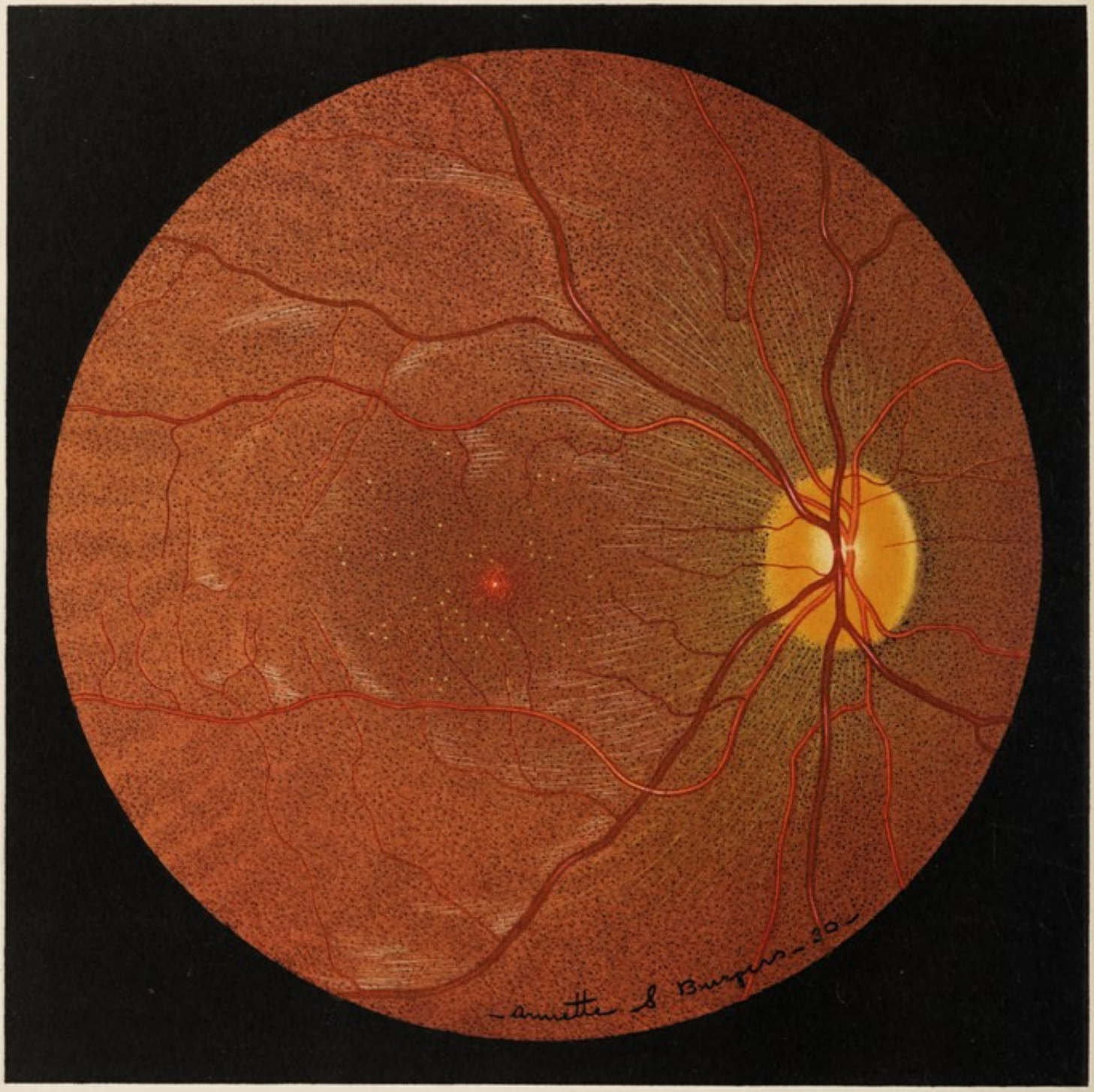


PLATE 19

"Gunn's Dots" [32] (**"Crick Dots"**), right eye of a 26 year old man of pronounced brunette colouring. W. O. I. No. 5,691.

Family History. — Negative. *Past History.* — Negative. *Present Illness.* — There were no subjective symptoms. The fundus condition, which is bilateral, was discovered during the course of a routine physical examination. A diagnosis of "acute retinitis" was made at that time, and a complete diagnostic survey ordered. This was entirely negative, as were all laboratory tests.

Eye Examination. — Externally, negative. Vision = 6/5 in each eye. Visual fields, blind spots, colour and light sense, are all normal. *Ophthalmoscopic Examination.* — Media, clear. The disk and retinal vessels are characteristic of the normal deeply pigmented fundus of the stippled, granular type, with its beautiful, fleeting light-reflexes.

The foveal reflection is small, yellowish white, and comparatively stable. Around this reflection, there is a rim of fundus which is about 2.5 mm. wide, and of a uniformly lighter red than the surrounding granular background. When examined with the red-free light, this area has a yellowish orange tint which suggests the presence of yellow colouring matter in the retina.

Around the macular region for a space a little more than two disk-diameters in size, there are scattered a number of minute, yellowish white, clear-cut spots. They are not unlike the foveal reflex in colour and size; but they are a trifle more yellow; and they do not vary with the movement of the ophthalmoscopic mirror. They appear to lie in the anterior portion of the retina. There is a similar condition in the left eye.

These dots are not infrequently found in normal eyes, and sometimes in several members of the same family. They have no pathologic significance.

[32] Gunn, R. M. "Peculiar Appearance in the Retina in the Vicinity of the Optic Disc Occurring in Several Members of the Same Family." Tr. Ophth. Soc. U. Kingdom. Vol. 3. p. 110. 1883.

PLATE 20

Primary Optic Nerve Atrophy, left eye of a 58 year old man. W. O. I. No. 2,677.

Family History. — Negative. *Past History.* — Negative, except for a specific primary lesion at the age of 40. *Present Illness.* — At the age of 53, the patient was in an automobile accident. Since then he has had rapidly failing vision, associated with pains in the back, chest, and abdomen.

Physical Examination. — Medical: low grade bilateral deafness, kyphosis, scoliosis, indentation of the chest (Harrison's groove), hyperactive reflexes, and positive Romberg. *Laboratory Reports.* — Blood. — Chemistry and cytology, essentially normal. Wassermann, 4 +. Urine, negative. Spinal fluid: Wassermann positive with paretic colloid of gold curve.

Eye Examination. — Externally, pupils are irregular and contracted; the left being slightly larger than the right. They show no reaction to light or accommodation. Vision in both eyes is limited to hand movements. *Ophthalmoscopic Examination.* — Left eye. Media, clear. Disk is bluish white in colour, and the margins are clear-cut. There is a slight accumulation of pigment around the disk. There are no signs of any previous inflammation. The retinal vessels, macular region, and periphery of the fundus are normal. There is almost complete absence of the normal capillaries over the disk. This, together with the definite atrophy of the optic nerve-fibres, gives the disk a slightly cupped, bluish white appearance. The normal physiological excavation in this case was evidently very slight. The right eye presents a picture similar to the left.

The etiological factor in this optic atrophy is syphilis of the central nervous system.

In primary optic atrophy, the disk may sometimes have a greyish white or even a greenish white colour, or a stippled appearance. The vessels may be normal in size, or they may be more or less attenuated.

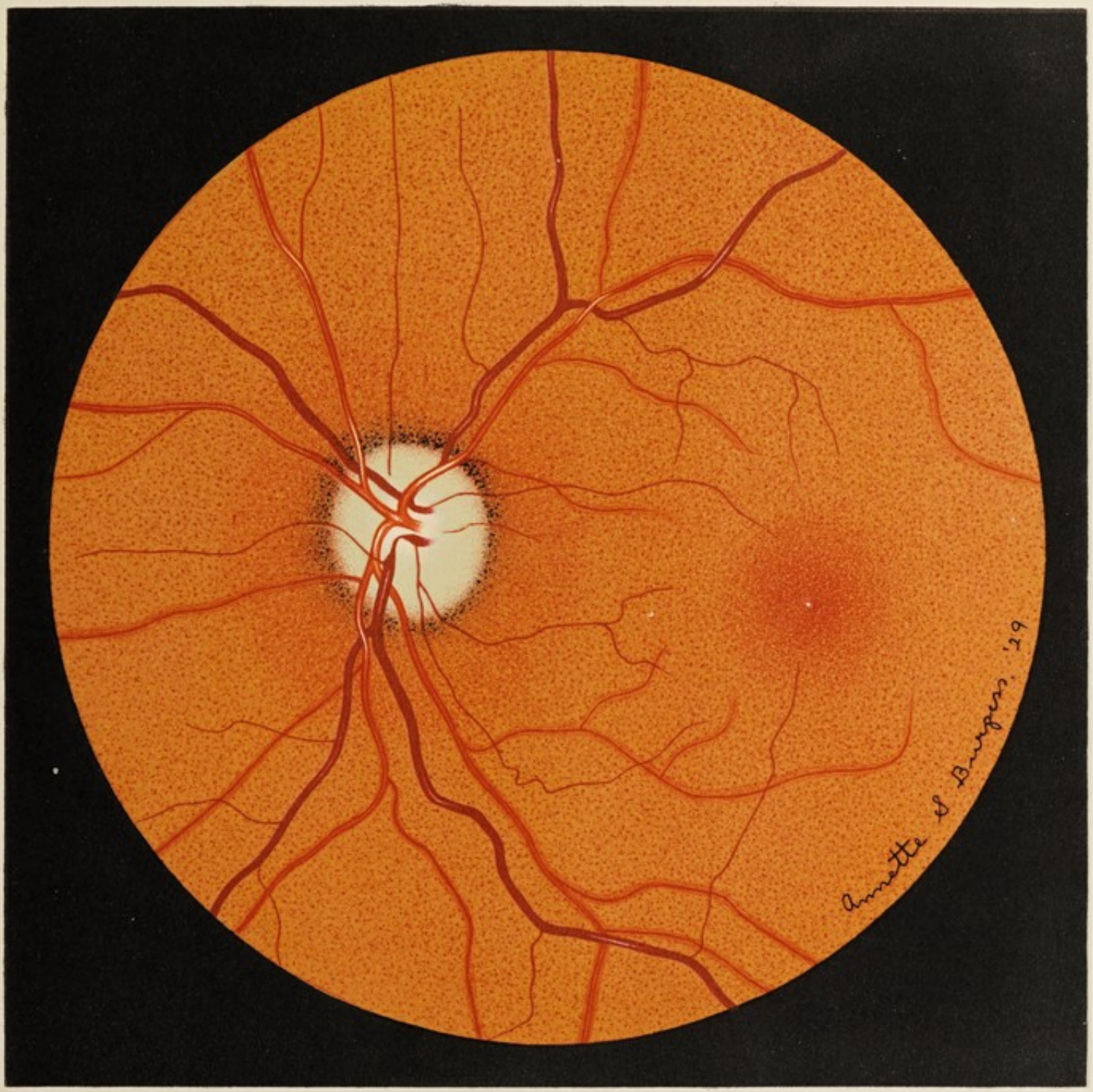

Annette S Burgess '29

PLATE 21

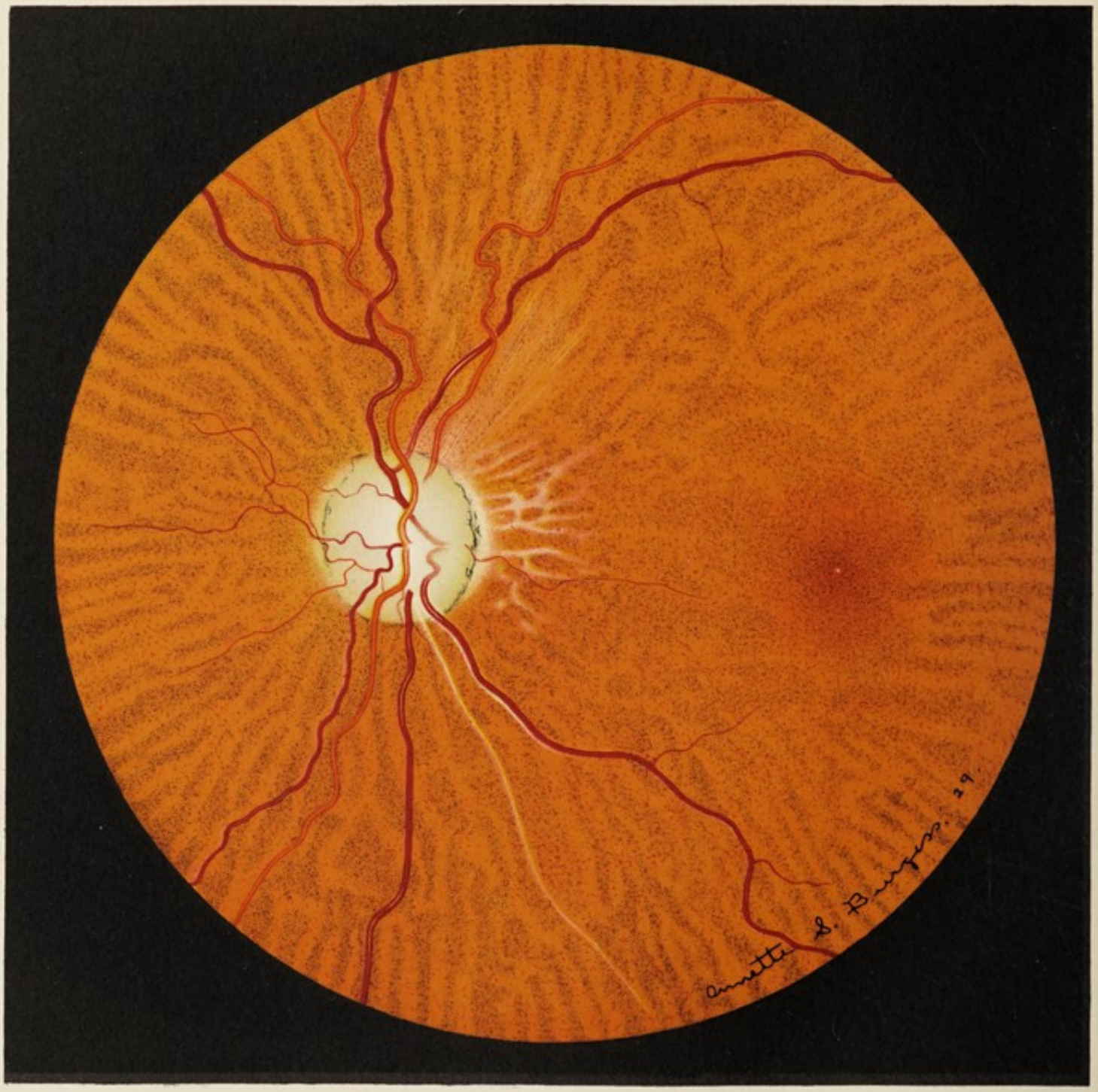


PLATE 21

Secondary Optic Nerve Atrophy, left eye of a woman 37 years of age. W. O. I. No. 3,218.

Sept. 1928. Family History. — Negative. *Past History.* — At 27 years of age, the vision of the right eye failed completely after an attack of influenza. *Present Illness.* — Two days before admission, spots began to appear suddenly before the left eye, and vision has been rapidly reduced.

Physical Examination. — Medical: hypertension, arteriosclerosis, cardiac hypertrophy. Blood pressure, 192/112. Four teeth with apical abscesses. *Laboratory Reports.* — Blood. — N. P. N., 41 mgm.%; sugar, 91 mgm.%; Wassermann, positive. Urine, albumin +. Phthalein excretion, 82%. X-ray of chest and sinuses, negative. Spinal fluid; Wassermann, negative. Pandy's test, negative.

Eye Examination. — Externally, the left eye is normal. L. E. V. = 1/60. Intraocular tension, normal. *Ophthalmoscopic Examination.* — There are many vitreous opacities; there is marked edema of the disk; and the retinal veins are greatly engorged. There are numerous exudates and hemorrhages throughout the retina.

Sept. 1929. This plate (21) illustrates the optic atrophy secondary to the inflammatory condition described above. The disk is greyish white and solid-looking. The physiological cup is filled with organized connective tissue. The entrance of the vein near the temporal margin of the disk is covered by a delicate, veil-like connective tissue. The vessels are tortuous and somewhat attenuated; and their light-streaks are insignificant. The inferior temporal artery is entirely obliterated. On either side of the lower temporal vein, there are white lines of connective tissue — the result of a former perivasculitis. In the retina, to the temporal side of the disk, there are traces of former exudations. All hemorrhages have disappeared. There is a small cilioretinal artery on the temporal margin of the disk.

The foveal reflex is bright. The periphery of the fundus belongs to the tessellated type.

The right eye presents a similar picture.

PLATE 22

Hereditary Optic Nerve Atrophy (Leber's Disease), right eye of a blond man 26 years of age. Unit No. 4,063.

Family History. — Patient, one of eight children; two died in infancy; six living and well. One brother, 27 years old, has had a similar ocular trouble for ten years. *Past History.* — Negative. Patient has always been very abstemious in regard to alcohol and tobacco. *Present Illness.* — Eleven months before admission, vision in the left eye became dim; and in two weeks' time, central vision was entirely lost. One month later, vision in the right eye failed in a similar manner.

Physical Examination. — Medical, negative. There was no clinical evidence of sinus disease. An exploratory operation on the sinuses showed nothing except a few polypoid masses in the ethmoids. Cultures from the sinuses were negative. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Wassermann, negative. Urine, negative. X-ray of head and sinuses, negative. Spinal fluid: Wassermann, negative. Tuberculin, negative.

Eye Examination. — Externally, eyes are normal. R. E. V. = 3/60. L. E. V. = 1/60. Visual fields show bilateral absolute central scotoma. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Right eye. Media, clear. Disk is cupped and greyish white in colour — simulating glaucoma. The lamina cribrosa is faintly visible. There is a wide scleral ring surrounding the disk. It is especially wide at the upper nasal margin. Evidently the normal physiological excavation was unusually deep and broad, which accentuates the pathologic cupping due to atrophy of the optic nerve-fibres.

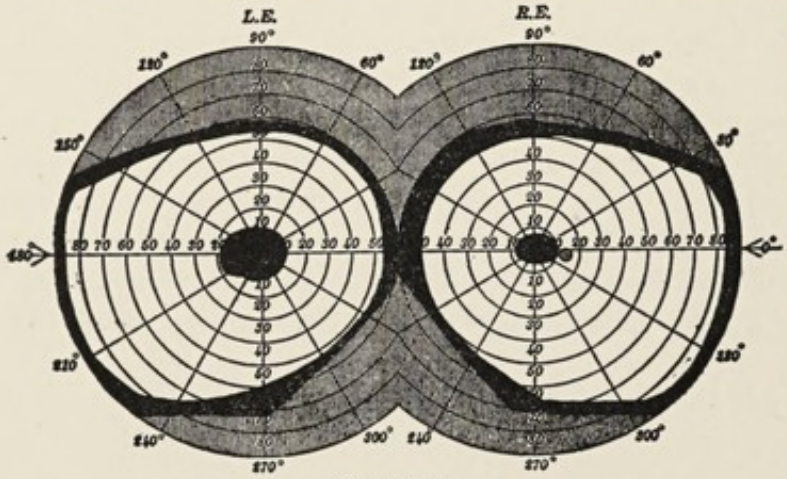


PLATE 22
LEBER'S DISEASE, CENTRAL SCOTOMA, BILATERAL

The macular region and peripheral fundus correspond to the normal blond type. The left eye presents a similar appearance.

NOTE: During the past three years, the vision and visual fields have not changed; but the cupping of the disk has increased, and the scleral ring has become narrower and whiter.

The eyes of the brother are similarly affected.

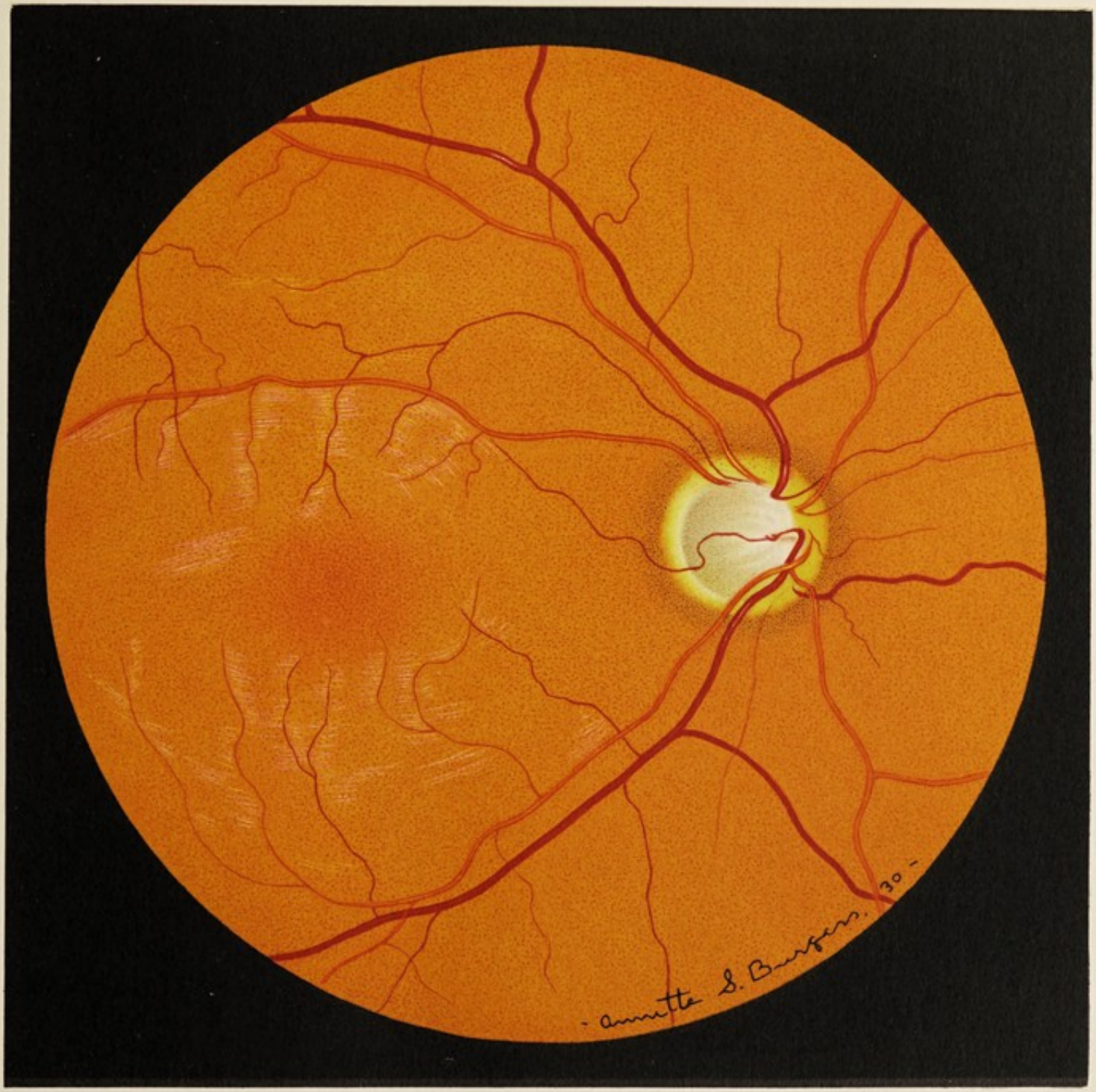

Annette S. Burgess. 30

PLATE 23

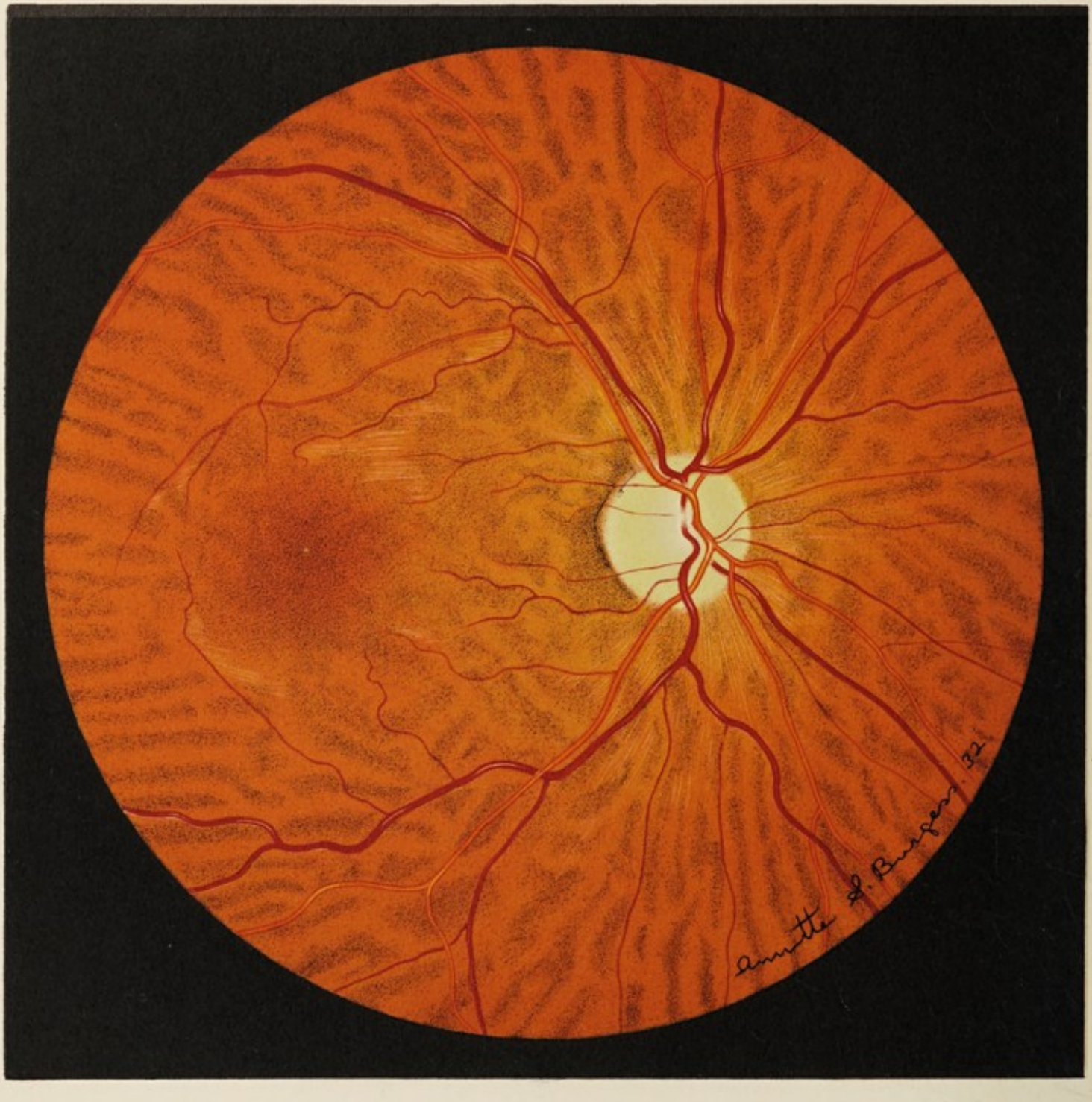


PLATE 23

Hereditary Optic Nerve Atrophy (Leber's Disease), right eye of a brunette man, 27 years of age. Dispensary No. 78,487.

Family History. — Maternal grandmother, mother, and maternal uncle were similarly affected. The uncle died at the age of 27 from pulmonary tuberculosis. One brother died in infancy. Two sisters living and well. *Past History.* — Pneumonia at the age of 5; influenza at 17. Otherwise negative. *Present Illness.* — Began at the age of 6 years, at which time a diagnosis of "optic nerve trouble" was made. There has been no change in vision during the last ten years.

Physical Examination. — Medical, negative. Nose, throat, and teeth, negative. Neurological: negative except for functional facial tic. *Laboratory Reports.* — Blood, Wassermann, and urine, negative. X-ray: sinuses and skull, negative.

Eye Examination. — Externally, the pupils are moderately dilated and the reactions are sluggish. R. E. V. = 3/60. L. E. V. = 6/60. Visual Fields: slight constriction of the peripheral fields, and absolute central scotoma in both eyes, more marked in the right. Slit lamp, negative. *Ophthalmoscopic Examination.* — Right eye. Media, clear. The disk is greyish white in colour with clear-cut margins. No evidence of pre-existing inflammation. There is no cupping of the disk, in contrast with Plate 22. There is a slight accumulation of pigment at the temporal margin of the disk. The retinal vessels, macular region, and periphery are characteristic of the youthful brunette fundus. The choroidal details are especially well seen owing to the general thinning of the retina. The left eye presents a similar picture.

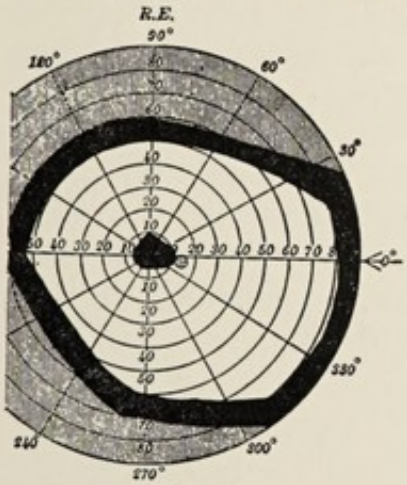


PLATE 23

LEBER'S DISEASE, CENTRAL SCOTOMA, RIGHT EYE

Leber's Disease is sex-linked. It is usually handed down from the healthy mother to the male offspring. But this case is interesting because there are two affected females in the family, and because the patient's eyes were involved at an unusually early age.

Pathologic studies of Leber's Disease by Rehsteiner [33] show there is definite atrophy of the papillo-macular bundle, of the ganglion cells, and of the nerve-fibre layer of the retina, with no evidence of previous inflammation.

[33] Rehsteiner, K. "First Anatomical Investigation of a Case of Racial-Hereditary Optic Atrophy (Leber's Disease)." Arch. f. Ophth. Vol. 125. p. 14, 1930.

PLATE 24

Primary Glaucoma, Chronic (Glaucoma Simplex), right eye of a man 59 years of age. W. O. I. No. 2,122.

Family History. — Negative. *Past History.* — At the age of 53, the vision in the right eye began to fail, and rapidly became worse. Four years later, both eyes were operated upon. At this time, the vision of the left eye was good; but shortly afterwards, it began to fail. *Present Illness.* — There has been no inflammation and no pain; but vision has been steadily decreasing.

Physical Examination. — Medical, negative. Blood pressure, 130/85. *Laboratory Reports.* — Blood. — N. P. N., 44 mgm.%. Sugar, 117 mgm.%. Uric acid, 3.5 mgm.%. Cytology, normal. Wassermann, negative. Urine: trace of albumin, and numerous white blood cells. Phthalein excretion, 65% in 2 hours. X-ray: sinuses, negative.

Eye Examination. — Externally, both eyes, post-operative coloboma of the iris; pupils dilated; do not react to light. There is a general greenish iridescent hue in the pupils. R. E. V. = light perception. Visual fields cannot be taken. Slit lamp: right eye, cornea slightly hazy. Intraocular tension, 40 mm. Hg. (Schiotz). *Ophthalmoscopic Examination.* — Media, clear. Disk, marked cupping; colour, a rather yellowish white. The centre of the cup is white, but the periphery is darker. The lamina cribrosa is visible, but it does not present any stippled effect. The scleral ring forms a wide halo-like margin around the cup. The ring, which is white at the margin of the excavation, grows yellowish toward the adjoining fundus. The vessels are pushed to the nasal side of the cup, and they bend forward over the margin like cilioretinal branches. The vessels — especially the veins — are slightly tortuous, but otherwise normal. Their origin is not clearly visible.

The general peripheral fundus has a tessellated appearance.

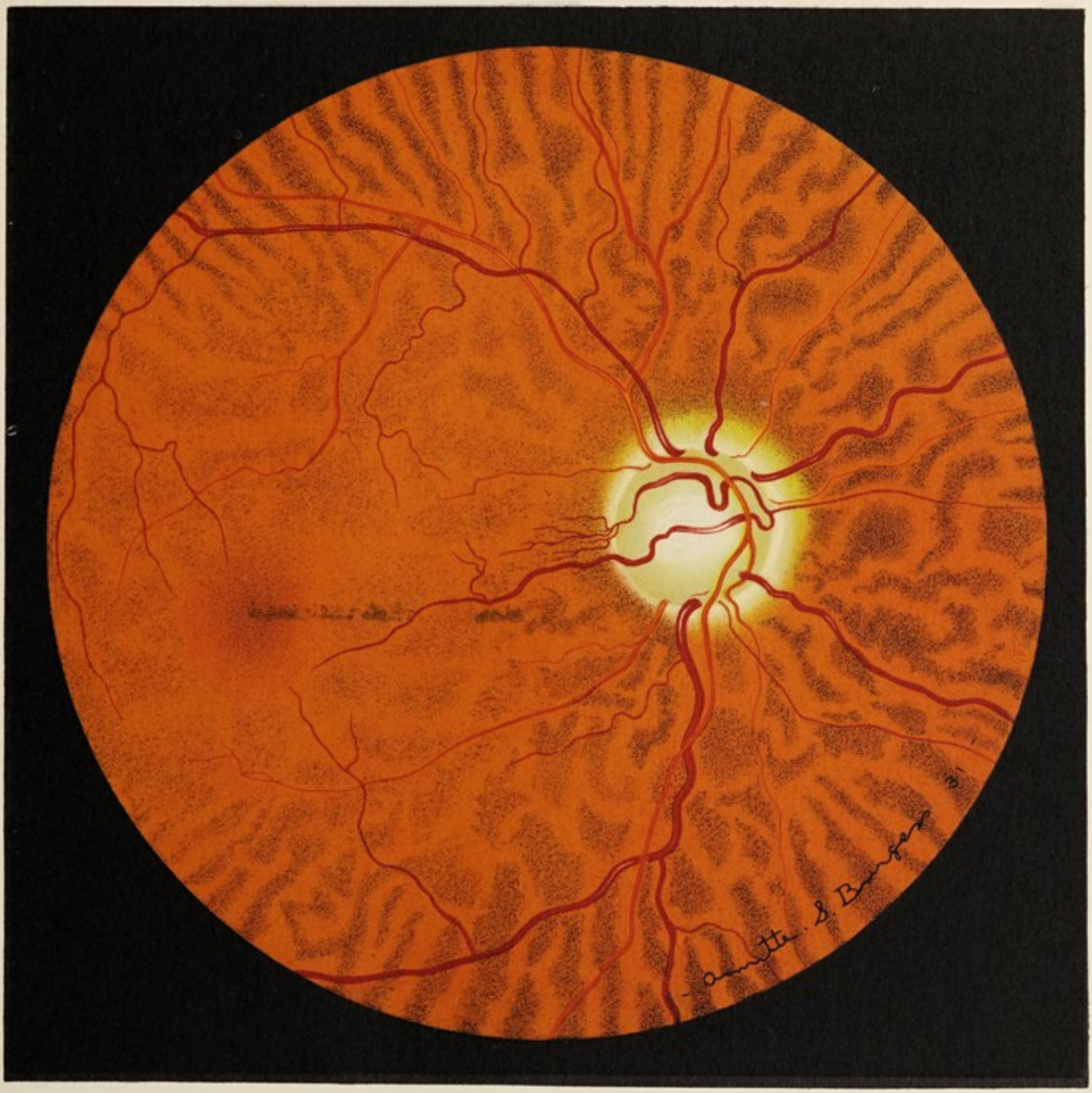


PLATE 25

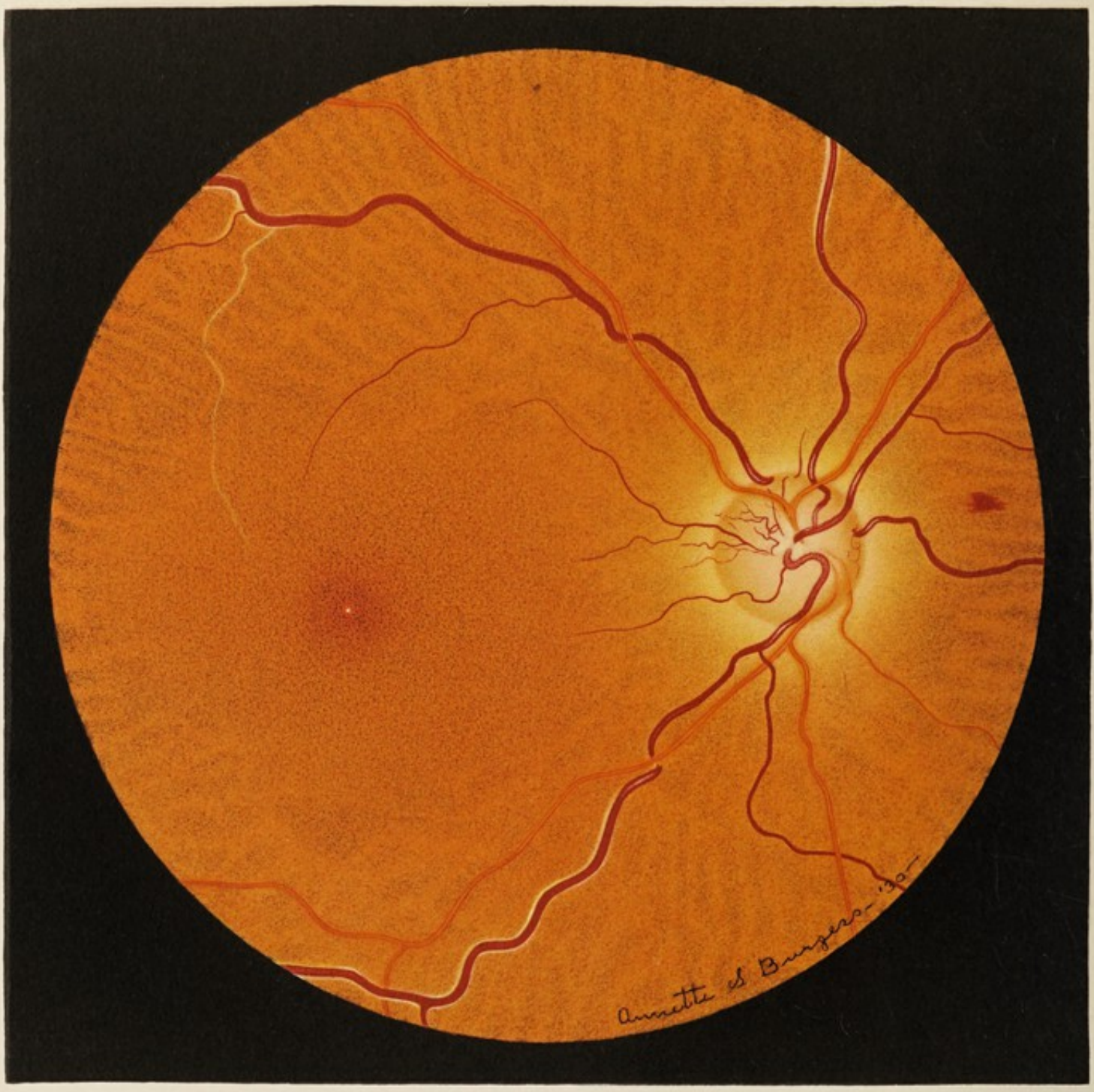


PLATE 25

Secondary Glaucoma, Chronic, right eye of a man 72 years old. W. O. I. No. 4,952.

Family History. — Negative. *Past History.* — General health has been good. *Present Illness.* — Eighteen months before admission, vision of right eye began to fail, followed shortly by dimness of vision in left eye. For six months, left eye has been entirely blind, and vision in right eye greatly decreased. At the onset of disease, there was some pain in both eyes for a short time. Has used miotics for one week.

Physical Examination. — Medical: cardiovascular-renal disease; hypertension (blood pressure 204/130); chronic arthritis; three infected teeth removed. Other physical tests, negative. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Wassermann, negative. Urine: trace of albumin; occasional granular casts. Phthalein excretion, 55%. X-ray: sinuses and chest, negative. B. M. R., + 16. Tuberculin, negative.

Eye Examination. — Externally, right pupil 5.5 mm. in diameter; left, 7 mm. Right pupil, direct reaction to light, sluggish; consensual, absent. Left eye, pupillary reactions, abolished. R. E. V. = 1/60. L. E. V. = no light perception. Visual Fields: right eye, limited to small temporal quadrant. Slit lamp: right eye, negative except for depigmentation of the pupillary border; left eye, cornea steamy. Intraocular tension right eye, 31 mm. Hg. (Schiotz); left eye, stony hard. *Ophthalmoscopic Examination.* — Right eye. Media, vitreous opacities. Disk, marked cupping; nerve-fibres, atropic; colour, pinkish from presence of newly formed vessels. The scleral ring surrounding the cup is so increased in size that it forms a large atrophic halo, like the ring around the moon on a misty night. The blood vessels bend sharply over the edges of the cup. There is marked vascular sclerosis, and the vessels have lost their normal translucency. The arteries are small and rather solid-looking, with pronounced light-streaks. The veins are tortuous and irregular in their size and course. There is a marked arteriovenous compression. Occasionally, the veins run through white lines of sclerosed adventitia. One small twig above the macular region is completely obliterated. There is a small retinal hemorrhage to the nasal side of the disk. The macula is quite normal in appearance.

PLATE 26

Secondary Glaucoma, Chronic,* right eye of a man 53 years old. (Plate 56, *Oct. 1931*, shows the appearance of this eyeground before the development of glaucoma).

Jan. 1932. Family History. — Negative. *Past History.* — See Plate 56. *Present Illness.* — In *Oct. 1931*, the patient developed iritis in the right eye, followed by glaucoma. During this period, the vision in the right eye was entirely lost, and in the left eye, slightly diminished.

Physical Examination. — Medical: beginning arteriosclerosis and hypertension. Blood pressure, 180/120. *Laboratory Reports.* — Negative.

Eye Examination. — Externally, right eye, pupil dilated; left eye, normal. R. E. V. = no light perception. L. E. V. = 6/9. Slit lamp: right eye, bedewing of cornea; increased visibility of aqueous ray. Intraocular tension, 51 mm. Hg. (Schiotz). *Ophthalmoscopic Examination.* — Media, slight lenticular opacities. The disk is greyish white in colour, and there is an entire absence of capillaries. The pathologic cupping is moderate. On the temporal margin there is a slight pigment ring and a beginning glaucomatous halo. A small cilioretinal artery arises from the lower temporal margin of the glaucomatous excavation. The retinal vessels are pushed to the nasal side of the disk. The arteries are solid-looking. The lumen of the superior temporal artery is reduced, and the inferior temporal artery is completely obliterated. The veins are somewhat irregularly dilated, and ribbon-shaped; and they are markedly compressed by the overlying arteries. An old hemorrhage in the macular region has been absorbed.

In comparing this plate with Plate 56, of Oct. 1931, the progressive arteriosclerosis is shown by the complete obliteration of some of the retinal arteries, and by the very marked arteriovenous compression. The effect of increased intraocular tension is indicated by the cupping and paleness of the disk, and by the altered position of the retinal vessels.

* Courtesy of Dr. C. A. Clapp.

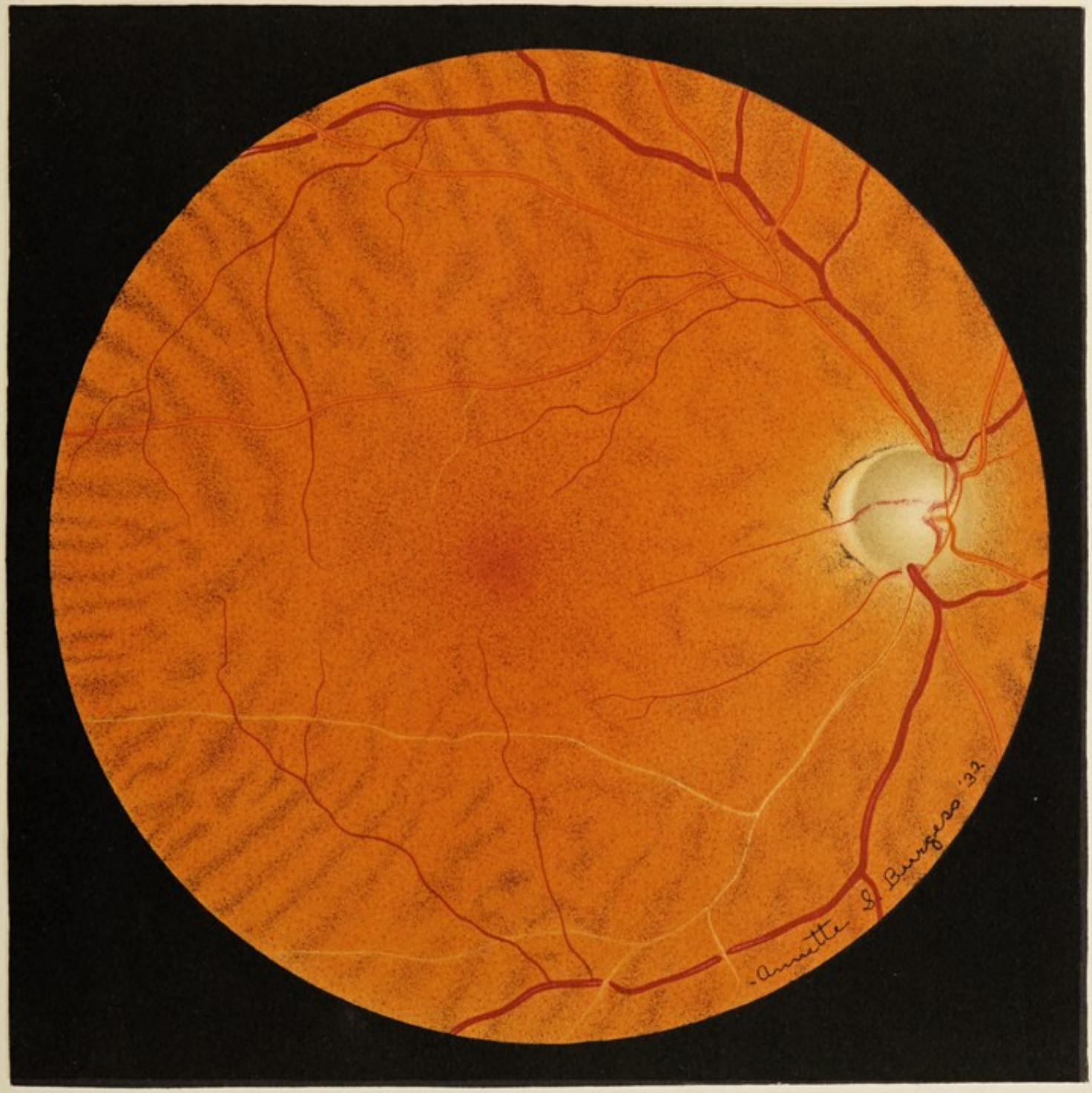

Annette S. Burgeson '32

PLATE 27

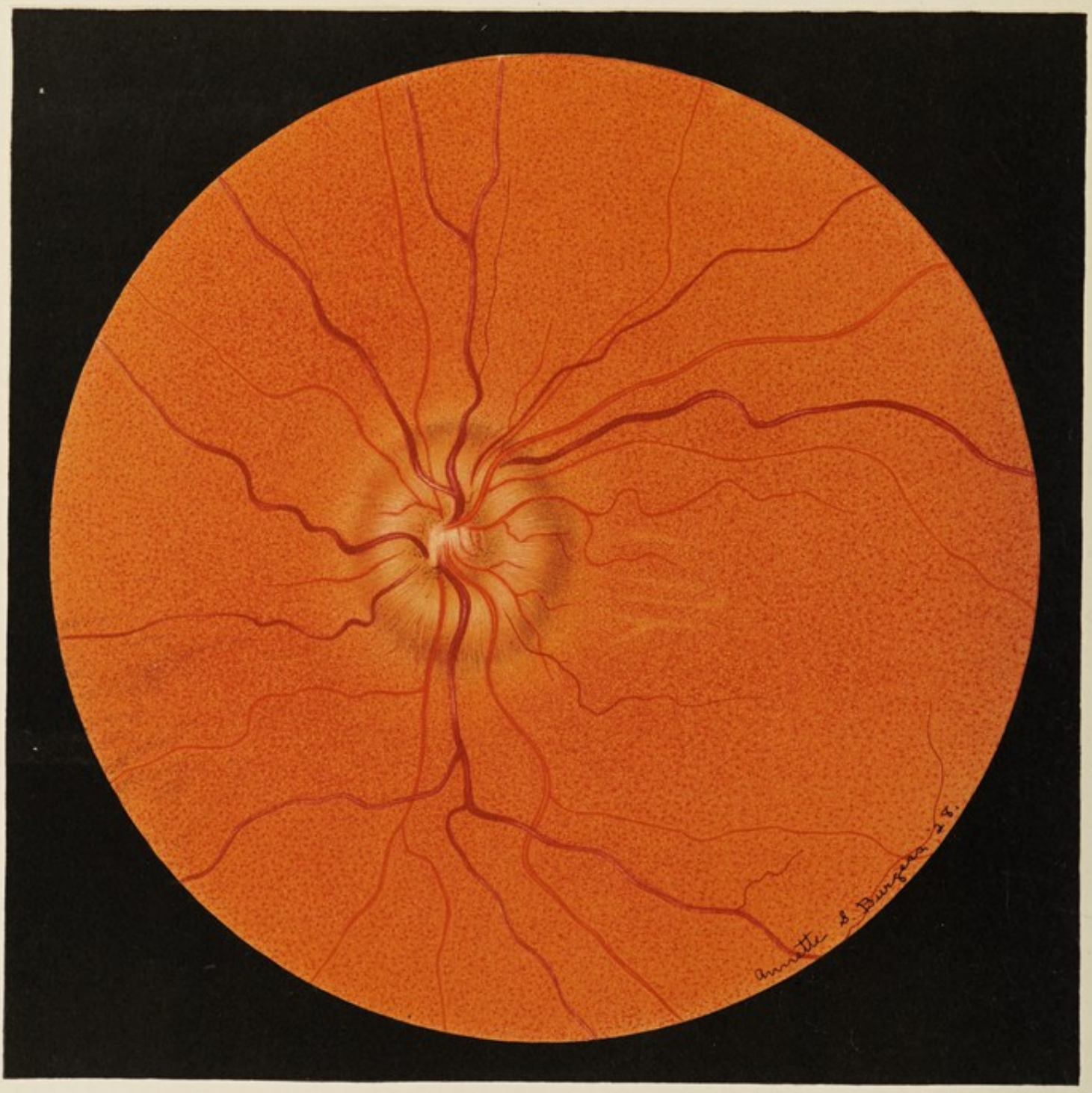


PLATE 27

Papilledema * **(Choked Disk) Mild,** left eye of a woman 36 years old, with cerebellar tumour. Unit No. 16,941.

Family History and *Past History.* — Negative. *Present Illness.* — Seven months before admission, the patient had severe pain in back of head, lasting a few hours. These attacks recurred nearly every morning. Menstrual periods became irregular. There was vomiting; increasing weakness; staggering gait; slight diplopia; and drooping of the left upper eyelid.

Physical Examination. — Medical: facial weakness; weakness of legs; unsteady gait; ataxia; impairment of finely coordinated movements. Romberg sign, positive; patient falls back and to left. No patellar or ankle clonus. No amnesia or aphasia. Vestibular apparatus, normal. *Laboratory Reports.* — Blood. — Chemistry, normal. R. B. C., 4,150,000; W. B. C., 11,625; Hgb., 66%; differential count, normal. Wassermann, negative. Urine: slight trace of albumin; no sugar. X-ray of head, negative. Spinal fluid: Wassermann, negative.

Eye Examination. — Externally, both eyes normal. Pupillary reactions, normal. Lateral nystagmus upon extreme rotation of eyes to right and left. Vision and visual fields, normal. Blind spots, slightly enlarged. *Ophthalmoscopic Examination.* — Left eye. Media, clear. Disk, elevated 4 dioptres. Swelling confined to disk and immediate surroundings. The swelling around the physiological cup gives the disk a mushroom-like appearance with a slight depression in the centre. The cup is whiter than the rest of the disk, which is a faded light red with greyish tinge at the margins. Arteries, a trifle attenuated; veins, slightly dilated, tortuous, and ribbon-shaped. Venous light-streaks, marked at points of greatest elevation on the disk, are insignificant at other places. The macula and peripheral fundus are normal. There is a similar condition in the other eye.

Ventriculography: bilateral dilatation of the ventricles, due to obstructive lesion; Pandy test, negative. Craniotomy disclosed a cerebellar cyst with intramural angioma. The angioma was excised. Recovery, uneventful.

* Courtesy of Dr. W. E. Dandy.

PLATE 28

Papilledema * **(Choked Disk) Severe,** left eye of a 7 year old girl with serous meningitis. W. O. I. No. 7,245.

Family History and *Past History.* — Negative. *Present Illness.* — One month before admission, abscess of left ear; rupture of drum; good drainage; rapid recovery. During this period, there was slight nausea and vomiting, and occasional blurred vision. Four days prior to admission, the left eye turned in.

Physical Examination. — Medical, negative. Nose and throat: infected adenoids. Audiometer: right ear, normal; left ear, marked loss for all tones; disturbance of left labyrinth. *Laboratory Reports.* — Blood. — Chemistry, normal. R. B. C., 4,700,000; W. B. C., 17,000; Hgb., 82%; differential count, normal. Wassermann, negative. Urine, negative. X-ray: skull and sinuses, negative. Ventriculography, negative. Spinal fluid: Wassermann, negative; increased pressure; cell count, normal. Tuberculin, negative.

Eye Examination. — Externally, pupils dilated; left eye, slight paresis of external rectus R. E. V. = 6/12. L. E. V. = 6/15. Visual Fields: slight concentric contraction for white and colours. *Ophthalmoscopic Examination.* — Media both eyes, clear. Disk, right eye, elevated 5 dioptres; left eye, 7 dioptres. The swelling extends only slightly into the retina. Physiologic cup, red and obliterated. Around its margin, there are faint, white, striate exudations. Margins of the disk are light red, with greyish tinge. There are brilliant, fleeting reflections around the disk and the macular region. On the disk, the capillaries are dilated, and the small venous twigs distended and tortuous. Except for their elevation by the swollen disk, the arteries are normal. The veins are dark, engorged, and tortuous; and the light-streaks are marked on their anterior arches. There are two linear hemorrhages on the nasal portion of the disk, and a minute one on the upper temporal side. In the macular region, the small white exudations form an imperfect star figure.

The peripheral fundus is normal except for the dilated veins.

NOTE: The history of the case, and the bilateral papilledema with absence of signs of brain tumour or abscess, suggested serous meningitis ("Otitic Hydrocephalus").[34] Decompression was followed by rapid recovery and disappearance of papilledema.

* Courtesy of Dr. L. J. Goldbach.

[34] Simonds, C. P. "Otitic Hydrocephalus." Brain, A Jour. of Neurol. Vol. 54, p. 55. April 1931.

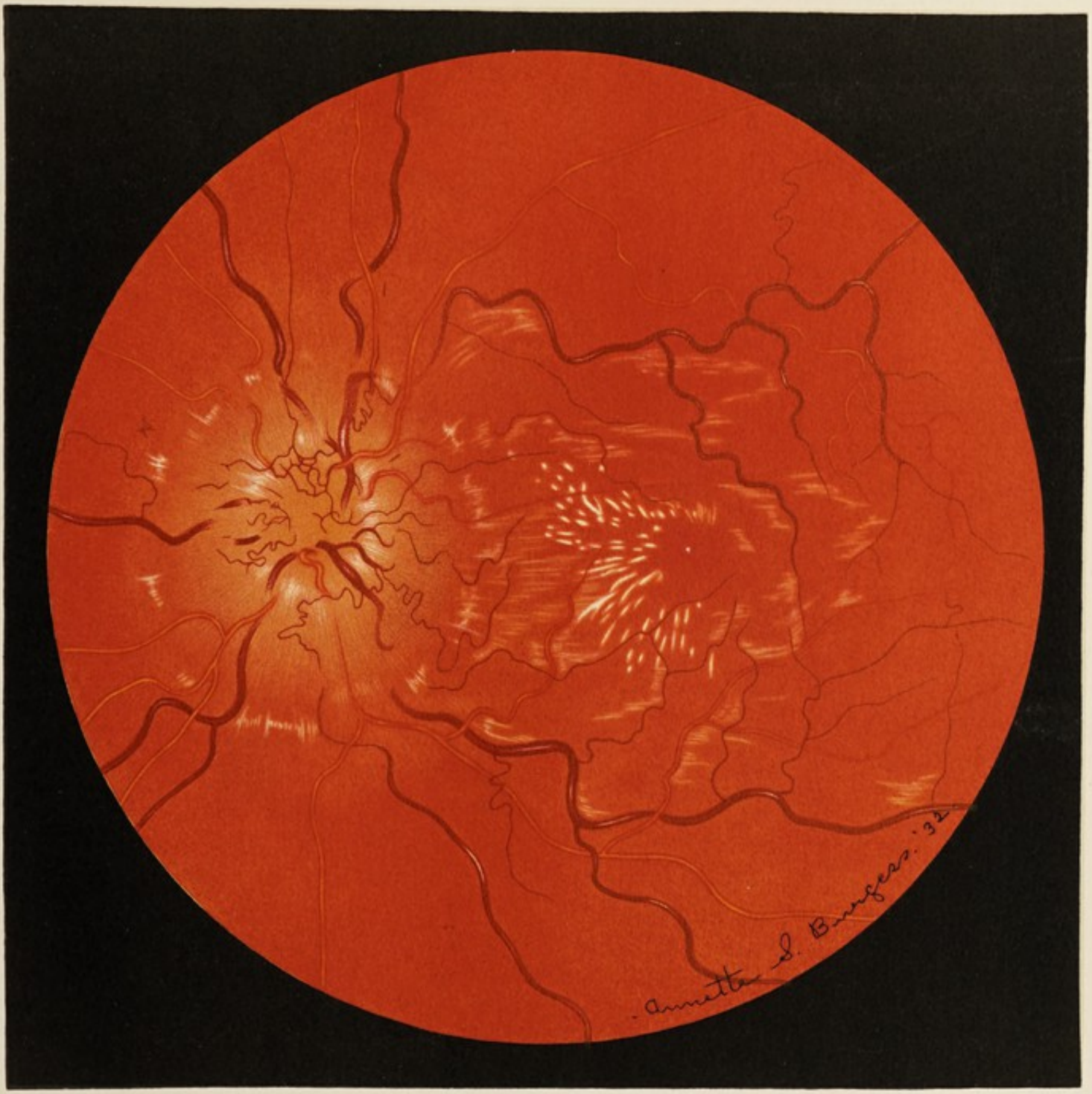

Annetta S. Burgess. '32

PLATE 29

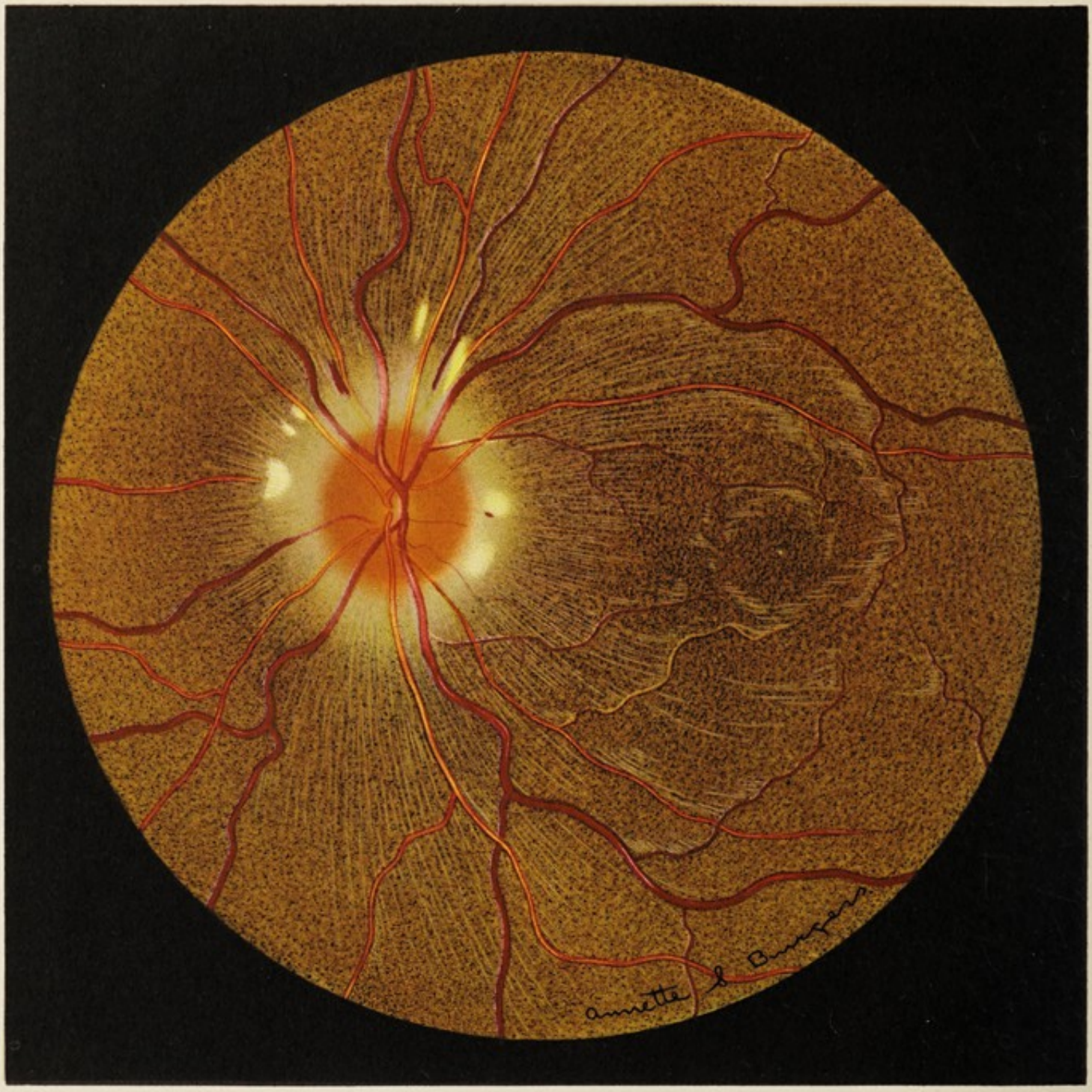


PLATE 29

Papillo-retinitis, Neuro-retinitis, Toxic, left eye of negro woman 26 years old. W. O. I. No. 2,404.

Family History. — Negative. *Past History.* — Appendectomy at 18. Three miscarriages. *Present Illness.* — Mass in right side of abdomen; pain; bleeding for seven days.

Physical Examination. — Medical: uterus slightly enlarged, very tender; pulse imperceptible. Immediate laparotomy performed for a right tubal pregnancy. Tube removed. Two weeks after operation, severe pain developed in chest. There was rise in temperature, pulse, and respiration, accompanied by severe headache and dimness of vision, especially in left eye. Blood pressure, 100/78. Nose, throat, and teeth, negative. Neurological, negative. *Laboratory Reports.* — Blood. — Chemistry, normal. R. B. C., 3,500,000; W. B. C., 9,860; Hgb., 52%. Wassermann, negative. Urine: trace of sugar, and a few white blood cells. Spinal fluid: Wassermann, negative; pressure, normal; cell count, 30 per cc.

Eye Examination. — Externally, both eyes normal. R. E. V. = 6/12. L. E. V. = 6/60. Visual Fields: both eyes, concentric contraction; left eye, central scotoma. *Ophthalmoscopic Examination.* — Left eye. Media, clear. Disk, marked hyperemia; red-brick in colour; margins, blurred; elevation, 1 dioptre. Physiologic cup, obliterated. Around the disk, there is a ring of edema, varying from 1/4 to 1/2 disk-diameters in width. There are small exudations in the surrounding retina, particularly above, and in the upper nasal quadrant. On the temporal margin of the disk, there are two round exudations, with a minute hemorrhage in front of the upper one. Above the disk, in the upper nasal quadrant, there is a larger linear hemorrhage. Arteries, normal. Veins, slightly distended, tortuous, dark in colour, with pronounced light-streaks in certain positions. Macular region and periphery, normal.

This plate suggests an actual inflammation rather than the mechanical edema shown in Plates 27 and 28.

NOTE: Five weeks later, R. E. V. = 6/6. L. E. V. = h.m. Papillo-retinitis much subsided, with secondary optic atrophy.

PLATE 30

Papillo-retinitis, with Papilledema, Toxic and Mechanical, left eye of a negro woman 37 years old. Unit No. 28,428.

Family History. — Negative. *Past History.* — Frequent tonsillitis. *Present Illness.* — One year prior to admission developed puffiness of eyelids in morning. Seven months later, shortness of breath and marked thirst. Patient ill in bed for three weeks, with headaches, nausea, vomiting. Since then has been languid, weak, unable to work, with persistent vomiting.

Physical Examination. — Medical: mucous membranes, pale; thyroid, slightly enlarged; heart and aorta, normal size. Heart sounds, accentuated. Systolic murmur. Peripheral vessels, firm. Blood pressure, 155/90. Chronic tonsillitis. Dental caries. *Laboratory Reports.* — Blood. — N. P N., 50 mgm.%. NaCl., 524 mgm.%; CO_2 combining power, 34.3 vol.%. Chemistry otherwise normal. R. B. C., 3,700,000; W. B. C., 9,150; Hgb., 60%. Wassermann, positive. Urine: cultures, negative; albumin, trace; white blood cells; occasional cast; Mosenthal test, sp. gr. low and fixed. Phthalein excretion, 15% in 2 hours. X-ray: head, lungs, sinuses, negative. Spinal fluid: Wassermann, negative; pressure, 421 mm. H_2O; cell count varied from 12 to 139 per cc.

Clinical Diagnosis. — Syphilis of the central nervous system (meninges); temporary impairment of renal function. The general and ocular symptoms believed to be due largely to increased intracranial pressure.

Eye Examination. — Externally, both eyes normal. Patient too ill for functional tests. *Ophthalmoscopic Examination.* — Left eye. Media, clear. Disk, elevated 1.5 D.; edema extending into neighbouring retina, particularly above and below; margins, blurred; physiologic cup, obscured. Around the cup, the disk is hyperemic; but it grows whiter towards the margin. The vessels — particularly the veins — are engorged, tortuous, very dark in colour, and obscured in spots by retinal edema. Vessel light-streaks, pronounced on anterior arches.

In the macular region, and to the temporal side of the disk, there are small, round, yellowish white spots. Right eye, similar condition, with thrombosis of inferior temporal vein.

NOTE: The appearance of the disk, with its active inflammation and edema, suggests a toxic and mechanical etiology. Complete symptomatic recovery, with normal blood pressure (130/75) and normal urine, followed antisyphilitic treatment.

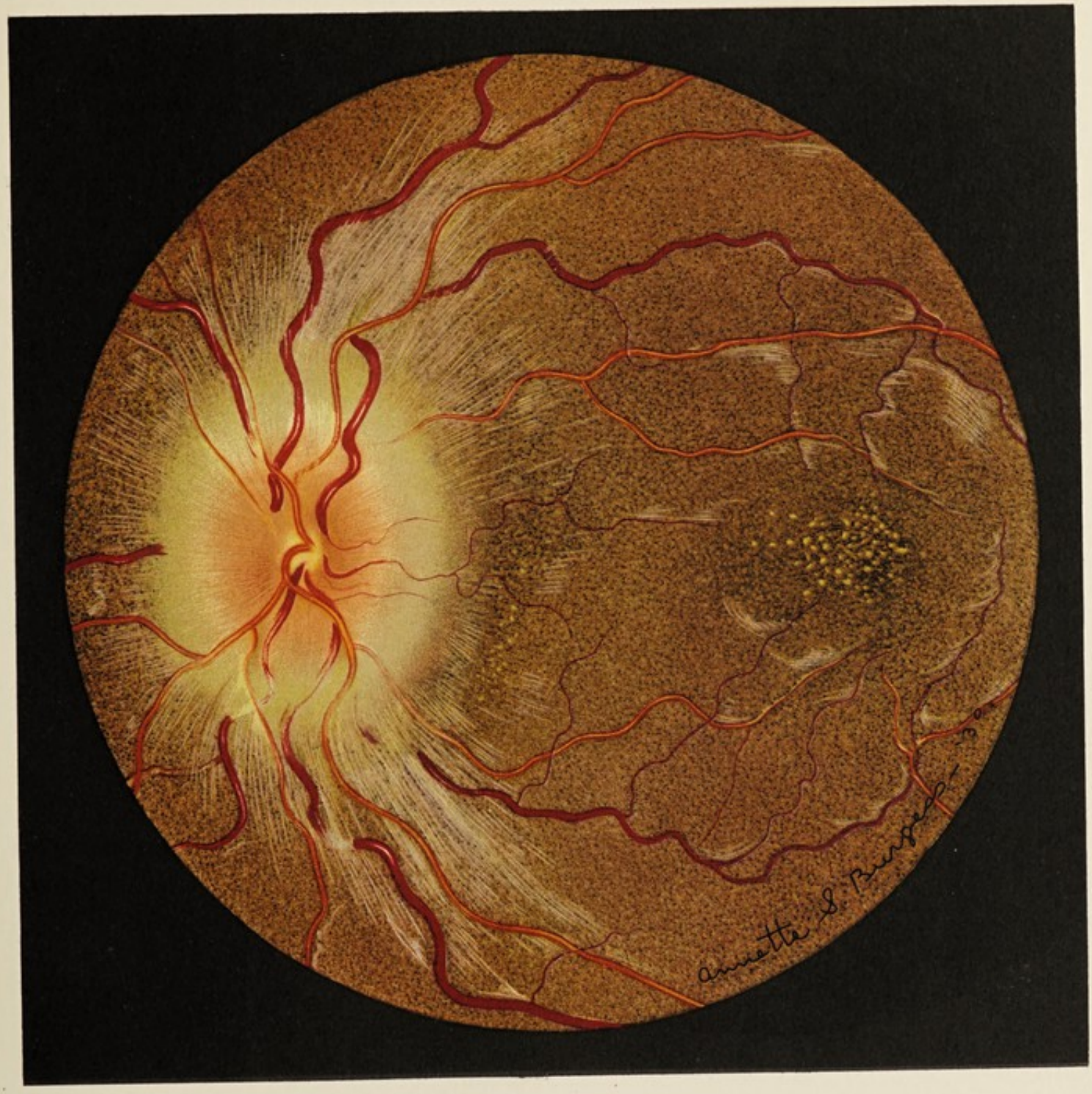

Annette S. Burpee '30

PLATE 31

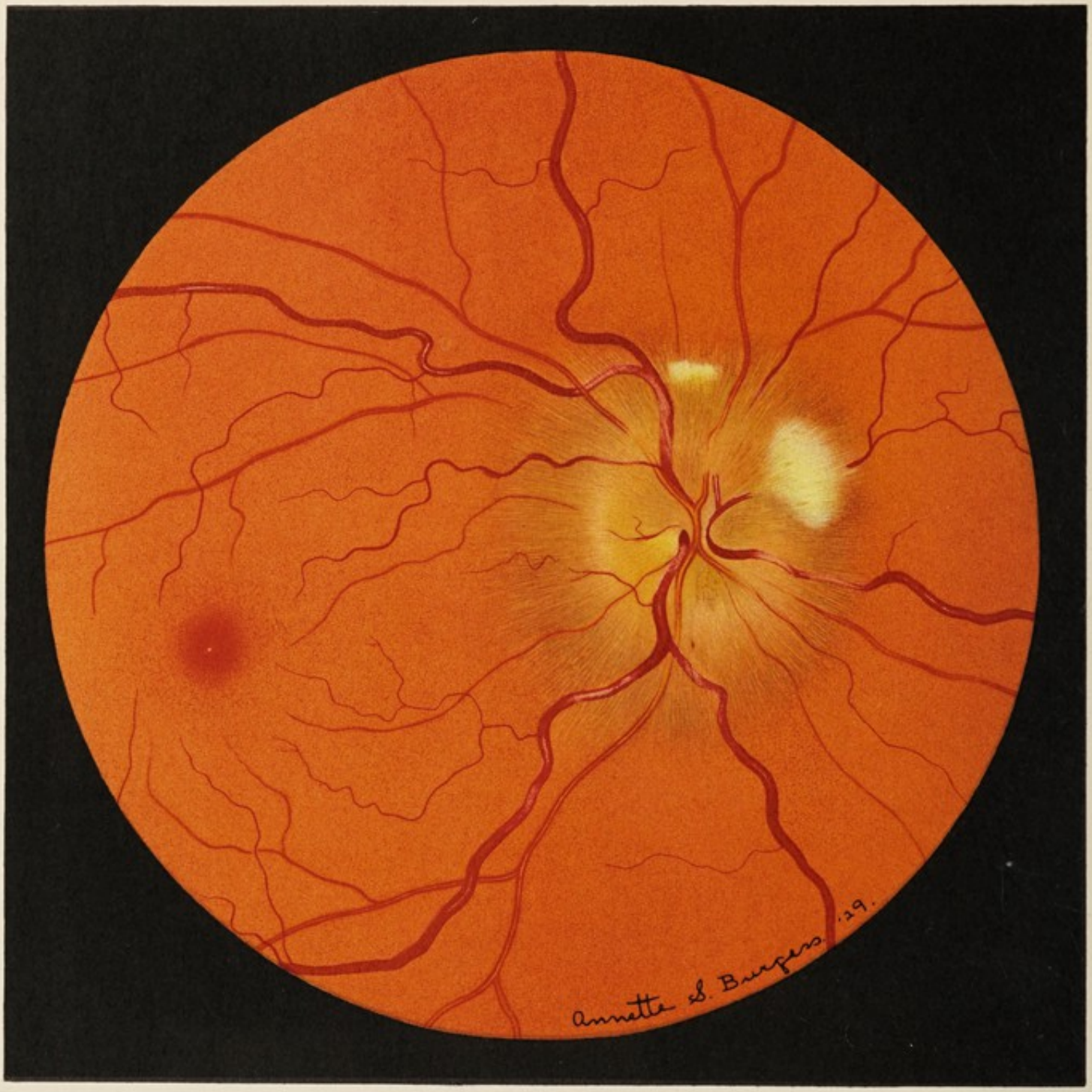


PLATE 31

Medullated Nerve-fibres and Papilledema, right eye of a woman 43 years of age. W. O. I. No. 3,760.

Family History. — Negative. *Past History.* — Negative. *Present Illness.* — Four weeks before admission, sudden pain developed in right eye, accompanied by nausea and vomiting. Vision grew worse; pain was constant, sharp, pulsating, and radiating from the back of the eye to the occiput.

Physical Examination. — Medical, negative, except for obesity. Blood pressure, 140/100. Gastro-intestinal tract, nose, throat, teeth, sinuses, negative. Neurological, negative. Gynecological: right ovary has been removed; otherwise, negative. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Wassermann, negative. Urine, normal. X-ray: sinuses, skull and orbits, negative. B. M. R., − 9. Spinal fluid: Wassermann, negative; pressure 140 mm. H_2O. Tuberculin, negative.

Eye Examination. — Left eye, entirely normal. Externally, right eye normal except for dilatation of pupil. R. E. V. = no light perception. *Ophthalmoscopic Examination.* — Media, clear. Disk, edematous; elevated 3 dioptres; margins, blurred; physiologic excavation, obliterated. The disk has a general mushroom-like appearance, with a light yellowish red centre and greyish margins. The capillaries are dilated. There is one minute hemorrhage at the lower part of the disk. The arteries are small, and their light-streaks normal. The veins are much engorged and tortuous; and the light-streaks are pronounced on their anterior arches. The edema is confined to the disk and its immediate vicinity. Above, and to the nasal side of the disk, there are two patches of opaque nerve-fibres. The larger one is in front of a branch of the superior nasal vein.

Macular region, normal. Periphery, normal with the exception of the dilated veins.

NOTE: No cause found for condition of right eye. Twenty days after admission: vision improved to 1/60 eccentric; edema of disk diminished; engorgement of veins reduced; absolute central scotoma.

PLATE 32

Medullated Nerve-fibres and Papillo-retinal Edema, left eye of a woman 39 years old. Unit No. 17,436.

Family History. — Negative. *Past History.* — Frequent colds and sore throat. *Present Illness.* — Swelling of face and legs. Sixteen days before admission, exposure to cold was followed by chills, fever, headache, dizziness, sore throat, and general malaise.

Physical Examination. — Medical: obesity; puffiness of lower eyelids. Blood pressure, 194/138. Cultures from tonsils: hemolytic streptococcus. Two infected teeth. *Laboratory Reports.* — Blood. — N. P. N., 73 mgm.%; sugar, 160 mgm.%. R. B. C., 5,150,000; W. B. C., 11,850; Hgb., 85%. Differential count: polymorph., 79%; small lymph., 14%; large lymph., 5%; transit., 1%. Wassermann, negative. Urine: sp. gr. 1022; sugar, negative; alb., +++; R. B. C., +; W. B. C., +; casts. Phthalein excretion, 65% in 2 hours. X-ray: chest, chronic bronchitis, emphysema; old tuberculous infection, right apex.

Clinical Diagnosis. — Acute hemorrhagic nephritis; acute tonsillitis.

Eye Examination. — Externally, both eyes normal. Central and peripheral vision, normal. *Ophthalmoscopic Examination.* — (Fig. 1). Media, clear. Disk, slightly hyperemic; margins, blurred; physiologic cup, insignificant. Vessels at margin of disk, blurred. Arteries, normal; veins, practically normal. Venous light-streaks, marked in places. The slight edema and the exudations around the disk mingle confusedly with the opaque nerve-fibres. There is slight edema over the whole retina. The right eye has a similar appearance, but there are no opaque nerve-fibres.

A year later (Fig. 2), margins of disk, clearly-cut except on nasal side, where there is a thin border of opaque nerve-fibres. Arterial light-streaks on disk, formerly faint, are now pronounced. The haze over the vessels has disappeared. The two small patches of opaque nerve-fibres are clearly-defined. One accompanies the lower branch of the superior nasal artery, and the other obscures the inferior temporal vein for a space. The white exudation above the disk — which simulated opaque nerve-fibres — has now entirely disappeared.

Note: Gradual recovery from acute nephritis. During later observation, moderate hypertension; occasionally, a trace of albumin. Nearly four years after onset of acute nephritis, phthalein excretion, 60%; N. P. N., 30 mgm.%; urea clearance, 126%, normal standard; urine, 1014 to 1020 sp. gr. Blood pressure, 150/90.

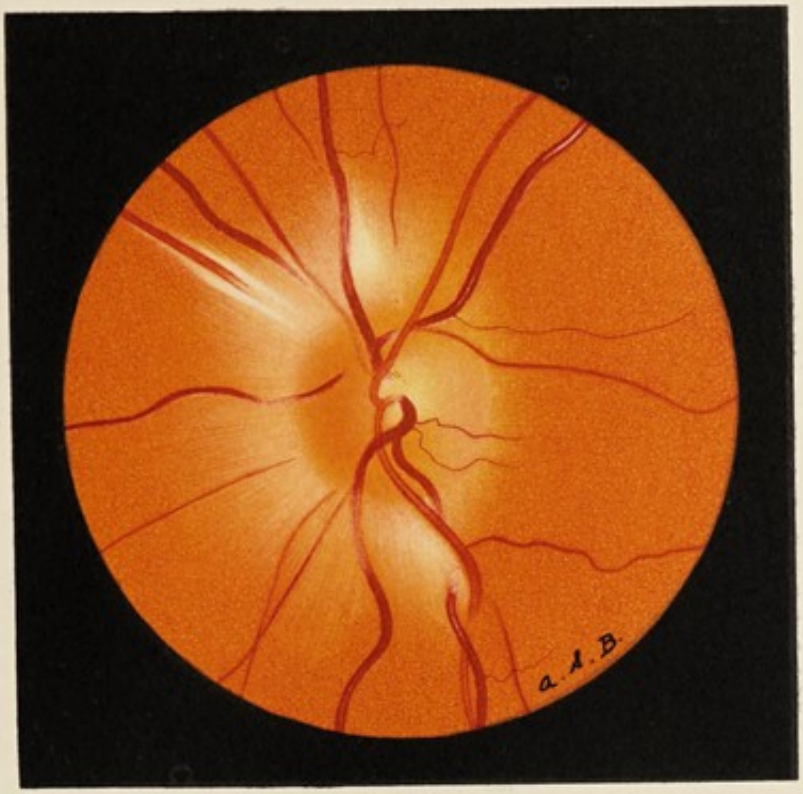


FIG. 1

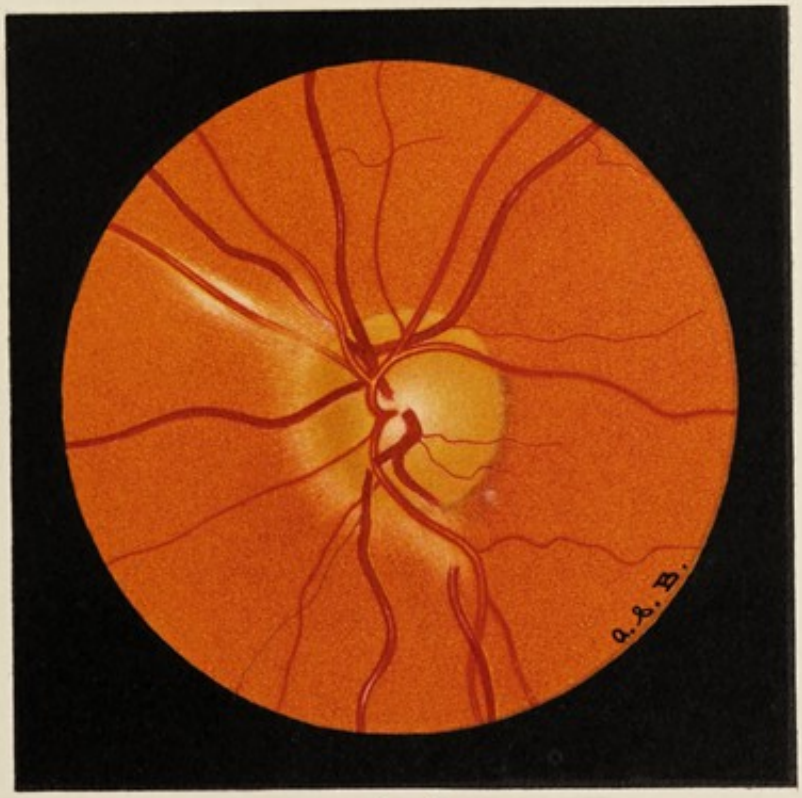


FIG. 2

PLATE 33

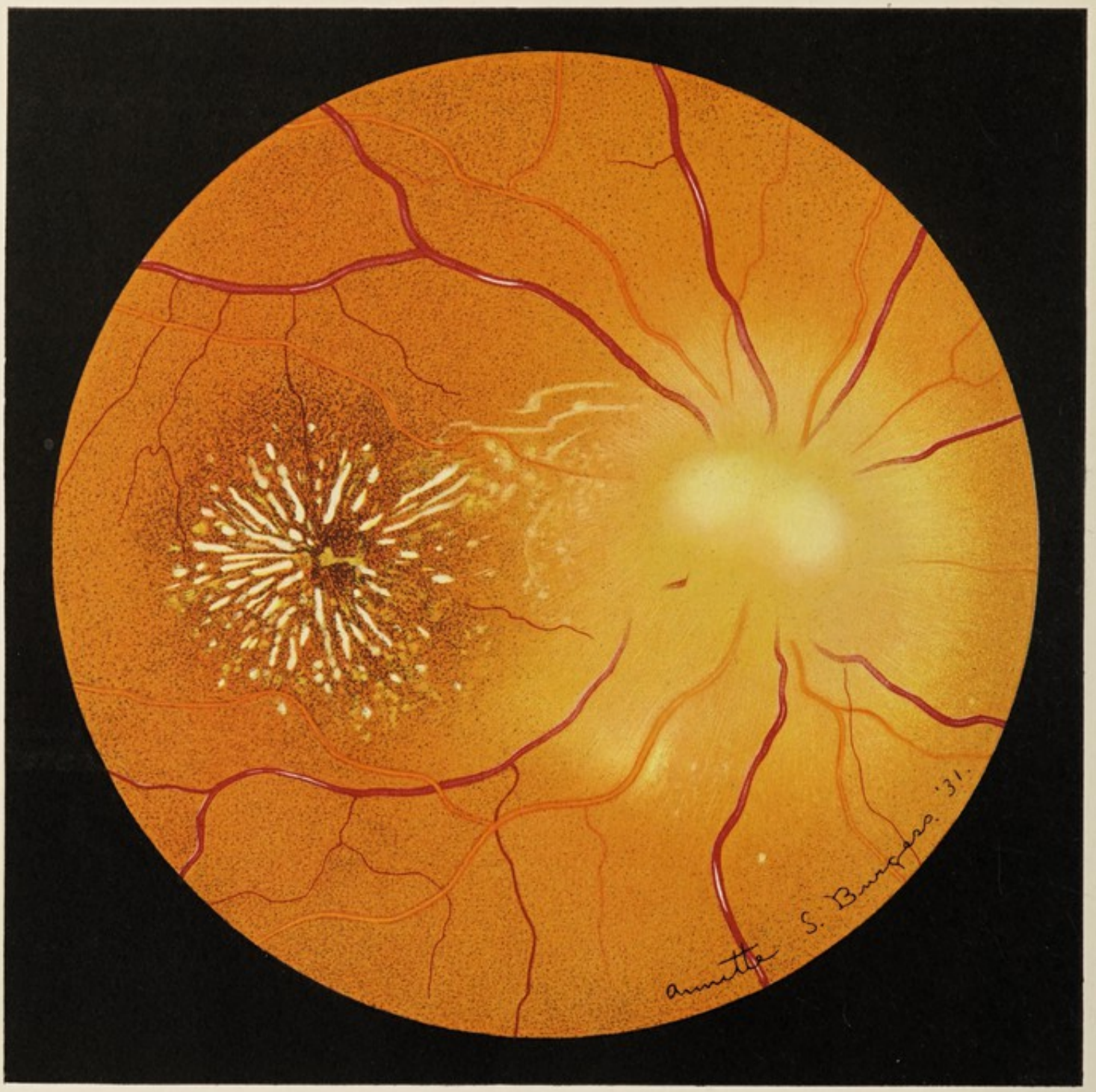


PLATE 33

Papillo-retinitis, right eye of a man 36 years old. W. O. I. No. 6,553.

Family History. — Mother had diabetes. *Past History.* — Negative. *Present Illness.* — One week before admission had severe frontal headache. Vision in the right eye was blurred, particularly above.

Physical Examination. — Medical, negative. Blood pressure, 125/80. Infected tonsils and adenoids. Abscess of one tooth. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Wassermann, negative. Urine, negative. X-ray: sinuses, negative; chest, chronic bronchitis. Tuberculin, positive to 1/100 mgm.

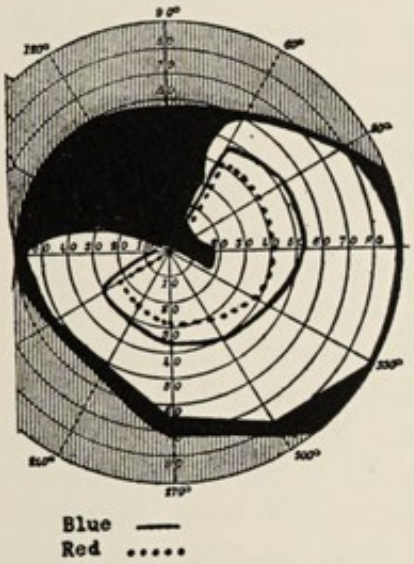


Fig. 1
VISUAL FIELD, RIGHT EYE

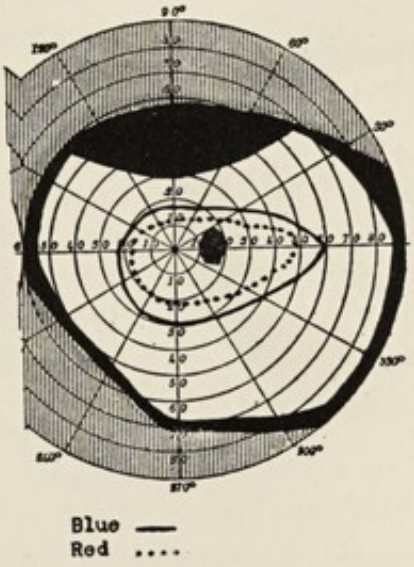


Fig. 2
VISUAL FIELD, RIGHT EYE

Eye Examination. — Left eye, entirely normal. Externally, right eye, normal. R. E. V. = 6/30. Visual Field. — Fig. 1. Slit lamp: diffuse, grey, central infiltration of corneal parenchyma. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Media, clear, except cornea. Disk and its vessels obscured by a massive, yellowish white exudation extending some distance into the retina, particularly at the lower, temporal quadrant. Arterial light-streaks, pronounced. Veins slightly engorged; irregular in calibre; light-streaks marked on anterior loops.

Between the disk and the macular region, there are thin, wavy lines of exudation, yellowish white in colour. Surrounding the macular region, there is a beautiful, white stellate figure — like a bursting "star shell." In addition to the radiating white lines of the figure, there are some small, yellow spots that seem to lie deeper in the tissues. The extreme periphery is practically normal.

NOTE: Following removal of infected tooth, tonsils, and adenoids, the eye steadily improved. About seven weeks later, the vision = 6/6. Visual Field. — Fig. 2.

PLATE 34

Choroiditis, Diffuse, with Ascending Perineuritis, right eye of a man 21 years old. W. O. I. No. 6,096.

Family History. — Negative. *Past History.* — At 9 years of age, tonsils and adenoids were removed. Had cystitis at the age of 19. Nine months before admission, appendectomy. *Present Illness.* — One month before admission, right eye became painful and sensitive to pressure. Vision was blurred.

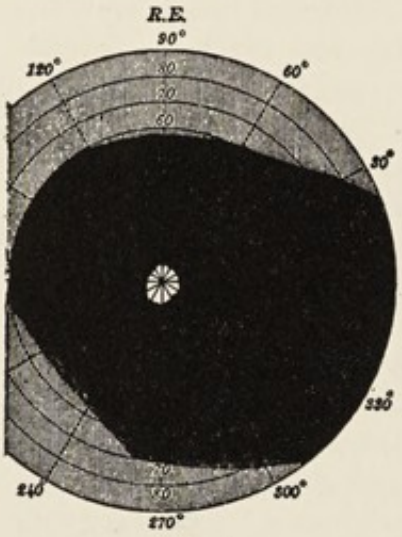


Fig. 1
VISUAL FIELD, RIGHT EYE

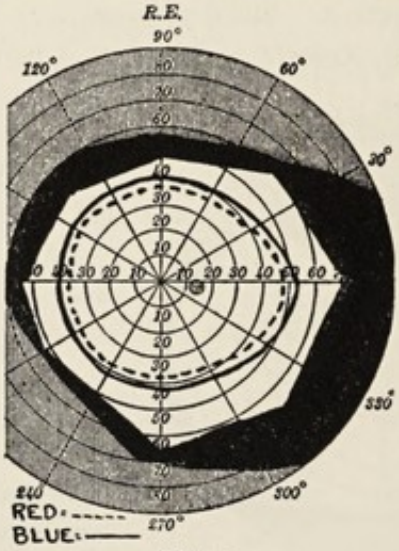


Fig. 2
VISUAL FIELD, RIGHT EYE

Physical Examination. — Medical and neurological, negative. Nose and throat: right posterior ethmoid and sphenoid infected. Teeth, negative. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Wassermann, negative. Urine, negative. X-ray of head, negative. B. M. R., — 13. Tuberculin, positive to 1/100 mgm.

Eye Examination. — Left eye, entirely normal. Externally, right eye, normal. R. E. V. = 6/20. Visual Field. — Fig. 1. Slit lamp, negative. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Media, many vitreous opacities. Disk, light yellow in colour; margins and physiologic cup, obscured. Vessels, pale and faded in colour. Light streaks on arteries faint; on veins, absent. Macular region, a trifle darker than rest of fundus.

The retinal reflections are absent, and no choroidal details are visible. The whole fundus has a hazy appearance, as if viewed through a mist.

NOTE: Right sphenoids and ethmoids were opened and drained. On discharge from hospital, R. E. V. = 6/6. Visual Field. — Fig. 2.

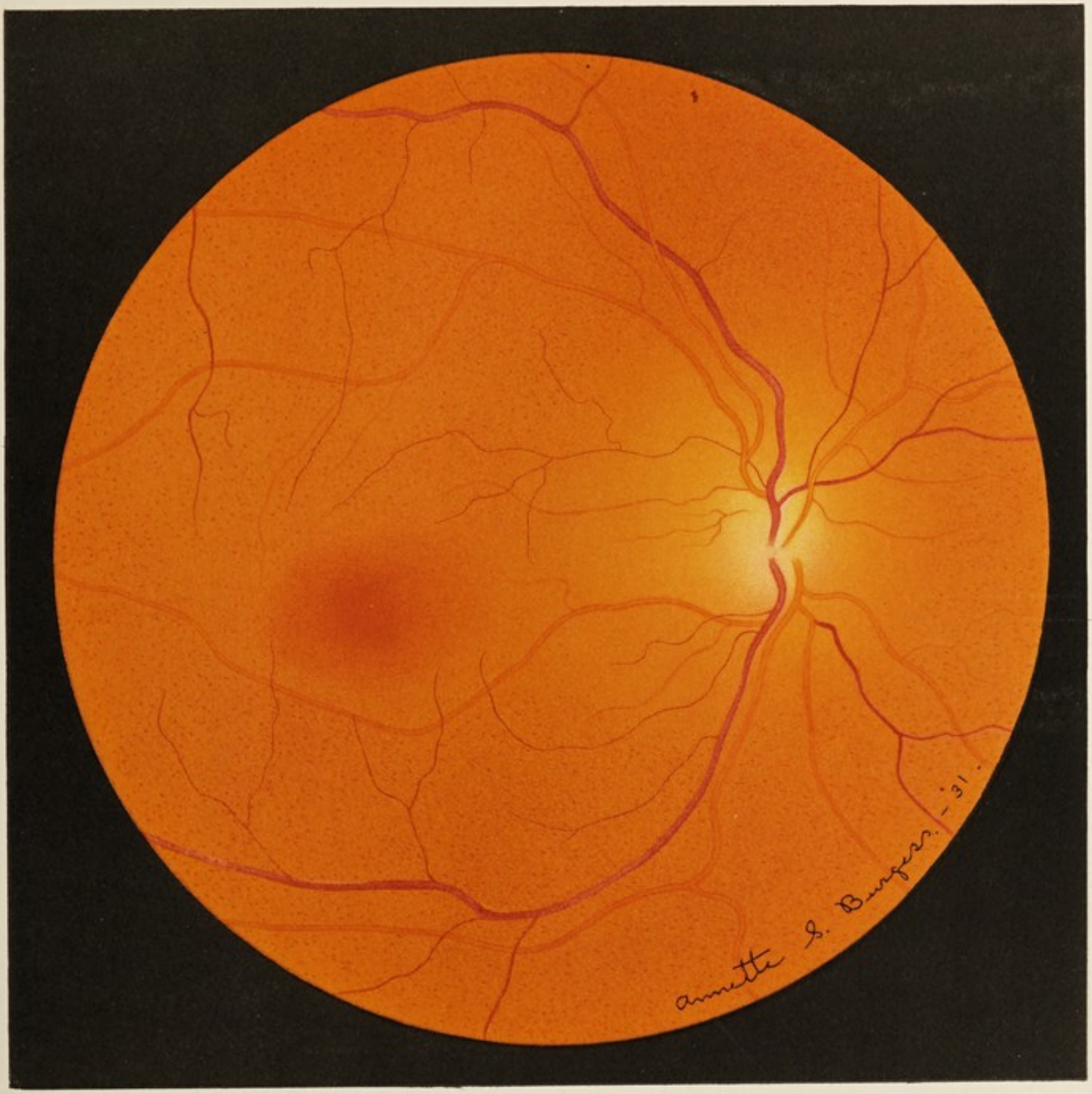

Annette S. Burgess. '31.

PLATE 35

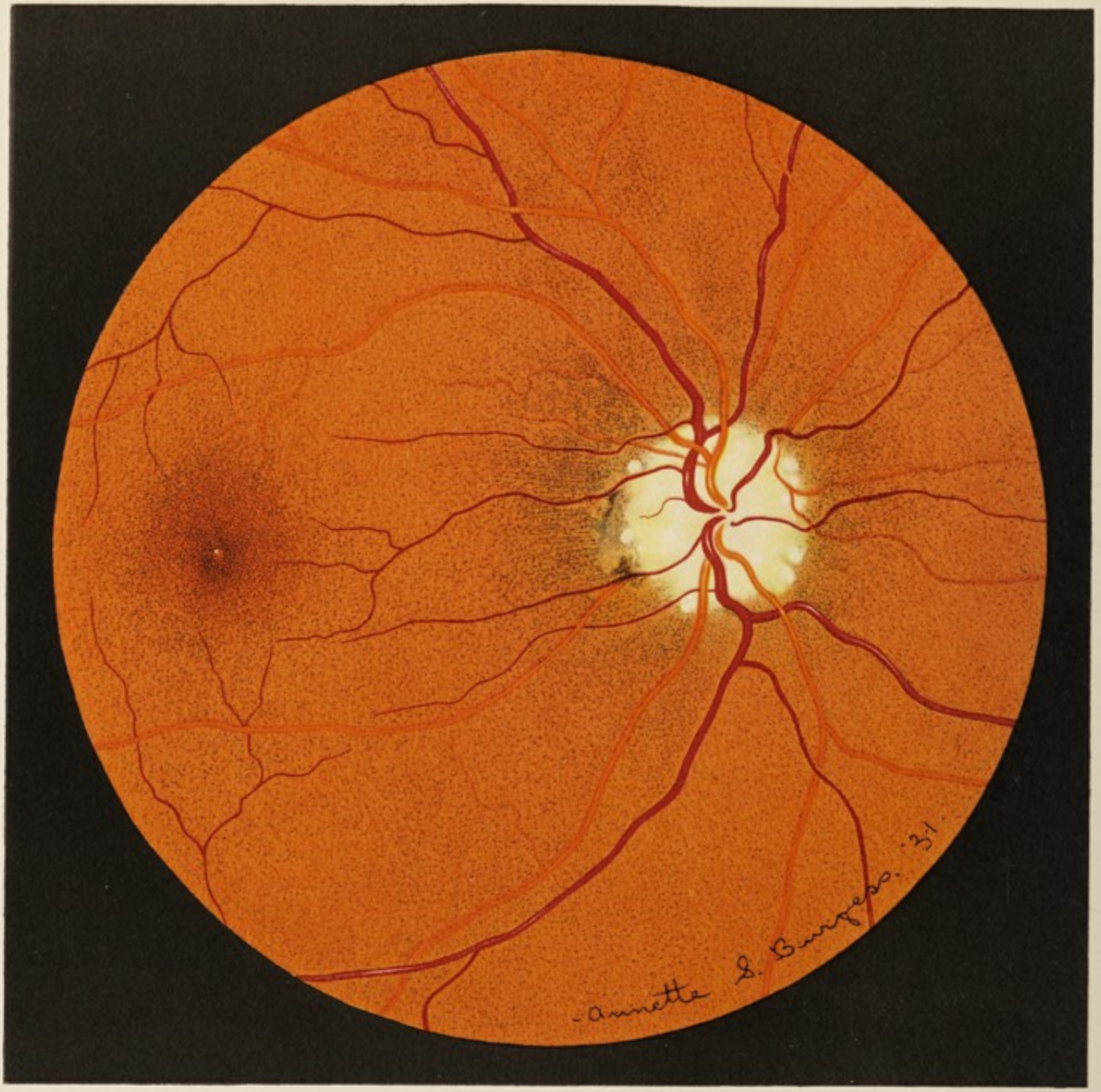


PLATE 35

Hyalin Bodies on Disk in Optic Nerve Atrophy,* right eye of a man 51 years old. W. O. I. No. 4,504.

Family History. — Negative. *Past History.* — There has been gradual impairment of vision for the last ten years. *Present Illness.* — The peripheral vision has been growing worse; but the central vision remains good, and the patient is able to continue work.

Physical Examination. — Medical, negative. Blood pressure, 128/70. Infected adenoids. Sinuses, negative. Teeth, negative. Neurological, negative. Genito-urinary, negative. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Wassermann, negative. Urine, negative. Phthalein excretion, 65% in two hours. X-ray: sinuses and head, negative. Spinal fluid, negative.

Eye Examination. — Externally, both eyes are normal. Pupillary reactions, normal. The vision of each eye, with correction, is 6/6. Visual Fields: marked concentric contraction in both eyes, more so in the right. Colour sense, impaired. Light sense, reduced. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Right eye. Media, clear. The disk is the colour of solid ivory. Capillaries are absent. The irregular, "scalloped" effect of the margins is due to the presence of a number of small, roundish, white prominences. There are a few similar bodies — less well-defined — on the disk itself. These bodies have the appearance of hyalin or colloid material. They are probably the result of proliferation of glial cells, with subsequent hyalinization. The physiologic cup is partially obliterated. There is an irregular deposit of pigment on the temporal side of the disk.

The macular region and the peripheral fundus are normal. The arteries also are normal; but the veins are slightly dilated, and irregular in calibre.

The left eye presents a similar appearance.

NOTE: No definite cause was found for the atrophy of the optic nerve; but probably it was the result of sclerosis of the nutrient vessels in the optic nerve. Three years later, central vision still good; but visual field more contracted.

* Courtesy of Dr. C. A. Clapp.

PLATE 36

Hyalin Bodies at Margin of Disk in Retinal Pigmentary Degeneration, right eye of a woman 28 years old. W. O. I. No. 5,350.

Family History. — Parents, second cousins. No similar eye affection in family. *Past History.* — Vision always poor. At age of 25, an infected abortion was followed by right-sided hemiplegia. *Present Illness.* — Vision has declined steadily; especially poor in dim light.

Physical Examination. — Medical, negative. Nose, throat, teeth, genito-urinary and gastro-intestinal tracts, negative. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Wassermann, and provocative Wassermann, negative. Urine, negative. X-ray: sinuses, chest, gall bladder, negative. B. M. R., — 14. Spinal fluid, negative. Tuberculin, positive to 1/10 mgm.

Eye Examination. — Externally, both eyes normal. R. E. V. with correction = 6/30. Visual Field: "gun-barrel." Colour sense, impaired; light sense, reduced. *Ophthalmoscopic Examination.* — Media, slight lenticular and vitreous opacities. Disk, pale reddish yellow; margins, blurred except on temporal side; physiologic cup, insignificant. There are two hyalin plaques below the disk. The larger mass at the lower nasal margin of the disk is brilliant, crystalline, white, translucent, with narrow, shining white border. The red background shows through, giving it a pinkish tint. The mass covers one venous, and three arterial, branches. Two arterial branches are seen dimly through it. A similar, but smaller, plaque lies beneath a branch of the inferior temporal vein and its minute twig, which are pressed forward 1.5 D. There are numbers of small, circular concretions on the margins of these masses, and one in the centre of the larger mass. Near the centre of these plaques, there are numerous, very minute, bright, whitish gold spots which suggest crystals of cholesterol. There are also two small concretions forming on the upper margin of the disk. The retinal vessels are small and solid-looking.

In the periphery, choroidal details are very distinct, owing to retinal atrophy; and there are numerous branching, pigment masses, typical of pigmentary degeneration of the retina. Above, and to the temporal side of the macula, there is a small white spot like that seen in retinal apigmentary degeneration.

In the left eye the condition is similar; but the hyalin masses are smaller and more scattered.

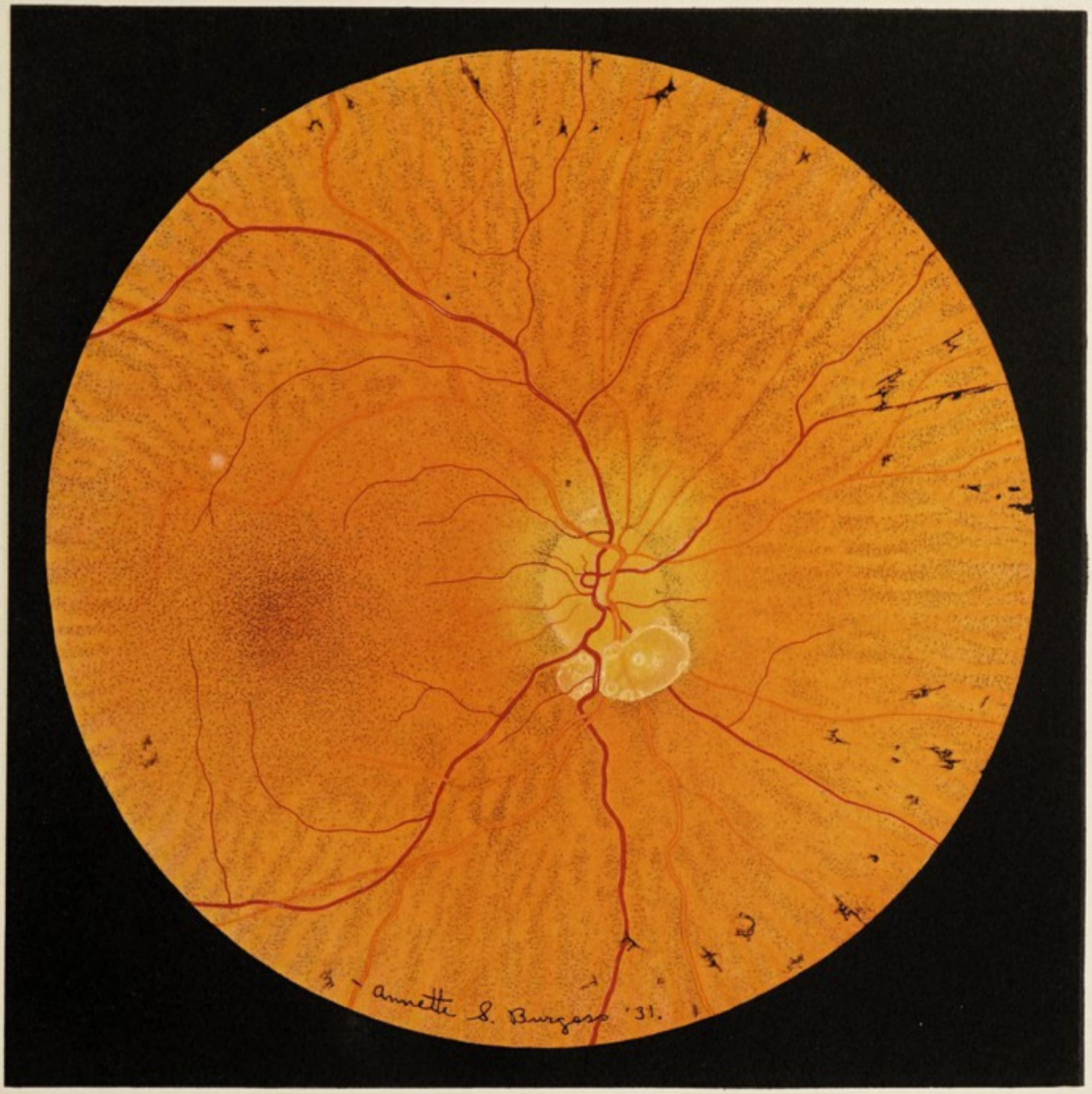

Annette S. Burgess '31.

PLATE 37

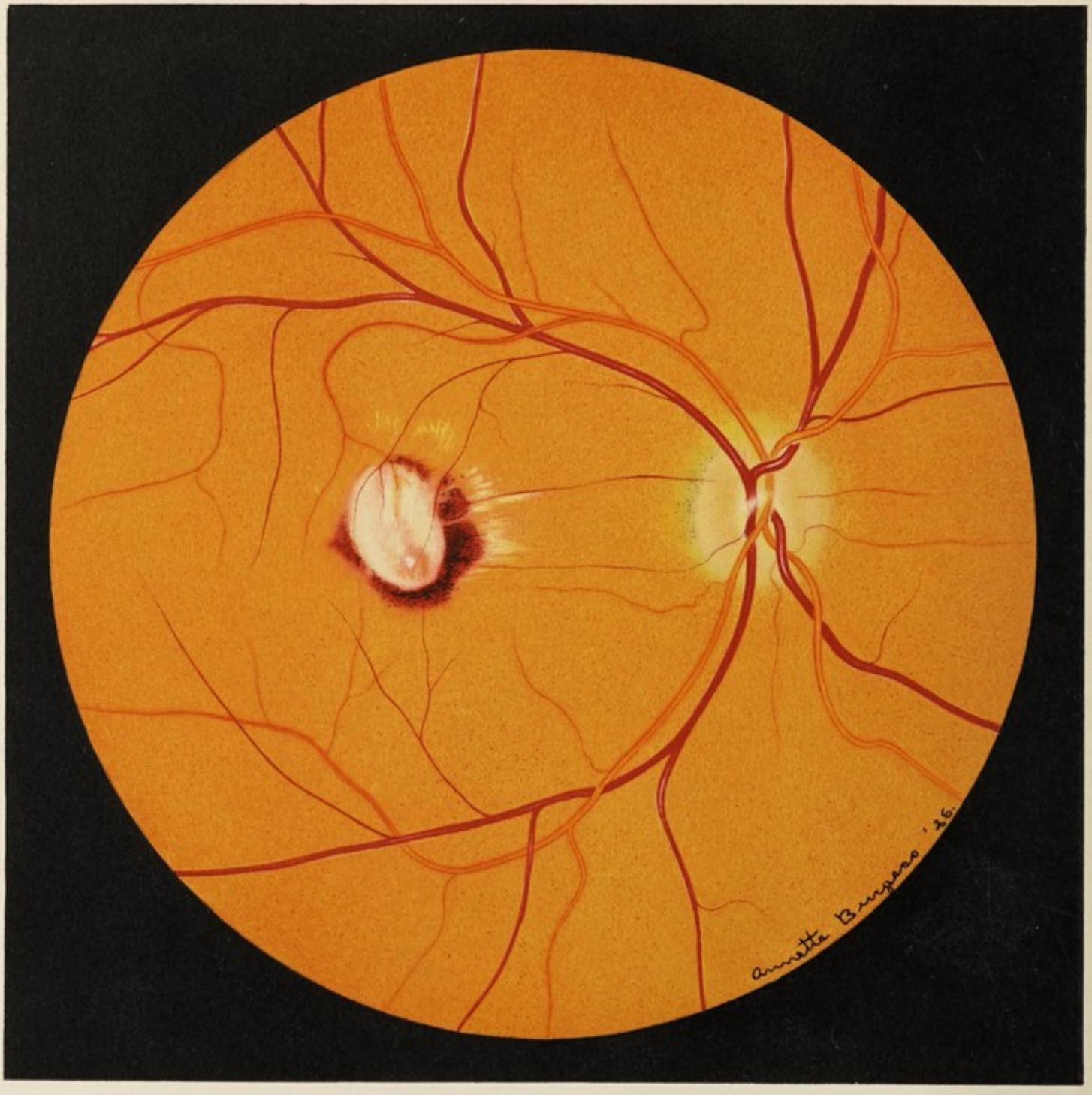


PLATE 37

Choroidoretinitis, Central, Tuberculous,* right eye of a blond man 40 years of age.[35] W. O. I. No. 1,040.

Family History. — Negative. *Past History.* — Erysipelas of face and head at age of 29. Tonsils have been removed. All teeth have been extracted on account of severe pyorrhea. For ten years, has had marked pain under right shoulder. Has always been very nervous. Twitching of eyelids, and of muscles of neck and shoulders. *Present Illness.* — Vision of left eye began to fail one year before admission; and that of the right eye, six months later.

Physical Examination. — Medical, negative except old fibrosis in the apices of both lungs. Blood pressure, 96/64. Nose, throat, genito-urinary tract, negative. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Wassermann, negative. Urine, negative. X-ray: sinuses, gastro-intestinal tract, negative. B. M. R., − 21.5. Tuberculin, positive to 1/1000 mgm.

Eye Examination. — Externally, both eyes are normal. R. E. V. = 6/20. L. E. V. = 1/60. Visual Field: right eye, peripheral, normal; but there is an absolute central scotoma. *Ophthalmoscopic Examination.* — Media, clear. Disk, hazy; margins, blurred; fundus, normal except in the macular region, where there is a dense, pinkish white exudation nearly as large as the disk. This mass is elevated above the surrounding retina, and on the surface of the exudation, small vascular twigs are plainly visible. Almost completely encircling it, there is an extravasation of blood into the deeper layers of the retina. There is slight retinal edema to the upper and nasal side of this hemorrhage. The condition improved rapidly under tuberculin therapy.

The fundus of the left eye evidently at one time presented a similar appearance; but the lesion has healed, leaving a dense, fibrous mass in the macular region.

* Courtesy of Dr. Emory Hill.

[35] Wilmer, W. H. "Clinical Aspects of Ocular Tuberculosis." Arch. Oph. Vol. 57. No. 1. p. 1. Jan. Feb. 1928.

PLATE 38

Choroidoretinitis, Central, Tuberculous, left eye of a girl aged 17. Marked brunette. W. O. I. No. 7,016.

Family History. — Negative. *Past History.* — General health has always been good. *Present Illness.* — Six months before admission, there was sudden blurring of vision in the left eye. The tonsils were removed as the probable cause of the eye lesion. Vision, however, grew steadily worse.

Physical Examination. — Medical, negative. Blood pressure, 104/80. Neurological, nose, throat, and teeth, negative. *Laboratory Reports.* — Blood. — Chemistry and cytology were normal throughout, except for a slightly elevated N. P. N. (50 mgm.%). Wassermann, negative. Urine, negative. X-ray: skull, sinuses, and chest, negative. B. M. R., − 4. Tuberculin, positive to 1/100 mgm.

Eye Examination. — Externally, both eyes are normal. Right eye, all functional tests are normal. L. E. V., with correction, = 3/60. Visual Field: left eye, peripheral, practically normal; there is an absolute central scotoma corresponding to the macular lesion. Slit lamp, negative. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Media, many dense, rapidly moving opacities in the vitreous. The disk is normal with the exception of the anomalous arrangement of the central retinal artery. The superior division of the artery is replaced by three large cilioretinal vessels. Two of these emerge from the upper margin of the disk, and one from just beyond the margin. The lower branch of the central artery is moderate in size, and it does not divide until it reaches a point below the margin of the disk. In the macular region, there is a large, yellowish red exudation which is still slightly elevated, although it is being absorbed. There are fine pigment granules around its margin and on its surface. The choroidal vessels are dimly visible through the exudation.

The general fundus shows the retinal reflections characteristic of the youthful brunette.

With the exception of a very slight edema of the disk, the fundus of the right eye is normal.

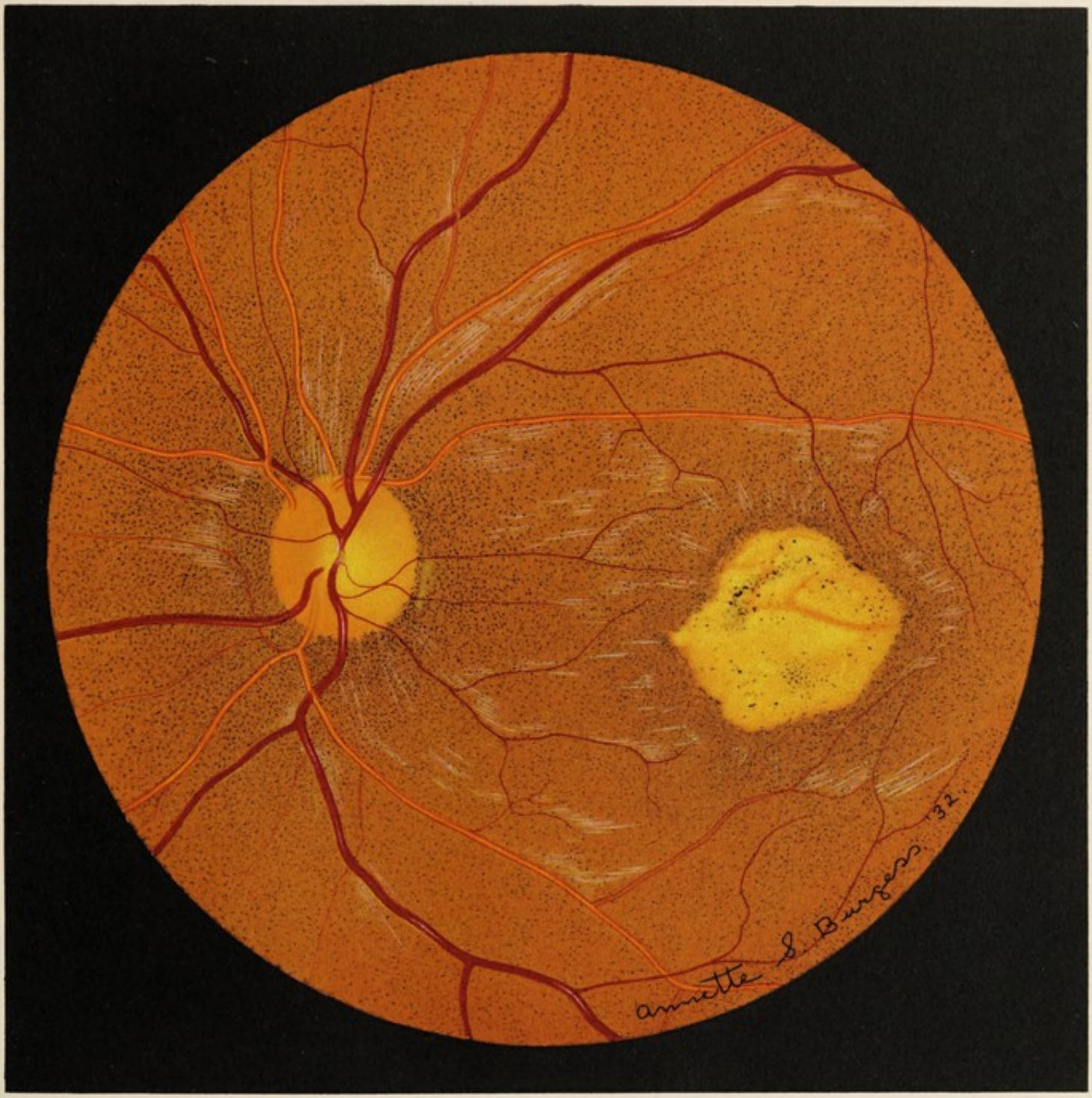

Annette S. Burgess '32

PLATE 39

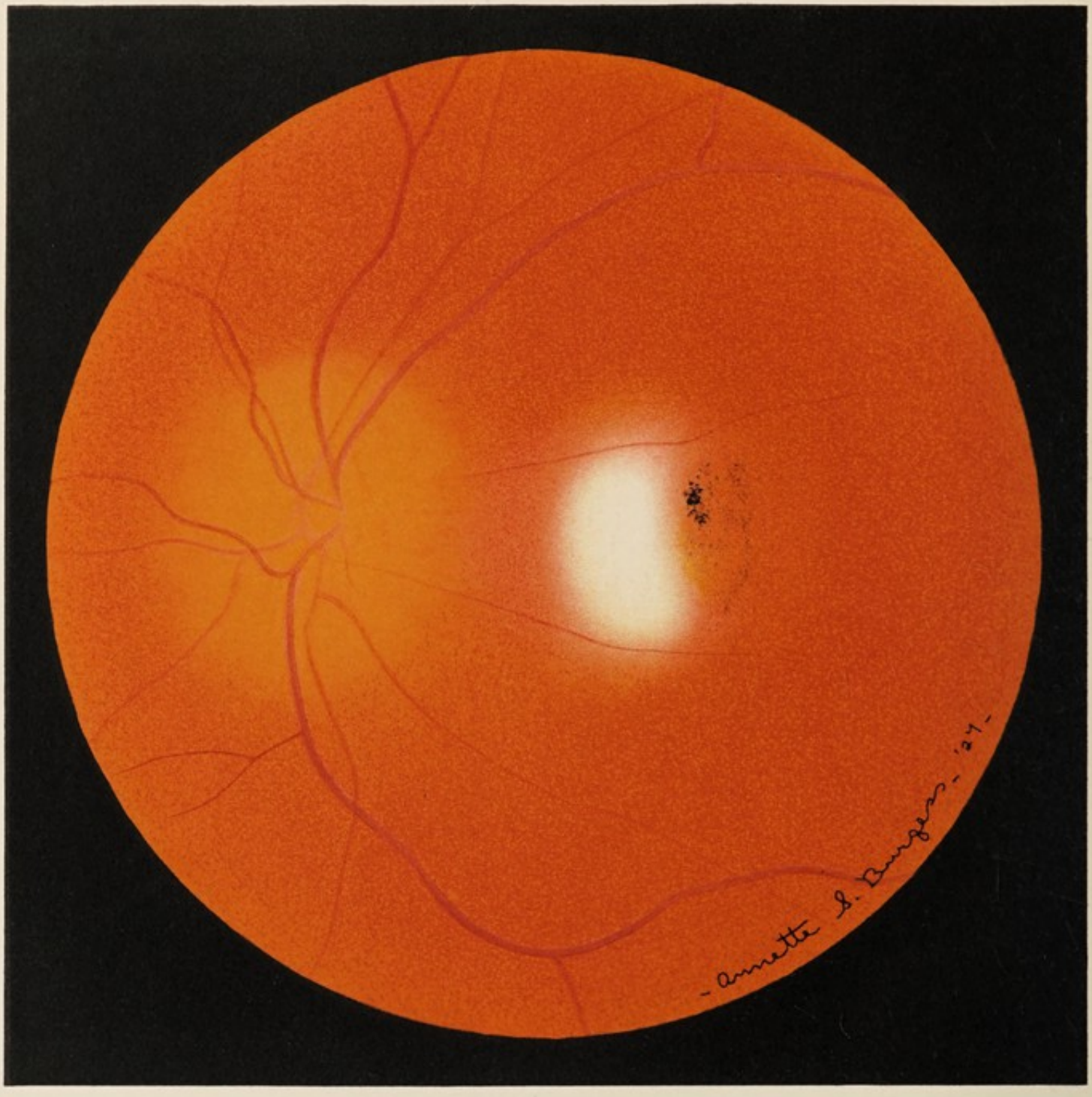


PLATE 39

Choroidoretinitis (Central) and Uveitis, Tuberculous, left eye of a woman 23 years of age. W. O. I. No. 1,434.

Dec. 1926. — Family History. — Negative. *Past History.* — An injury to the right leg at the age of 12 years was followed by septicemia and tuberculous osteomyelitis. From the age of 12 to 21, underwent nineteen operations for widely disseminated osteomyelitis. *Present Illness.* — One year prior to admission, the patient developed severe cranial pain for which no cause was found, and which was unrelieved by refraction correction. One month before admission to the hospital, the vision of the left eye became impaired.

Physical Examination. — Medical, negative except for ankylosis of several joints, and scars from former operations. Blood pressure, 102/70. Gastro-intestinal tract, negative. Tonsils, infected. Teeth, negative. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal except slight increase in white blood cells. Wassermann, negative. Urine, negative. X-ray: chest and sinuses, negative. B. M. R., — 6. Tuberculin, positive to 1/1000 mgm.

Eye Examination. — Right eye, normal in all respects. Externally, left eye, sluggish pupillary reactions and slight circumcorneal injection. Vision = 1/60. Visual Field: absolute central scotoma. Slit lamp: there are deposits on the posterior surface of the cornea, and on the anterior surface of the lens capsule; the visibility of the aqueous ray is markedly increased. *Ophthalmoscopic Examination.* — Media, vitreous opacities. The disk is swollen and blurred, and the margins are indefinite. The retinal vessels are so faint that it is difficult to distinguish the arteries from the veins. In the macular region, there is a large, white, billowy exudation which is markedly elevated. To the temporal side of this mass, there is an older spot of choroidoretinitis with accumulation of pigment. The whole fundus is blurred, and the retina edematous.

NOTE: With removal of the infected tonsils, careful regimen, and the therapeutic use of tuberculin, the deposits on the cornea and on the lens capsule disappeared; the vitreous became clear; and the fundus lesion inactive. Plates 40 and 41 illustrate the fundus appearance at later periods.

PLATE 40

Choroidoretinitis, Central, Tuberculous. W. O. I. No. 1,434. (Plate 39, *Dec. 1926*, illustrates the earlier appearance of this fundus).

April 1927. Family History and Past History. — Plate 39. *Interval History.* — The patient has gained in weight and is feeling better generally. The vision seems somewhat clearer.

Eye Examination. — The right eye remains normal. Externally, the left eye is normal; and the pupillary reactions are normal. Vision = 3/60. The central scotoma is unchanged. Slit lamp: the deposits on the posterior surface of the cornea appear small and "ghost-like"; and the deposits on the anterior capsule of the lens are thinner. The aqueous ray is now normal. *Ophthalmoscopic Examination.* — Media: the opacities in the vitreous are less dense, and the vitreous much clearer than when Plate 39 was drawn. The disk, which formerly was very much blurred, is now quite distinct; and the pigment granules on its temporal side are well-defined.

The white, billowy exudation in the macular region has become much smaller; and its colour has changed to a dirty grey. There is now an accumulation of pigment along its borders, especially below, and to the temporal side. The site of the exudation is much less elevated than in Plate 39.

With the subsidence of the retinal edema, and the absorption of the exudation, the surrounding atrophic area appears larger and better-defined.

NOTE: The patient is receiving tuberculin treatment regularly twice a week, in very gradually increasing doses.

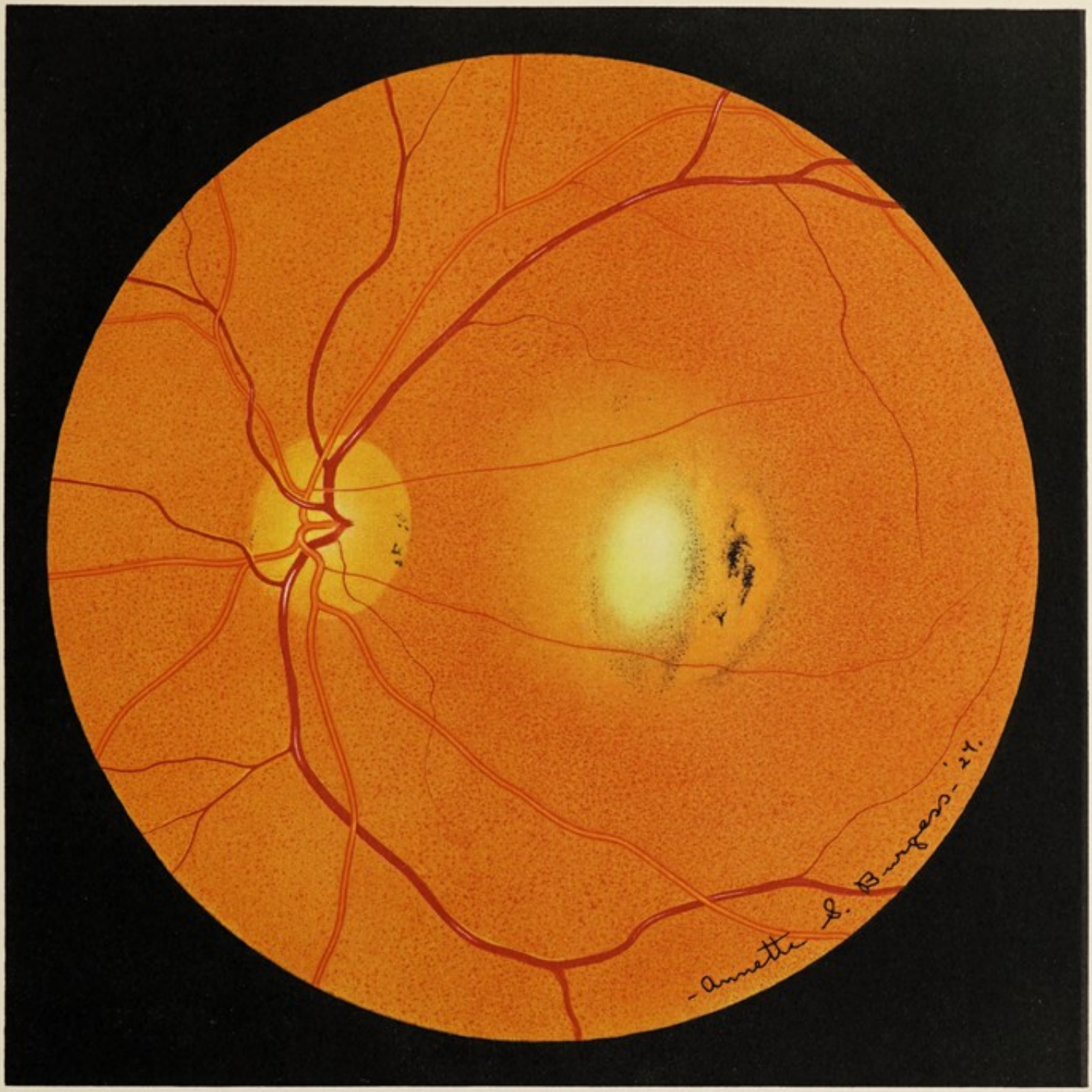

-Annette S. Burgess- '24.

PLATE 41

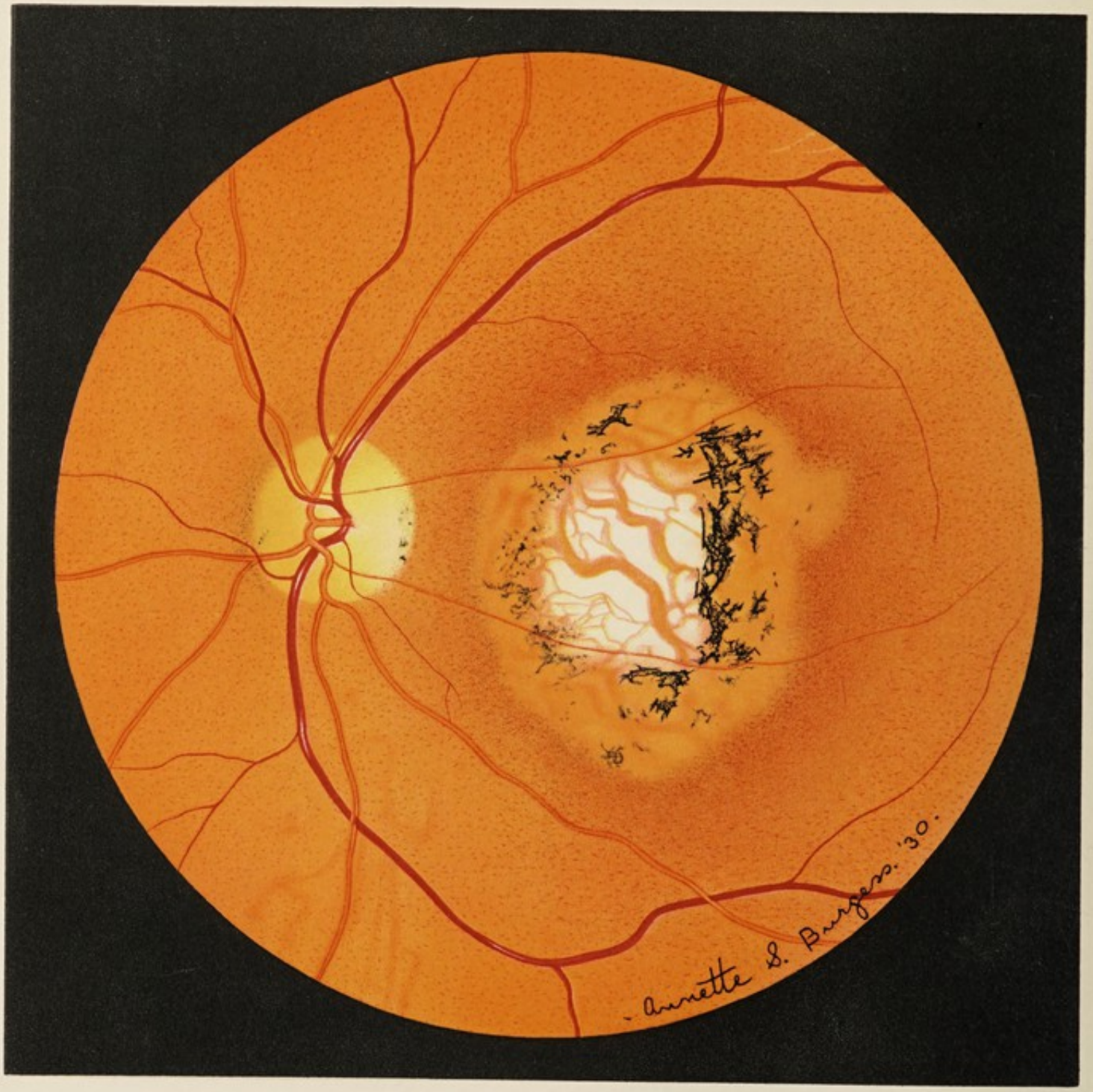


PLATE 41

Choroidoretinitis, Central, Atrophic, Tuberculous. W. O. I. No. 1,434. (Eye described in Plates 39 and 40. The present plate was made three and a half years after the first illustration).

July 1930. Family History and *Past History.* — Plate 39. *Interval History.* — During the last three and a half years, the general health of the patient has improved, with a gain in weight; and there has been no recurrence of the osteomyelitis. In addition, there have been no exacerbations in the eye lesions. During this period, the dose of tuberculin (bouillon filtrate) has been steadily increased without any unpleasant results. The patient feels that the vision is improving.

Eye Examination. — The right eye continues normal. Externally, the left eye is normal. Vision = 6/50. The central scotoma is practically unchanged. Slit lamp, normal. *Ophthalmoscopic Examination.* — Media, clear. The disk is a trifle whiter on the temporal side than in Plate 40. The pigment on the margin of the disk is well-defined. In the macular region, the dirty grey exudation has disappeared. In its place, there is atrophy of the choroid and retina, which allows the choroidal vessels to be seen clearly against the white background of the sclera. The site of the original exudation, which was elevated, is now depressed. Around this depression, there is a broad ring of partial atrophy, with a heaping-up of pigment granules into irregular masses. In this zone, the choroidal vessels are only faintly visible.

NOTE: *In 1926*, the patient was very sensitive to 1/1000 mgm. of old tuberculin. The initial therapeutic dose of bouillon filtrate of 1/100,000 mgm. has been gradually increased to 100 mgm. once a week. *1931.* There is now a sensitivity of 1/100 mgm. There has been no focal or general reaction, and the tuberculin has been discontinued. *1933.* There has been no return of the uveitis or choroiditis; and the patient's health is excellent. *1934.* The patient is still sensitive to 1/100 mgm. of tuberculin (infiltration of skin, 1.0 cm.; redness, 1.5 cm.). There has been no relapse of the eye lesion.

PLATE 42

Choroidoretinitis, Discrete, Recurrent, Tuberculous, right eye of a man 41 years of age. W. O. I. No. 281.

Family History. — Father was blind from choroiditis. *Past History.* — Patient has always been nearsighted. *Present Illness.* — *Jan. 12, 1917.* Patient had noticed black spots before the right eye for several weeks. At this time, R. E. V. = 6/9. L. E. V., normal. In the right eye there were corneal deposits, vitreous opacities, and spots of acute choroidoretinitis temporal to the disk. In *March 1919*, the left eye became affected in a similar manner. The disease in that eye rapidly progressed; and by *Dec. 1920*, L. E. V. was reduced to light perception; and there was detachment of the retina with complicated cataract. At that time, R. E. V. = 6/30. Since that date, there have been repeated attacks of choroidoretinitis in the right eye.

Jan. 22, 1926. Physical Examination. — Medical, negative. Nose, throat, and teeth, negative. Urological, chronic prostatitis. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Wassermann, negative. Urine, negative. X-ray: fibrosis, apex of right lung; sinuses and gastro-intestinal tract, negative. B. M. R., 0. Tuberculin, positive to 1/1000 mgm.

Eye Examination. — Externally, right eye, normal. Left eye, very soft, with a complicated cataract. R. E. V. = 6/60; L. E. V. = L. P. Visual Field: right eye, concentric contraction with small scotomata. Slit lamp: deposits on the posterior surface of the cornea. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Media, vitreous opacities. Disk, blurred. Around the macular region, there are grouped spots of choroidoretinitis of varying ages. The oldest (nine years) is a roundish spot to the temporal side of the disk. It is a faded yellow colour, with deposits of pigment over its surface. The next oldest — the largest — is situated below, and to the temporal side of the macula. It is irregularly elongated, and dirty yellow in colour. On its surface, and around its margin, there are patches of pigment. This spot, like the former, is quiescent. To its nasal side, there is a more recent spot, lighter in colour than the two older ones, without pigment, and still slightly active. Above macular region, a fresh, yellowish white exudation, elevated. Small retinal hemorrhage below, and to the temporal side of this exudation. In upper temporal quadrant of fundus, many minute, yellowish white flecks, similar in appearance to druses.

NOTE: *1926.* Markedly sensitive to 1/1000 mgm. of tuberculin. *1932.* Barely sensitive to 1/10 mgm. tuberculin. Present maximum dose, 100 mgm. once a week. R. E. V. = 6/20. Cornea, clear; vitreous opacities, less; fundus lesions, quiescent; but choroidal and retinal atrophy more marked. *1933.* A new small choroidoretinal lesion just above the macula.

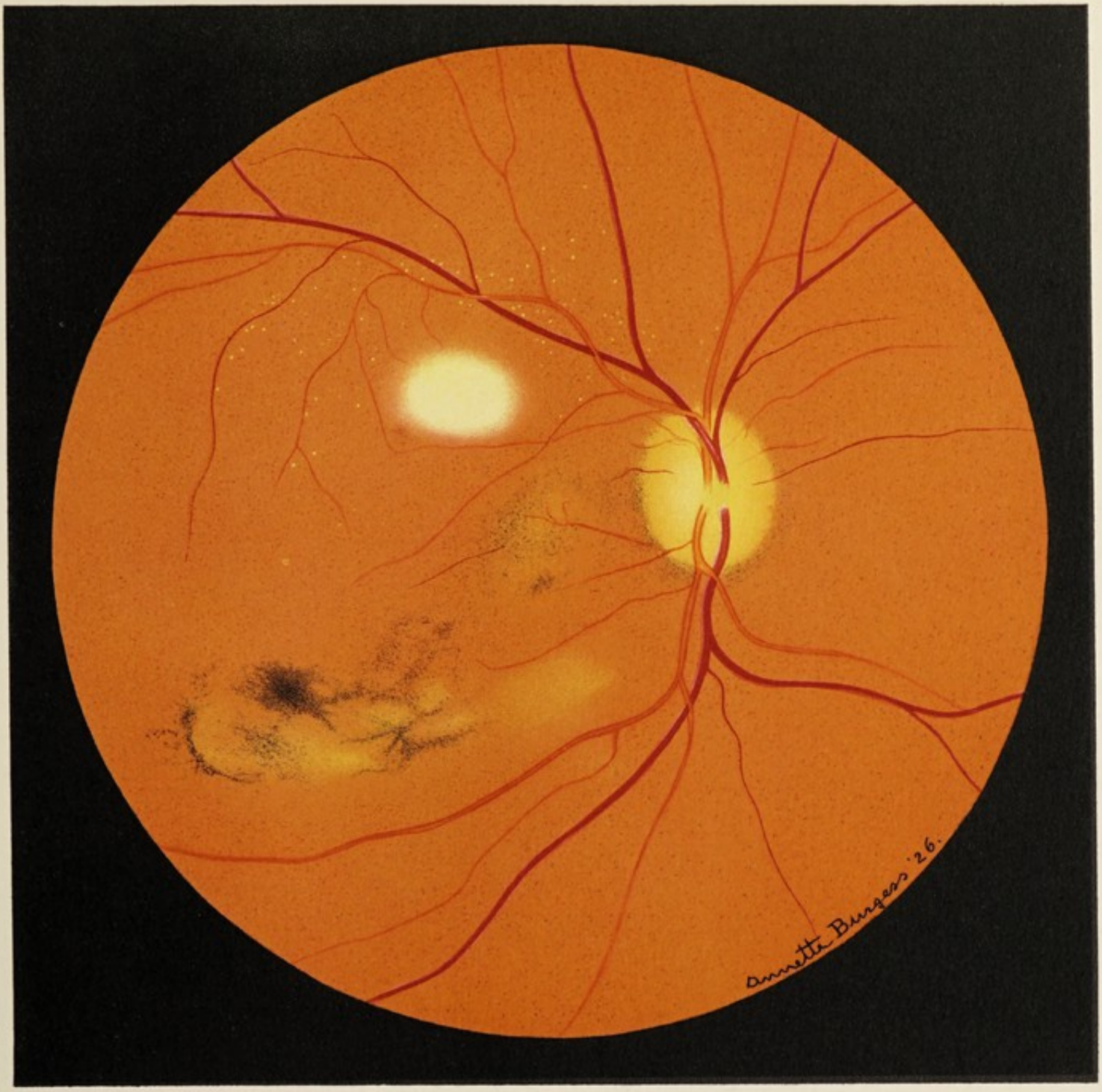

Annette Burgess '26.

PLATE 43

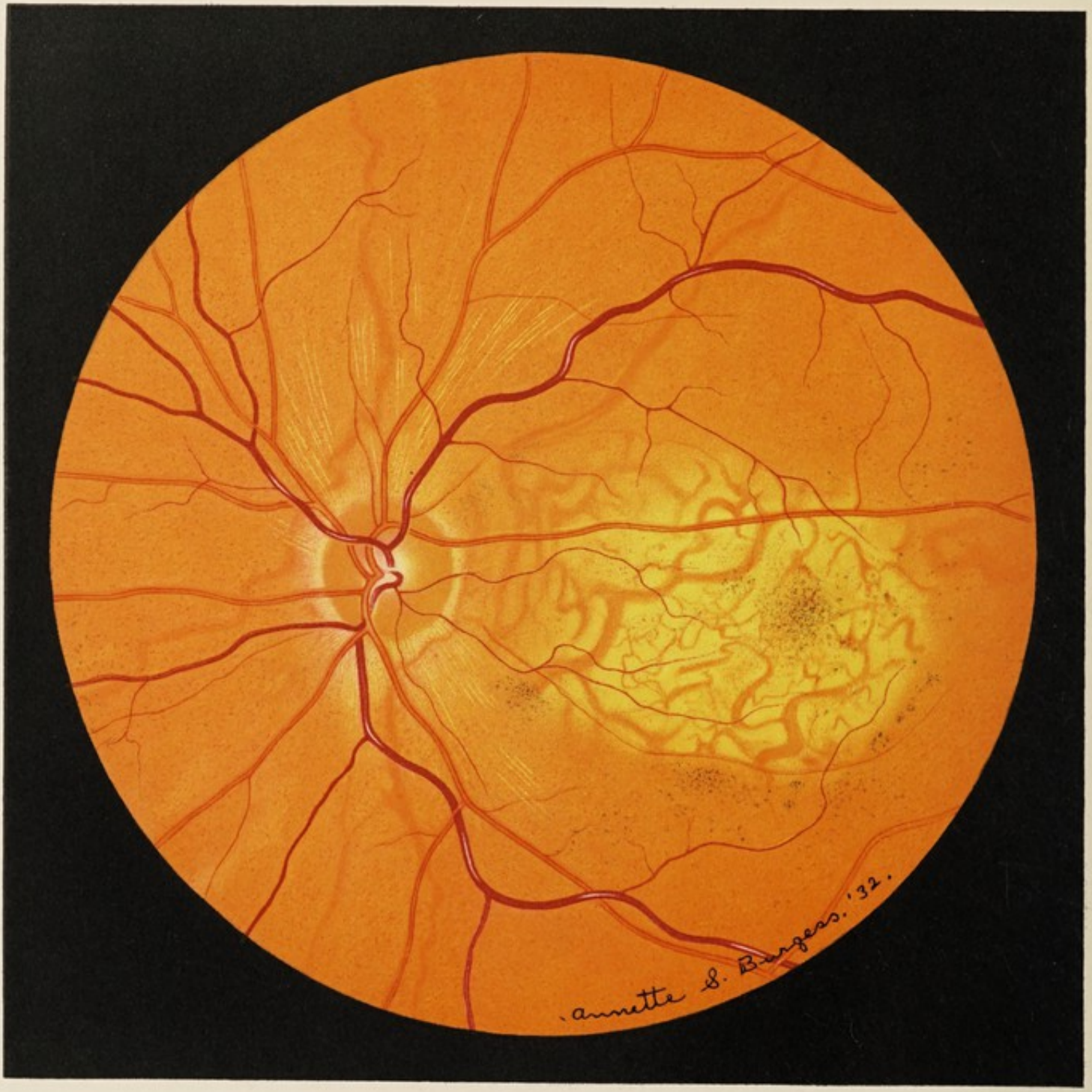


PLATE 43

Choroidoretinitis, Central, Tuberculous,* left eye of a woman 46 years of age. W. O. I. No. 7,198.

Family History. — Negative. *Past History.* — General health has always been poor. At the age of 28, operation for tubal pregnancy. For fifteen years, has had high blood pressure. At the age of 34, abortion on account of hypertension. Tonsillectomy in childhood; remaining tags removed at the age of 39. At the age of 40, both legs operated on for varicose veins. Six months before admission, began therapeutic use of tuberculin. *Present Illness.* — Vision of right eye suddenly failed at the age of 38. Left eye at the age of 46.

Physical Examination. — Medical, negative. Blood pressure, 148/84. Gastro-intestinal tract, nose, throat, teeth, negative. Gynecological: ureteral stricture, possible left urinary tract infection. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Wassermann, negative. Urine: (catheterized specimen) a few white blood cells; no casts; no acid-fast organisms. Phthalein excretion, 60% in 2 hours. B. M. R., − 5. Tuberculin, positive to 1/10 mgm.

Eye Examination. — Externally, both eyes, normal. L. E. V., with correction, = 6/9. Visual Field: relative central scotoma. Blind spot, normal. Colour sense and light sense much impaired. Slit lamp: depigmentation of pupillary border of iris; slight increase in visibility of aqueous ray. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Media, vitreous opacities. Disk, margins indistinct, surrounded by halo-like scleral ring; slight retinal edema, above and below. Retinal veins, a trifle enlarged. In macular region, large, light yellow spot due to atrophy of retina and choroid. In this area, the choroidal vessels appear as a light red, lace-work pattern on the yellow background. Deposits of pigment in macula, and around lower margin of atrophic area. Large irregularly beaded, light red, choroidal vessels radiate around disk. With red-free light, light-streaks are visible upon these vessels.

Right eye, similar condition, but lesion more extensive.

NOTE: The low cutaneous specific sensitivity is probably due to the previous therapeutic use of tuberculin.

* Courtesy of Dr. Leroy W. Hyde.

PLATE 44

Choroidoretinitis, Diffuse, Exudative, Tuberculous, right eye of a negro youth 16 years of age. W. O. I. No. 543. Unit No. 1,262.

Family History. — Negative. *Past History.* — General health has been good. *Present Illness.* — For three months prior to admission, there had been gradual failure of vision in both eyes, associated with frequent headaches.

Physical Examination. — Medical, negative. Blood pressure, 122/78. Nose, throat, neurological, neuro-surgical, ventriculograms, negative. Genito-urinary: bilateral tuberculous epididymitis. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Wassermann, negative. Blood cultures, negative. Urine, negative. X-ray: infiltration at base of the lung, suggesting old tuberculosis; sinuses, old infection of antra; lateral stereo of head, negative. B. M. R., − 3. Spinal fluid: pressure increased (250 mm. H_2O); Wassermann and Pandy tests, negative; cell count, 16 per c.c. (lymphocytes); no acid-fast organisms. Tuberculin, positive to 1.0 mgm.

Eye Examination. — Externally, both eyes, normal. Vision of each eye = 1/60. Visual Fields: much contracted, especially in the left eye. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Right eye. Media, vitreous opacities. The entire fundus appears blurred. The disk is covered by a massive exudation and all the details are obliterated; it is elevated 5.0 D. There are extensive, light yellow exudations over a large portion of the fundus, particularly along the vessels. The vessels are tortuous, and the veins engorged. The thrombosis of both the arteries and the veins suggests a preceding endarteritis and endophlebitis. There is a rupture of the occluded vessels, particularly of the veins, with secondary hemorrhages and new vessel formation. Near the macular region, there are a few minute, whitish yellow spots, similar in appearance to tubercles. The portion of the fundus between the exudation is stippled, and greyish green in tint.

The left eye presents a similar appearance.

NOTE: This case is especially interesting because the probable old tuberculous affection of the lung, the active tuberculosis of the eyes, and the bilateral tuberculous epididymitis are associated with a very slight sensitivity to tuberculin. This very mild allergic reaction is probably due to the exhaustion of the available cellular antibody by the active and extensive infection. Under tuberculin therapy and better hygiene, the exudates absorbed, vision improved, and the patient gained in weight.

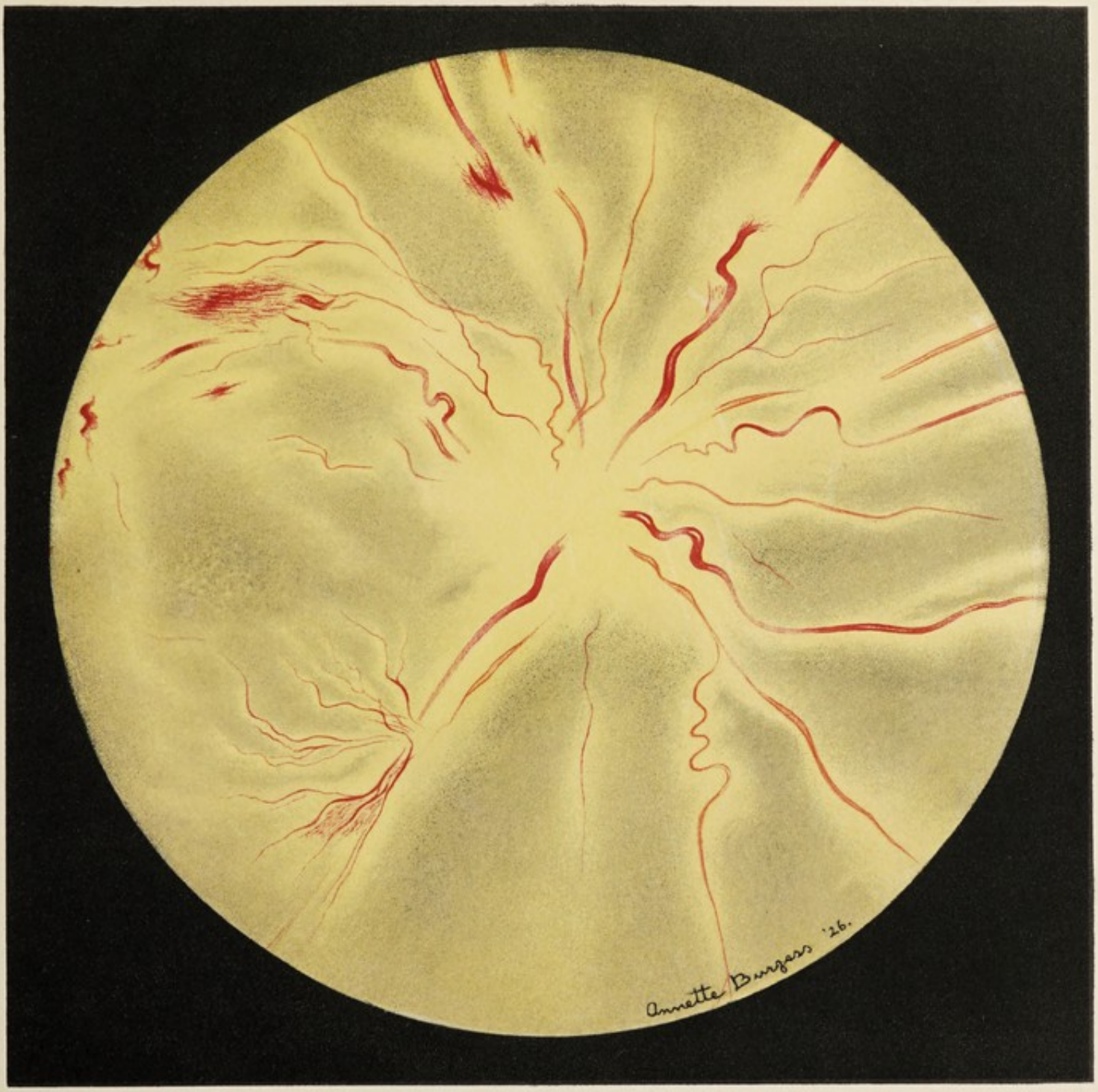

Annette Burgers '26.

PLATE 45

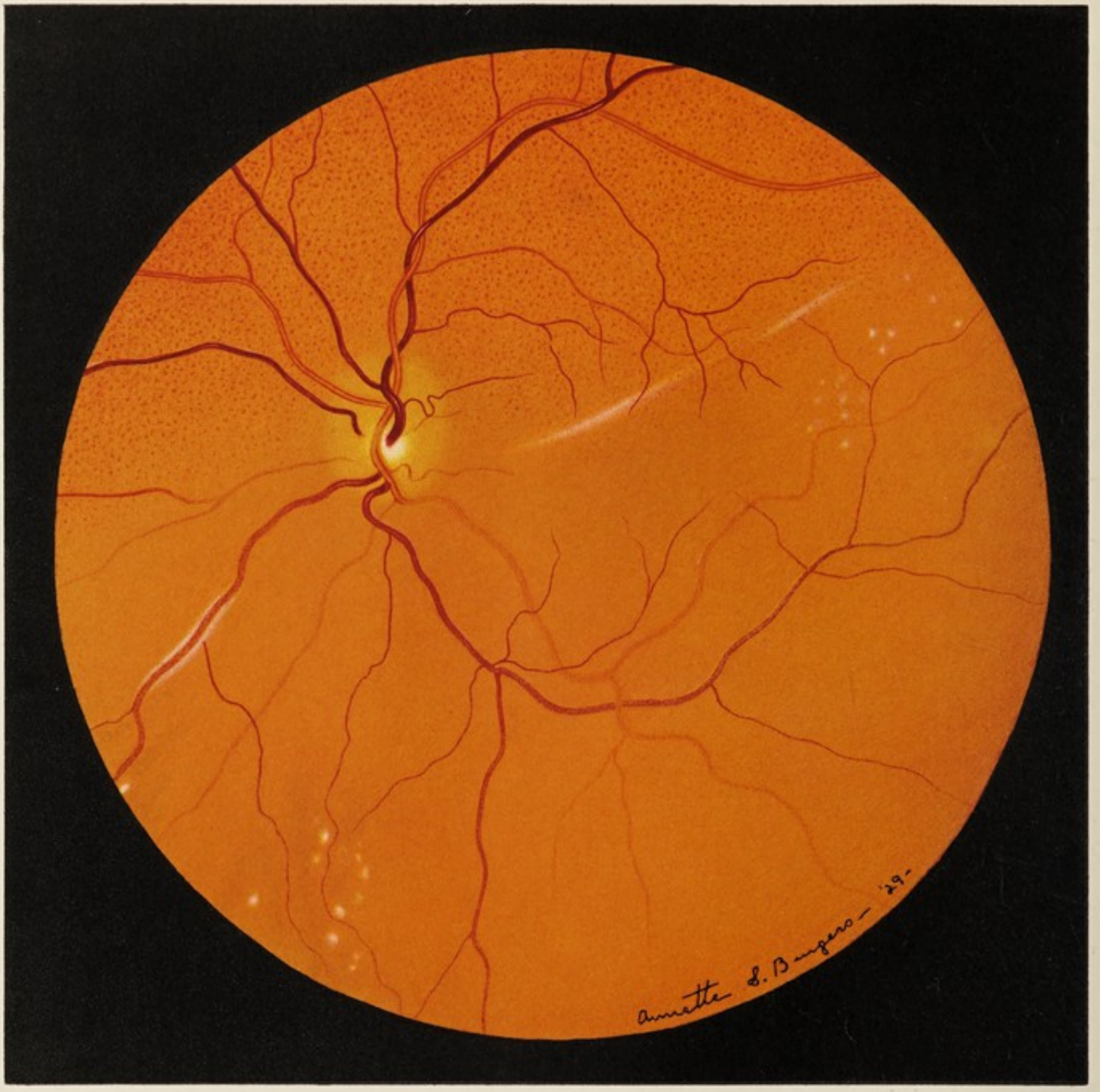


PLATE 45

Choroidoretinitis, Exudative, Tuberculous, with Detachment of Retina, left eye of 15 year old boy. W. O. I. No. 4,505.

Family History. — Brother, 22 years old, similar condition in left eye. (Plate 46). *Past History.* — General health has always been good. *Present Illness.* — The vision in the left eye has been impaired for one year. One month prior to admission, the lesion was diagnosed as a choroidal tumour.

Physical Examination. — Medical, mitral insufficiency. Blood pressure, 120/70. Gastro-intestinal tract, nose, throat, teeth, negative. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal; clotting time, 3-1/2 min. Wassermann, negative. Urine, negative. X-ray: sinuses clear; remains of old mediastinal tuberculosis. B. M. R., − 1. Tuberculin, markedly positive to 1/1000 mgm.

Eye Examination. — Right eye, normal throughout. Externally, left eye, normal. L. E. V. with correction = 3/60. Visual Field: contracted nasally and above; relative central scotoma. Light and colour sense, much reduced. Intraocular tension, normal. Transillumination, normal. *Ophthalmoscopic Examination.* — Media, clear. Upper part of fundus, normal. Disk, yellowish red; margins, blurred. The detached retina extends upward to the lower border of the disk, and on the temporal side, to a little above the macula. The upper limit of the detachment appears as a faint, white, oblique line. Over the entire detachment, the red-reflex is good, with a smooth, yellowish red colour. The normal portion of the retina is seen best with a + 0.5 D. lens; the macular region with + 4.0 D.; and the inferior portion of the fundus, with a + 6.0 D. Choroidal details are lost. Below the disk, and to the temporal side of the macula, there are small, white, retinal exudates. There is a disturbance of retinal pigment in places. Along the inferior nasal retinal vein, there are remains of a periphlebitis. The lower part of the fundus suggests that an extensive choroidal exudate lifts up the retina, although there is very little fluid between these two structures.

NOTE: The normal retina above, and the detachment below, are each reproduced in focus in order to show the fundus details in the respective areas.

PLATE 46

Choroidoretinitis, Exudative, Tuberculous, with Detachment of Retina, left eye of a man 22 years old. W. O. I. No. 6,063.

Family History. — One brother has a similar eye lesion. (Plate 45). *Past History.* — Had malaria at the age of 6. Tonsils and adenoids removed when 8 years old. At the age of 17, was struck in left eye, and the vision in that eye was blurred for a while. But he was told that the eye was uninjured. Otherwise, general health has been good. *Present Illness.* — When 19 years old, he felt in need of glasses. He consulted an oculist who discovered a "spot" in the left eye. Recently, vision in the left eye has been blurred and objects distorted.

Physical Examination. — Medical, negative. Blood pressure, 125/70. Nose, throat, teeth, negative. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal; clotting time, 2-1/2 min. Wassermann, negative. Urine, negative. X-ray: sinuses, normal. B. M. R., − 9. Tuberculin, positive to 1/1000 mgm.

Eye Examination. — Right eye, entirely normal. Externally, left eye, normal. L. E. V. with correction = 6/15. Visual Field: upper nasal defect. Intraocular tension, somewhat reduced. Transillumination, normal. *Ophthalmoscopic Examination.* — Media, clear. Fundus above disk, and a narrow strip below, normal; best seen with a + 0.5 D. Macula, slight retinal edema; best seen with + 2.0 D. Retina detached below. Over the lower portion of the detachment, the red-reflex is good; but there are some pigment changes that resemble mosaic; best seen with + 10.0 D. No fluid visible under lower portion of retina. At the upper border of the detachment, the fluid under the retina gives a bluish white appearance which suggests the snow-capped mountains of a Japanese print. The upper margin of the detachment is seen best with lenses from + 4.0 D. to + 6.0 D. In the lower, temporal quadrant, there is a fairly large bluish white retinal exudate; and above, many smaller and whiter spots. In the undetached retina, the vessel light-streaks are normal. They disappear as the vessels climb over the margin of detachment; and reappear over the detached portion when viewed at right angles. The sides of the venous loops seem almost black from the deflection of the returning light rays.

NOTE: Two brothers, aged 15 and 22 respectively, had a similar condition in the left eye. Both were very sensitive to tuberculin; and both improved under tuberculin therapy.

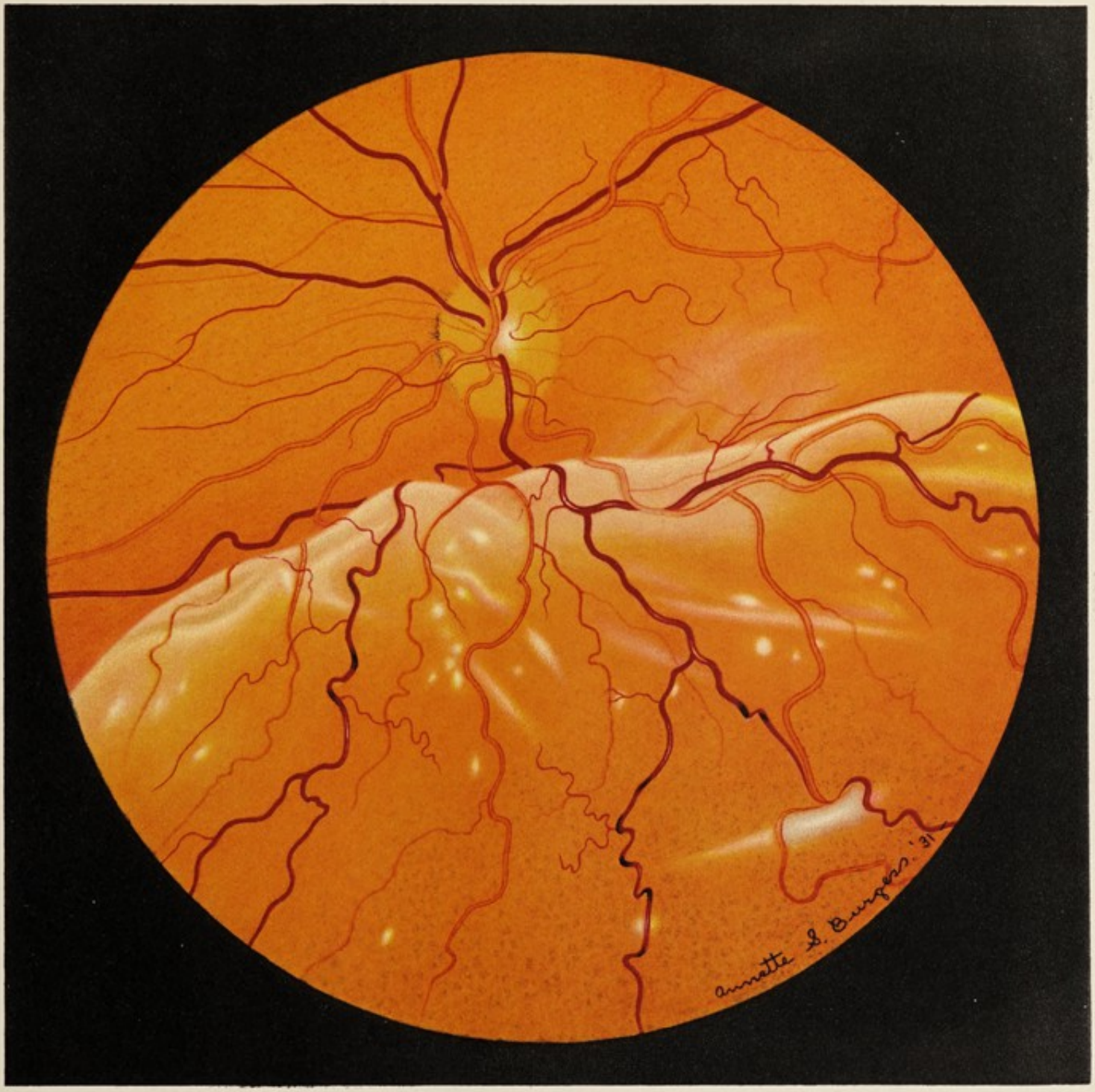

annette L. Burgess '31

PLATE 47

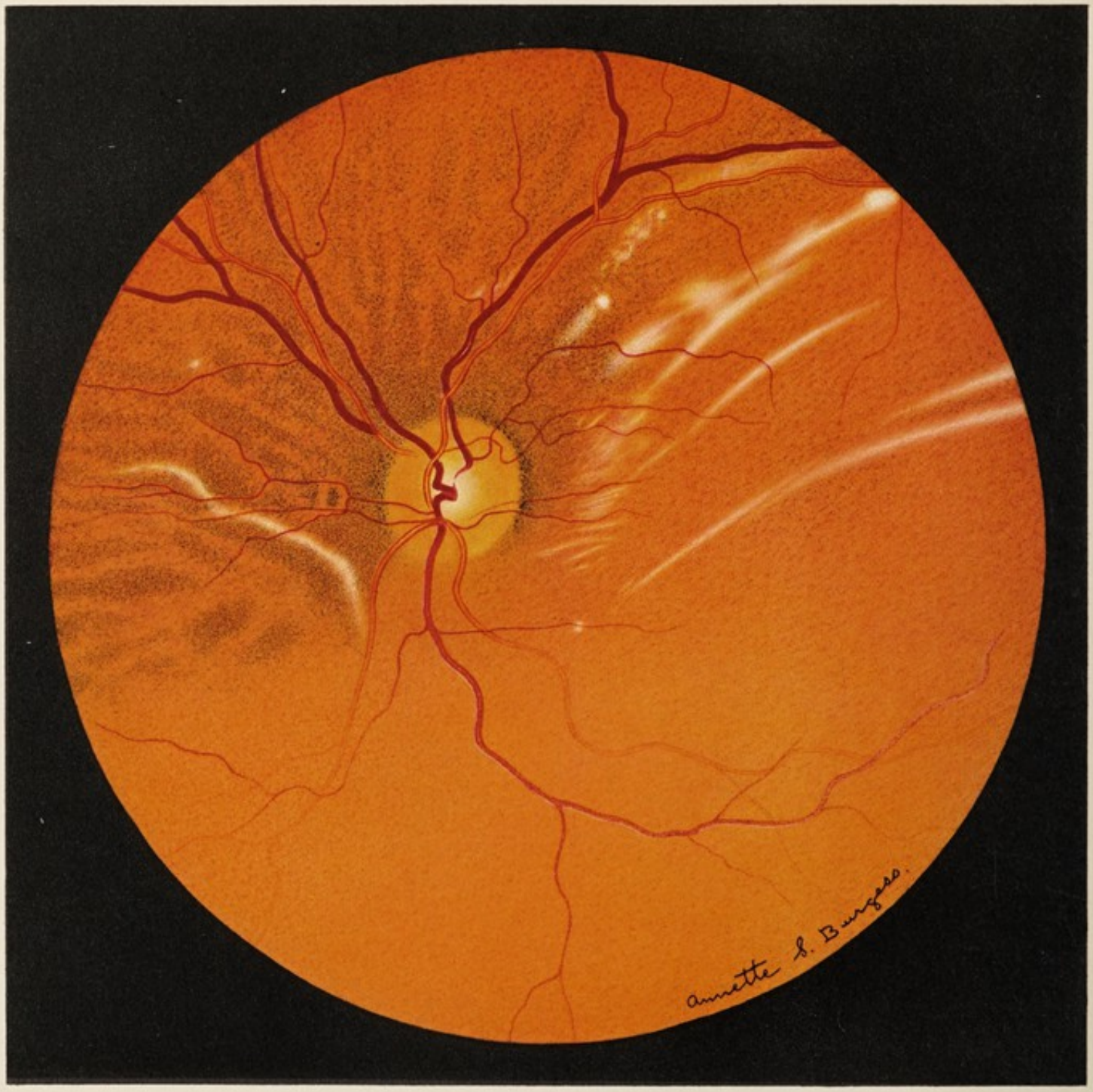


PLATE 47

Choroidoretinitis, Exudative, with Detachment of Retina, left eye of a brunette man 26 years old. W. O. I. No. 4,659.

Family History. — Father died at 48 from cancer of liver. *Past History.* — At the age of 16, had pneumonia followed by empyema. When 18 years old, vision of left eye became blurred, and a diagnosis of detached retina was made. Three years later, a similar condition occurred in the right eye. Had many forms of treatment: tuberculin, rest in bed with sweating, etc. *Present Illness.* — Recently, there has been very little change in vision.

Physical Examination. — Medical, negative, except for old empyema, left side. Blood pressure, 120/60. Infected tonsils. Teeth, negative. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal; clotting time, 4 min. Wassermann, negative. Urine, negative. X-ray: sinuses, clear. B. M. R., − 7. Tuberculin, negative to 1/100 mgm.

Eye Examination. — Externally, both eyes normal. R. E. V. with correction = 6/60. L. E. V. with correction = 3/60. Visual Fields: both eyes, marked contraction above. Intraocular tension, normal. Transillumination, normal. *Ophthalmoscopic Examination.* — Left eye. Media, clear. Disk, colour, normal; lower margin, markedly blurred. Upper nasal portion of fundus, normal for a pronounced brunette. The entire lower portion of the fundus is a smooth, light red colour, and all details are blurred, as in Plates 45 and 46. The retinal vessels appear as though viewed through a mist. Details of macular region are also lost. To the nasal side of the disk, there is a long oblique, striate exudation in the choroid. Above, and to the nasal side of the disk, there are a few irregular, choroidal exudates. In the retina, in the vicinity of the macular region, there are long, oblique, streamer-like effusions.

The normal part of the fundus is best seen with a + 2.0 D. lens; just below the disk with a + 6.0 D., and the lowest portion with a + 12.0 D.

The right eye presents a similar condition.

PLATE 48

Choroidoretinitis Juxtapapillaris (Retino-chorioiditis Juxtapapillaris Jensen[36]), Early Stage, right eye of a blond girl 16 years old. W. O. I. No. 6,195.

Family History. — Negative. *Past History.* — Frequent colds. At the age of 9, had acute tonsillitis. *Present Illness.* — Six nights prior to admission, retired with vision normal. The next morning, the vision of the right eye was markedly impaired.

Physical Examination. — Medical, negative. Blood pressure, 105/65. Nose and throat: infected tonsils and adenoids. Gynecological, negative. Teeth, negative. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Wassermann, negative. Urine, negative. Phthalein excretion, 80% in 2 hours. X-ray: sinuses and chest, negative. B. M. R., − 10. Spinal fluid, negative. Tuberculin, negative to 1 mgm.

Eye Examination. — Left eye, normal in all respects. Externally, right eye, normal. Pupillary reactions, sluggish. R. E. V. = 1/60. Visual Field: peripheral outlines, normal; central scotoma, including blind spot. Slit lamp: aqueous ray increased in visibility. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Media, vitreous opacities. The fundus is blurred. Disk, all details are lost; and it suggests the sun on a misty morning. From the temporal margin of the disk, a markedly elevated, yellowish white exudation extends beyond the macula.

From a histologic examination, Abraham[37] believes that the process is primarily a choroiditis which follows an infection, or intoxication, of the outer half of the circle of Zinn; and that the involvement of the retina is secondary.

NOTE: Rapid improvement in the eye lesion followed the removal of the tonsils and adenoids.

[36] Jensen, Edmund. "Retino-chorioiditis Juxtapapillaris." Arch. f. Oph. Vol. LXIX. p. 41. Aug. 1908.
[37] Abraham, Samuel V. "Chorioretinitis Juxtapapillaris (Jensen)." Arch. of Oph. Vol. 8. No. 4. p. 503. Oct. 1932.

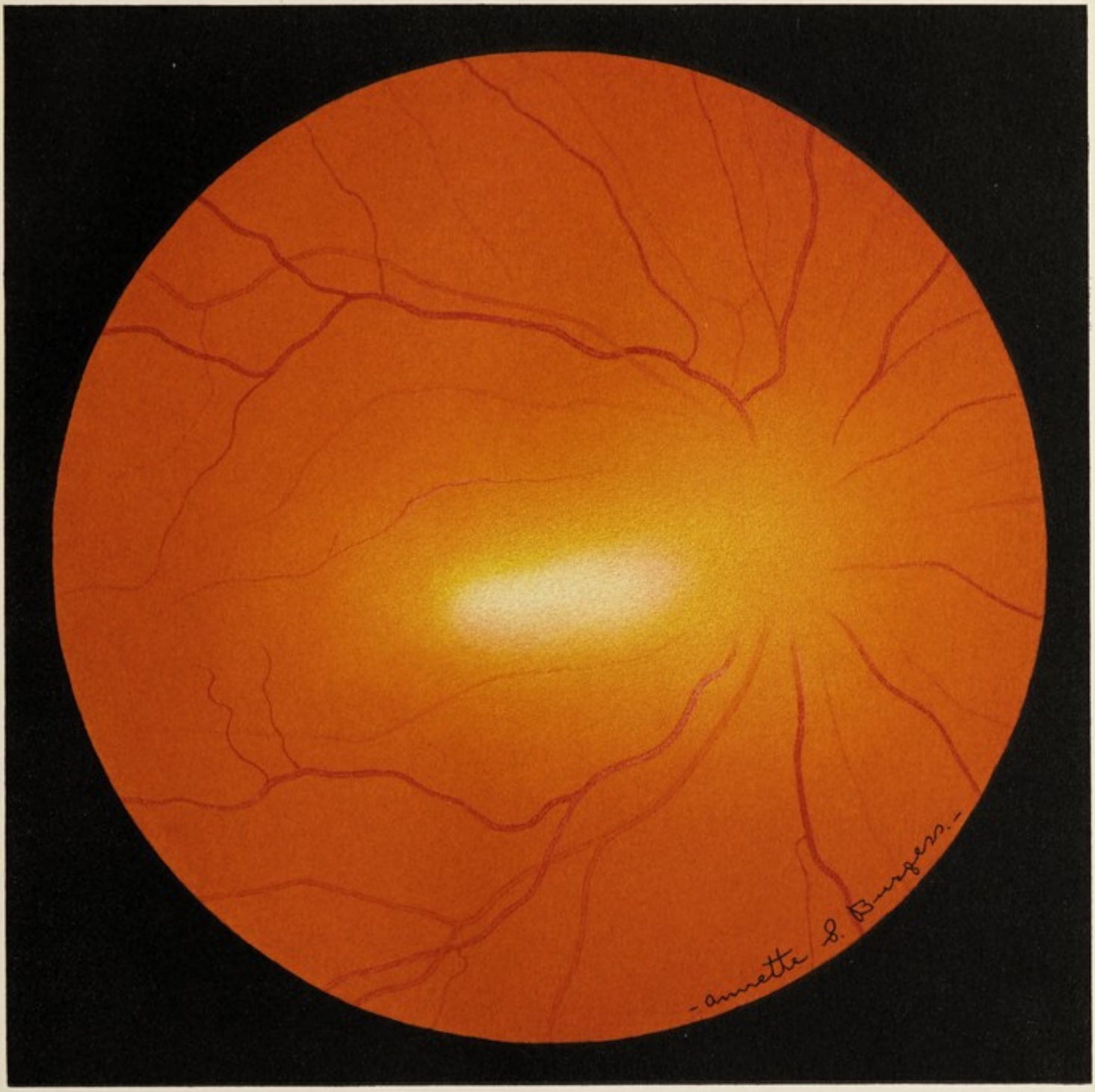

Annette S. Burgess

PLATE 49

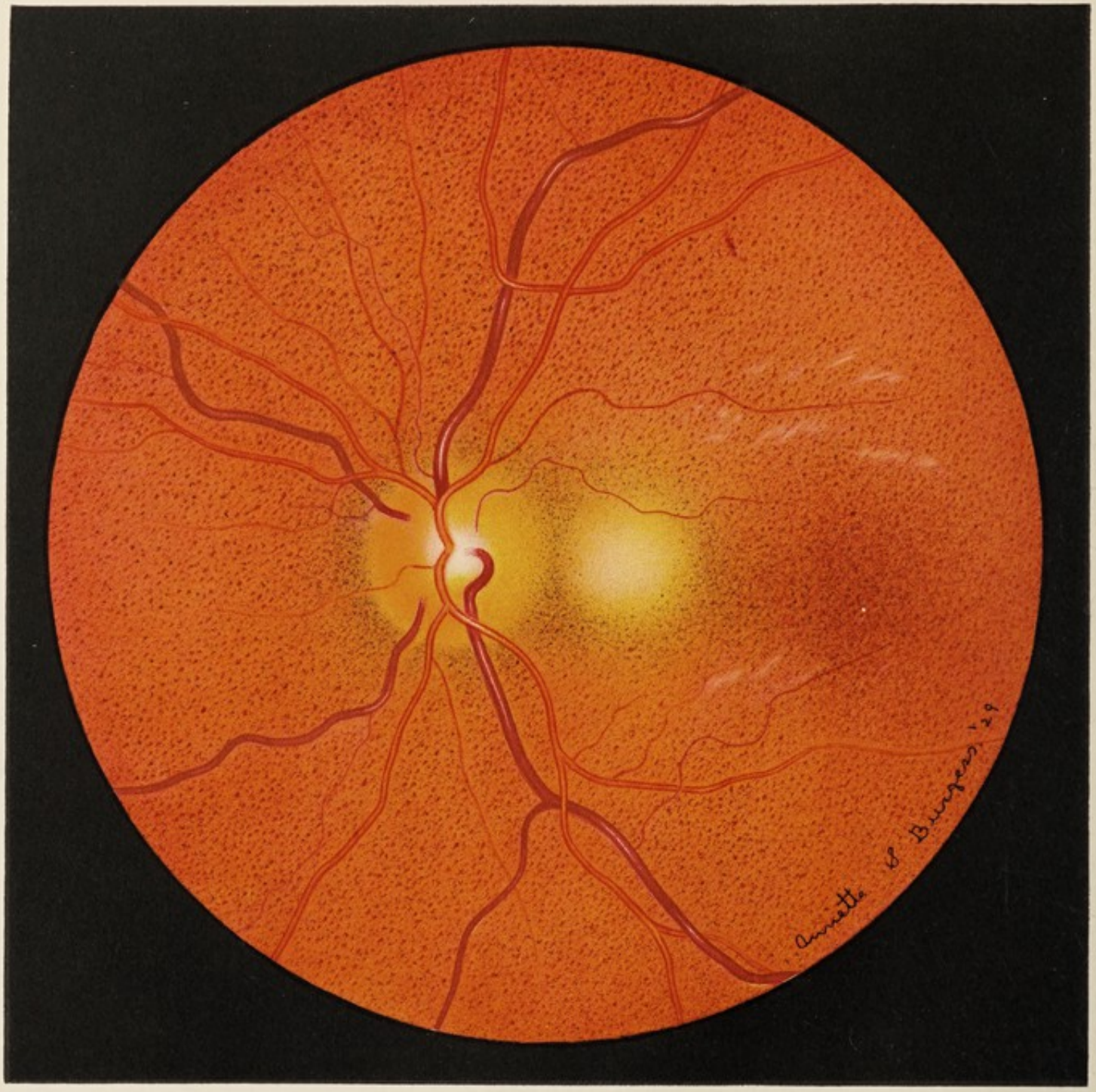


PLATE 49

Choroidoretinitis Juxtapapillaris (Retino-chorioiditis Juxtapapillaris Jensen), Later Stage, left eye of a blond man 25 years old. W. O. I. No. 4,066.

Family History. — Negative. *Past History.* — No illness except left mastoiditis at the age of 13, followed by infection of the jugular vein. An operation was followed by complete recovery. *Present Illness.* — Two months prior to admission, the vision of the left eye became much blurred. The tonsils were removed and the vision rapidly improved from 4/60 to 6/15.

Physical Examination. — Medical, negative. Blood pressure, 110/60. Gastro-intestinal tract, nose, throat, teeth, negative. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal; clotting time, 4-1/2 minutes. Wassermann, negative. Urine, negative. Phthalein excretion, 66% in 2 hours. X-ray: sinuses, negative. B. M. R., − 7. Spinal fluid, negative. Tuberculin, negative to 1/10 mgm.

Eye Examination. — Right eye, normal in all respects. Externally, left eye, normal. L. E. V. = 6/6 − 2. Visual Field: peripheral outlines, slightly contracted; central scotoma for blue and red; blind spot, much enlarged, extending almost to point of fixation. Colour sense, impaired; light sense, normal. Slit lamp, negative. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Media, clear. Disk, reddish yellow; margins, slightly blurred. Arteries, fairly normal. Veins, enlarged. Macular region, normal. At the outer margin of the disk, extending to a point half way between the disk and the macula, there is a light yellowish exudation a trifle raised above the surface of the general fundus. A small retinal vessel is plainly seen on its surface. This spot seems to be undergoing absorption.

It is important to differentiate this disease from a tumour or a localized tuberculous choroidoretinitis.

The causes usually assigned for this affection are syphilis, tuberculosis, influenza, disseminated sclerosis, etc. In the author's experience, it generally occurs very suddenly in healthy young people with some remote focus of infection, but whose Wassermann and tuberculin reactions are negative. In several instances, the exudation has been absorbed quickly after the removal of diseased tonsils, or after the drainage of infected parinasal sinuses.

PLATE 50

Choroidoretinitis, Discrete, left eye of a brunette woman 50 years old. W. O. I. No. 347.

Family History. — Negative. *Past History.* — At the age of 31, had renal colic. Since then, frequent attacks of cystitis. At the age of 33, the right eye was operated upon for glaucoma, secondary to an anterior adherent leucoma. *Present Illness.* — Five months prior to admission, the vision of the left eye became blurred; and objects were distorted. A diagnosis of central choroiditis was made. Tonsils were removed; and several teeth extracted. Vision improved, but there have been two attacks of blurred sight since these operative procedures.

Physical Examination. — Medical, negative. Blood pressure, 130/80. Gastro-intestinal tract, nose, throat, teeth, negative. Genito-urinary tract: heavy growth of staphylococcus albus in urine catheterized from right kidney; urine from left kidney showed no growth. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Wassermann, negative. Urine: mucous shreds; many epithelial cells; a few red and white blood cells; occasional cast. Phthalein excretion, 70% in 2 hours. X-ray: sinuses, chest, gall bladder, negative. B. M. R., + 11. Tuberculin, negative to 1/10 mgm.

Eye Examination. — Externally, left eye, normal. L. E. V. = 6/12. Visual Field: normal for form and colours; colour sense, normal; light sense, reduced. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Media, clear. Disk, margins, well-defined. Arteries, tortuous. Veins, full. The foveal reflex is lost. In the macula, there are several small, clearly-cut, chalky, reddish yellow spots. Three small, rounded, light yellowish red exudations are situated below, and to the temporal side of the disk.

NOTE: The patient was put upon a careful regimen. Hexylresorcinol was prescribed internally. One month later, culture from right kidney was sterile; vision increased to 6/9 + 3; fundus condition improved. Nine months later, vision = 6/6 − 4; exudates difficult to locate.

Seven years later, Dr. A. L. Prince writes: "L. E. V. with correction = 6/7. Visual field and blind spot, normal. Fundus, vessels tortuous, light-reflexes slightly increased. Slight irregularity of pigmentation at macula."

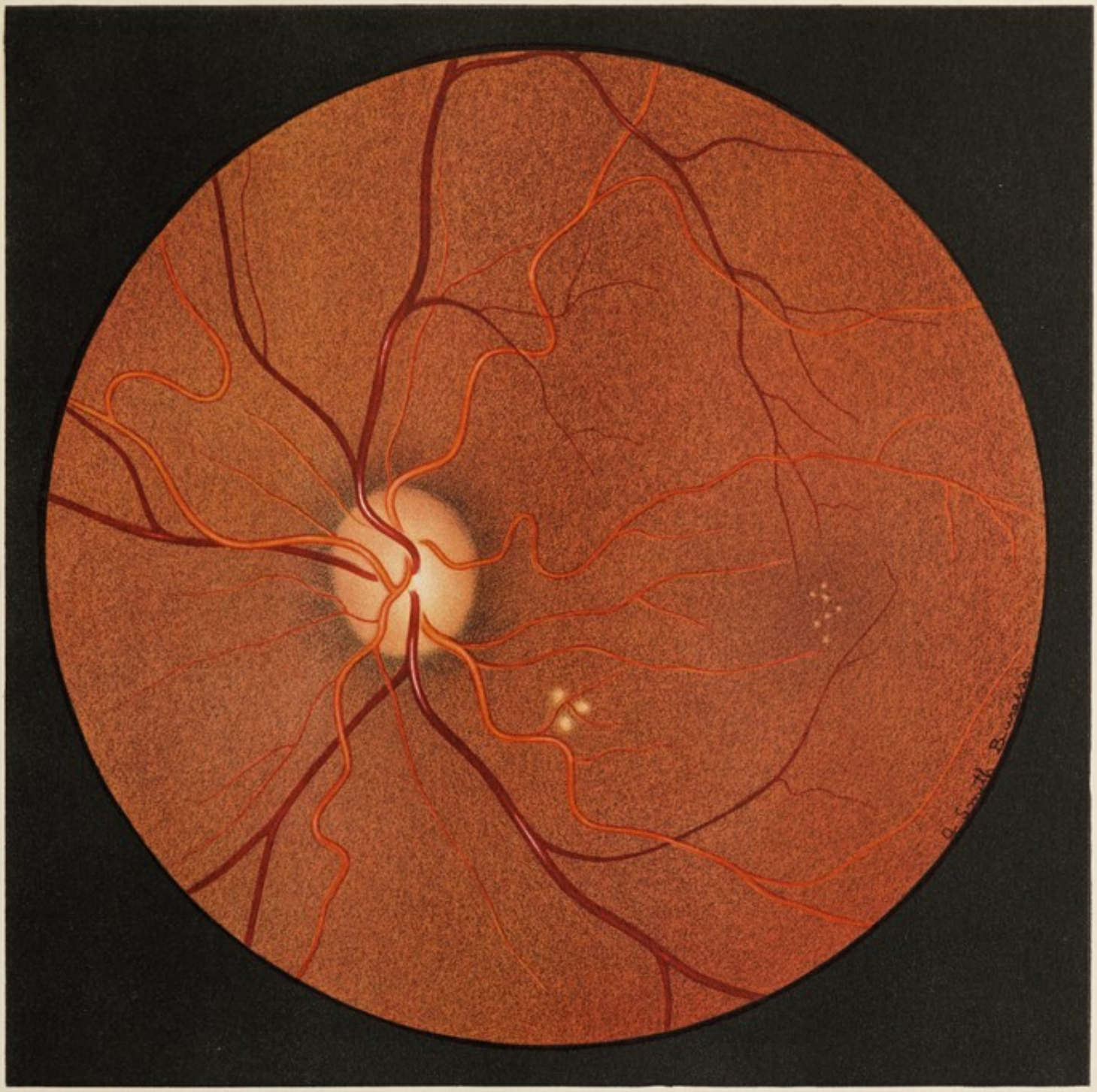


PLATE 51

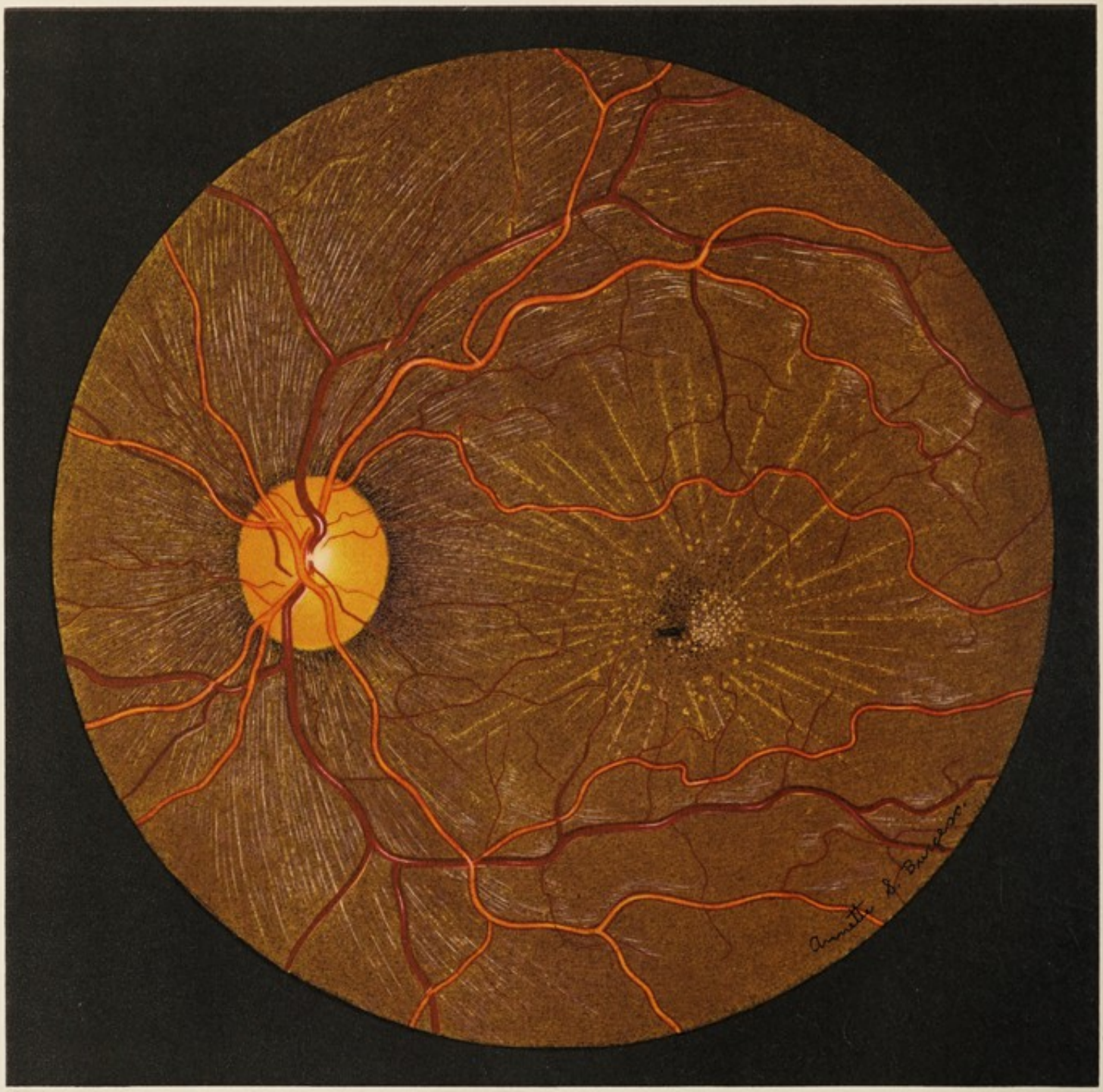


PLATE 51

Choroidoretinitis, Central, left eye of a negro man 23 years old. W. O. I. No. 6,126.

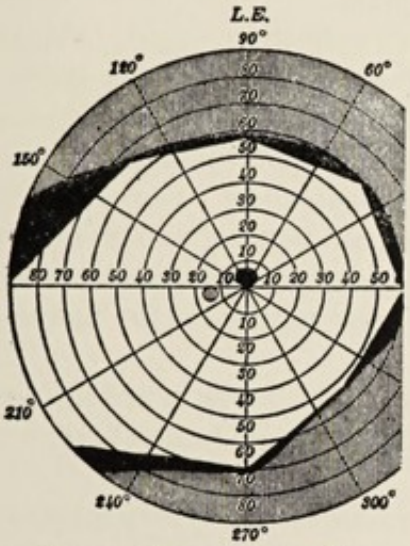
Family History. — Negative. *Past History.* — Negative. *Present Illness.* — For the last six years, progressive failure of vision, both eyes.

Physical Examination. — Medical, negative. Blood pressure, 140/80. Nose, throat, teeth, negative. Genito-urinary tract: post-gonorrheal urethritis. *Laboratory Reports.* — Blood. — Chemistry, normal except low calcium content, 7.8 mgm.%. Cytology, normal. Wassermann, negative. Urine, negative. Phthalein excretion, 85% in 2 hours. X-ray: sinuses and chest, clear. B. M. R., + 1. Tuberculin, positive to 1/100 mgm.

Eye Examination. — Externally, normal. L. E. V. with correction = 6/30. Visual Field, shown in chart. Colour sense, slightly impaired. Slit lamp, negative. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Media, clear. Disk, normal; slightly oval; long axis, vertical. Arteries, slightly tortuous; veins, a trifle full. To the nasal side of the fovea, there is a small mass of pigment. In the macula proper, there are many minute spots. Some are yellowish red, and others are whitish. Surrounding this region, there are numerous, concentrically placed, larger, round, reddish yellow spots; and there are many radiating yellowish red streamer-like lines similar to the rays of the sun. These radial lines begin at the margin of the macular region, and extend peripherally for a distance of as much as 1½ disk-diameters. These lines appear to be more superficial than the spots. The vessels and the retinal light reflections are characteristic of the negroid fundus.

The fundus of the right eye is similar.

NOTE: The only positive findings were urethritis, and a slight sensitivity to tuberculin.



CENTRAL SCOTOMA, LEFT EYE

PLATE 52

Choroidoretinitis, Central, right eye of a brunette woman 45 years old. W. O. I. No. 5,624.

Family History. — Negative. *Past History.* — At the age of 34, appendectomy; two years later, suspected tuberculosis of spinal vertebrae. Many teeth have been extracted. *Present Illness.* — Six years before admission, was conscious of brilliant flashes of light and spots before the eyes. One year later, vision of right eye failed; a month afterwards, vision of left eye blurred.

Physical Examination. — Medical: lower dorsal spine prominent and immobile; slight bronchitis. Blood pressure, 126/80. Gastro-intestinal, negative. Nose and throat: infected tonsils. Teeth, negative; many have been extracted. Gynecological, negative. *Laboratory Reports.* — Blood. — Chemistry, normal. R. B. C., 4,100,000; W. B. C., 11,400; Hgb., 65%. Wassermann, negative. Urine, negative. Phthalein excretion, 50% in 2 hours. X-ray: sinuses and gall bladder, negative; chest, slight bronchitis. B. M. R., − 1. Tuberculin, positive to 1/100 mgm.

Eye Examination. — Externally, both eyes normal. R. E. V. with correction = 3/6. Visual Field: central scotoma. Blind spot, enlarged. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Media, vitreous opacities. Disk, normal. Arteries, loss of transparency; light-streak, increased; veins (particularly inferior temporal), markedly compressed and irregular in size. In the macular area, there are mosaic-like spots which vary in colour, size, and distinctness. Some are encircled by pigment rings. Between the macula and the disk, there are several pigment masses in the anterior portion of the retina. On the temporal side of the macula, the deeper red, stippled fundus suggests a fading retinal hemorrhage. Above the macula, and in the lower portion of the fundus, there are a few small, more recent, white exudations.

The periphery presents a faint dappled appearance, like the decolouration of a red, stippled surface by drops of rain. To the lower nasal side of the disk, there is one small faint retinal hemorrhage.

There is a similar condition in the left eye.

NOTE: In view of the low blood pressure of 126/80, the arteriovenous compression is very marked. The only positive findings were infected tonsils and a slight sensitivity to tuberculin.

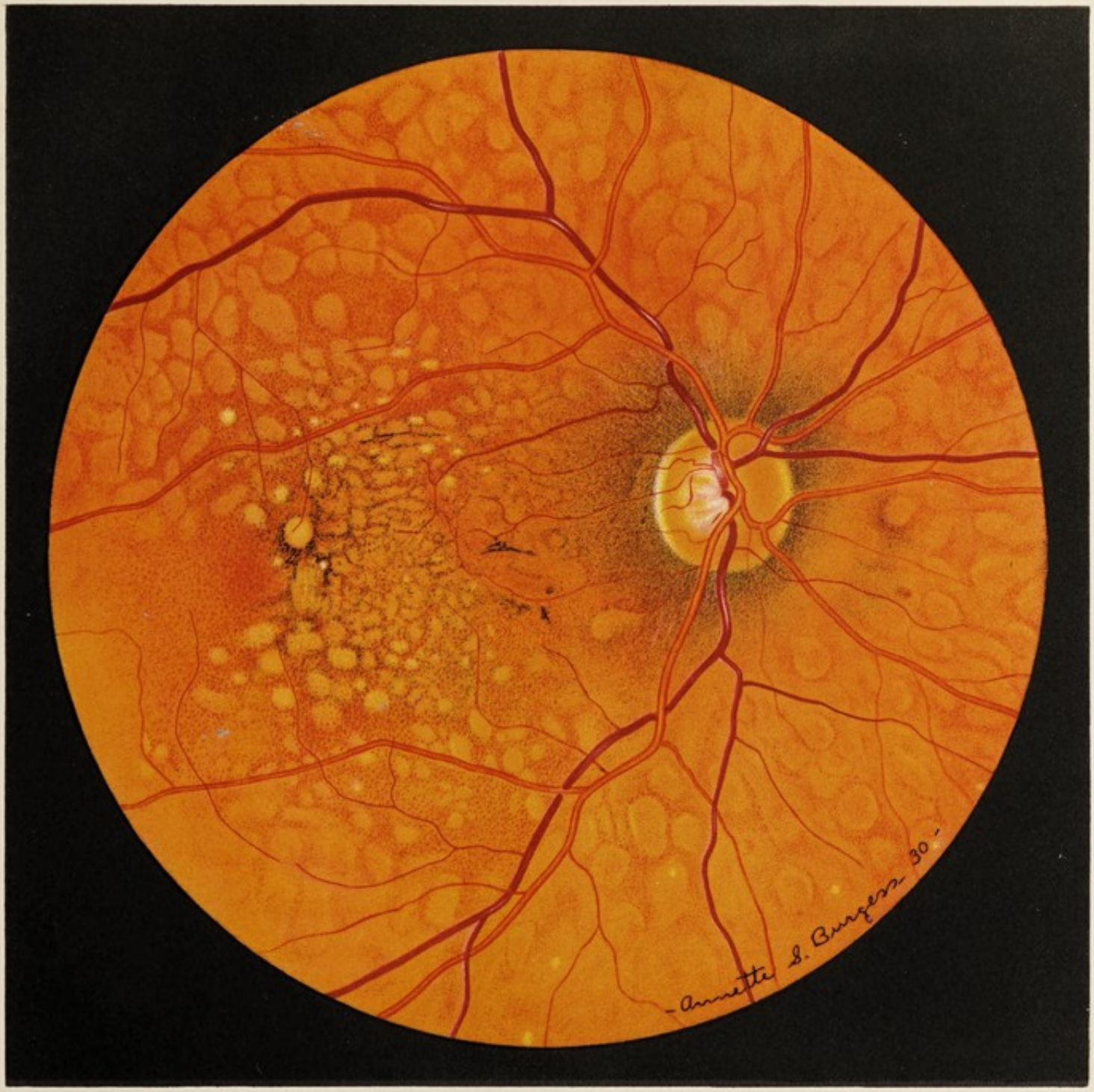

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PLATE 53

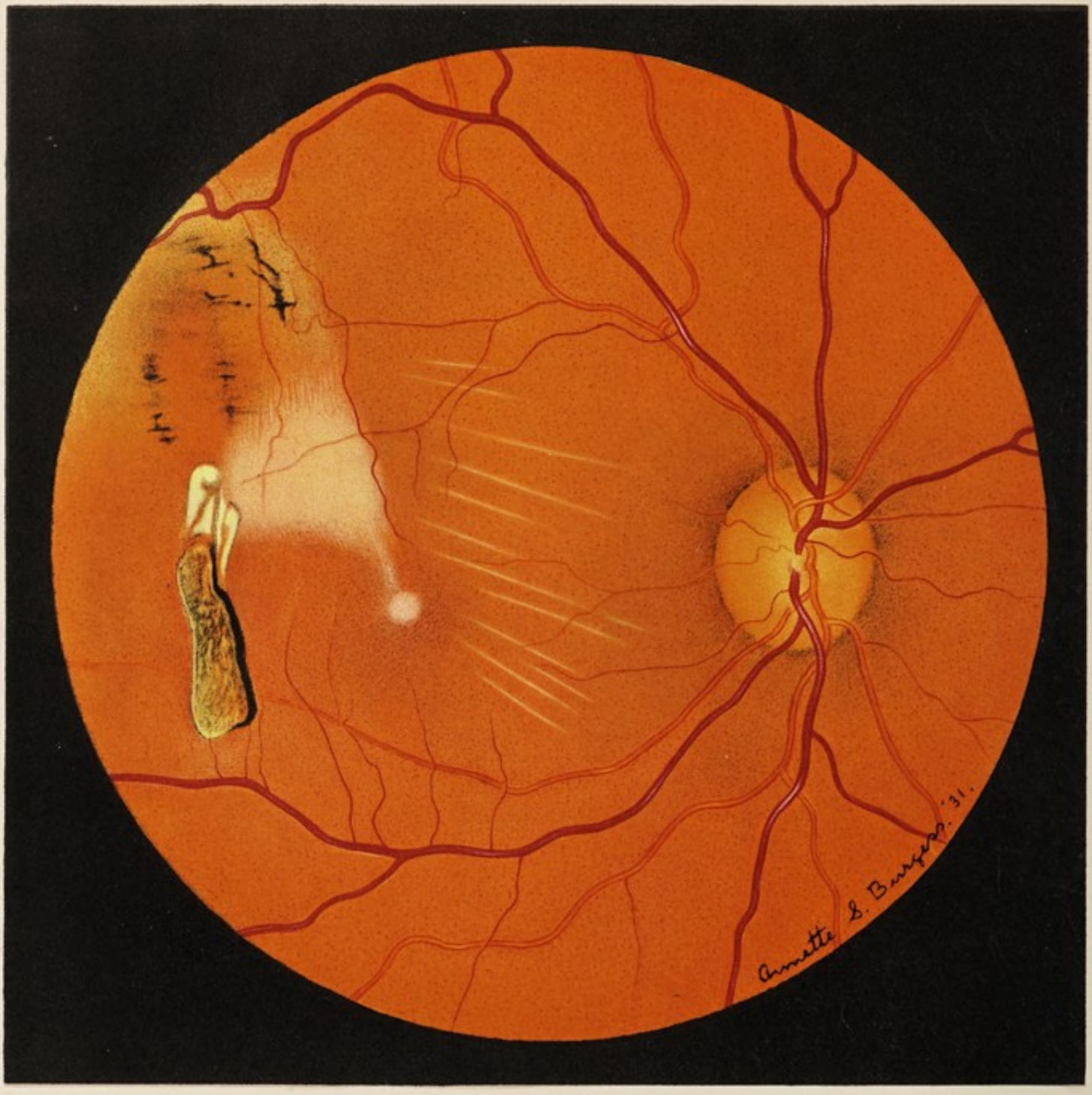

PLATE 53

Intraocular Foreign Body, right eye of a youth 19 years old. W. O. I. No. 6,098.

Family and *Past History.* — Negative. *Present Illness.* — Three weeks previous to admission, the right eye was struck by a piece of shell from a 22-calibre rifle. Immediately after the accident, the central vision became markedly blurred, but the peripheral vision remained clear.

Physical Examination and *Laboratory Reports.* — Unimportant. Uveal pigment test, negative.

Eye Examination. — Externally, at margin of cornea (corresponding to 10 o'clock on watch dial), small white scar. No conjunctival or deep injection. Pupillary reactions, normal. R. E. V., with correction = 6/30. Visual Field: marked nasal contraction. Blind spot, enlarged; covers about twice normal area. Slit lamp: there is a small bleb at the limbus of the cornea in the region of 10 o'clock. From this bleb, a deep, whitish, linear area of infiltration extends toward the centre of the cornea for a distance of 2–3 mm. Directly behind the corneal lesion, the iris presents a shallow depression containing many small, dust-like, pigment granules. Visibility of aqueous ray, not increased. Lens, normal. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Media, clear. Disk and retinal vessels, normal. About one disk-diameter to temporal side of fovea, a foreign body is plainly visible, with its long axis vertical, and resting upon the surface of the retina. It has the beautiful iridescence of metallic copper. Its nasal margin appears black from reflection of light away from the eye of the observer. In the fovea, there is a small greyish white exudation surrounded by scattered pigment granules. Above, and to the temporal side of the macula, there is a larger, whitish, slightly elevated exudation. To the nasal side of the macula, there are radiating white lines of retinal edema. Just above the foreign body, there is a small, very white spot of beginning retinitis proliferans. Above this, there is a larger, partially atrophic spot with accumulation of pigment on its surface.

PLATE 54

Choroiditis, Disseminated, right eye of a blond woman 44 years old. W. O. I. No. 3,510.

Family History. — Negative. *Past History.* — At 14 years of age, had pneumonia, followed by hemiplegia, which involved first the left, and later the right side. The sight of both eyes was seriously affected for six months. At 26, suffered from malaria. *Present Illness.* — For two years prior to admission, there has been progressive loss of sight; difficulty in reading; headaches; nausea.

Physical Examination. — Medical, negative. Blood pressure, 130/80. Gastro-intestinal, negative. Nose and throat: infected tonsils. Teeth: slight pyorrhoea. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Wassermann, constantly negative. Urine, negative. X-ray: chest, sinuses, gall bladder, negative. B. M. R., − 7. Tuberculin, positive to 1/10 mgm.

Eye Examination. — Externally, both eyes normal. R. E. V. with correction = 6/15. Visual Field: there are numerous scotomata. Colour sense, impaired. Light sense, much reduced. Slit lamp: depigmentation of pupillary border; pigment granules on posterior surface of cornea and anterior capsule of lens; aqueous ray, visibility increased. *Ophthalmoscopic Examination.* — Media, vitreous opacities. Disk, margins, blurred. Retinal arteries are small; and the light-streaks faint. Light-streaks on the veins are almost imperceptible.

In the macular region, there is a small vertical spot of nearly normal choroid and retina. There are several larger portions of practically normal fundus around the disk. Near the macular region, there are two very white, circular spots where there has been complete atrophy of retinal and choroidal tissues. Over the rest of the background, there are large yellow areas of atrophy, and accumulated pigment masses. The condition at present is quiescent.

The fundus of the left eye is similar, but the lesions are more extensive.

NOTE: The character of the fundus lesions suggests a luetic origin — in spite of the negative Wassermann.

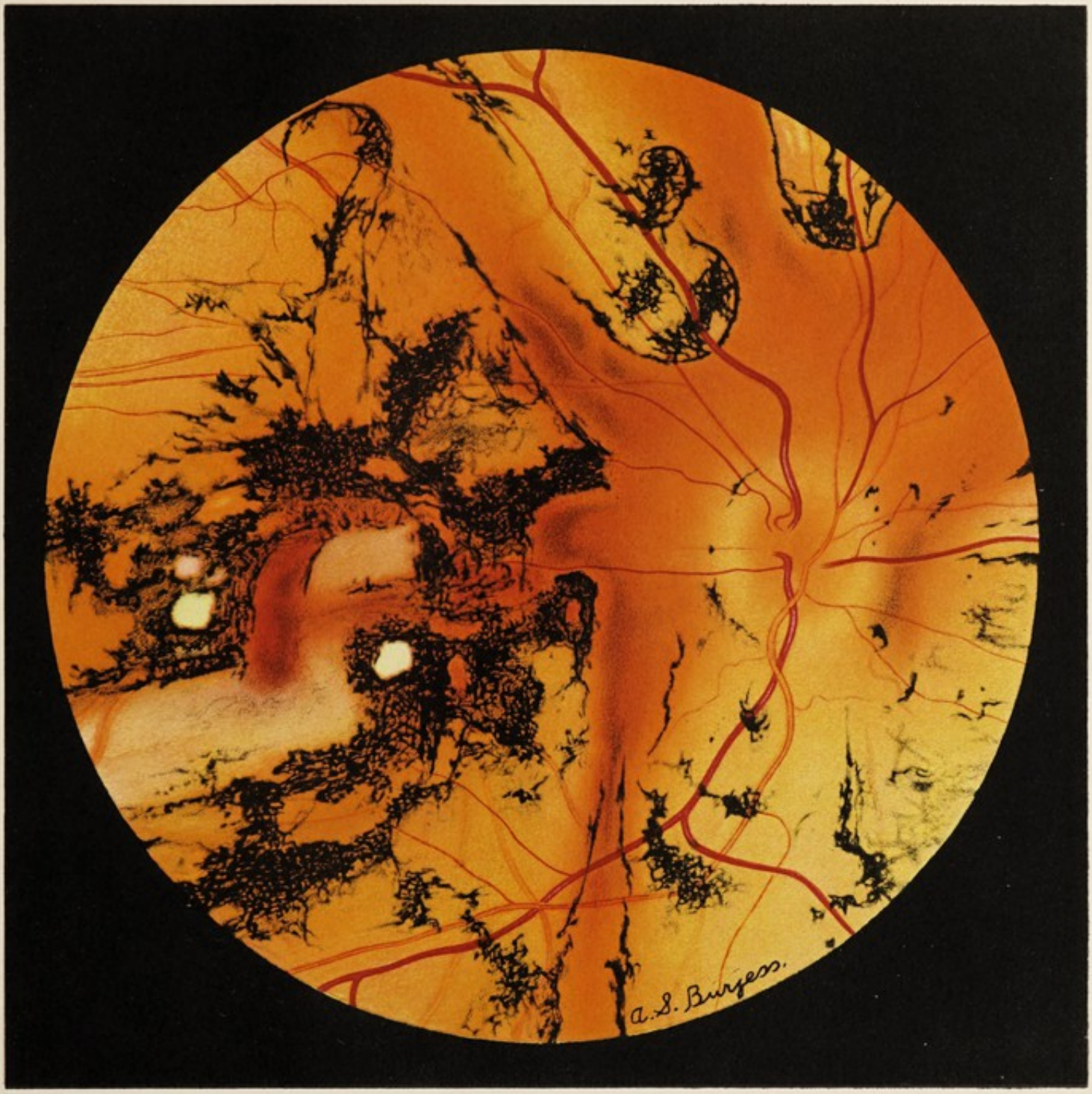
A. S. Burgess.

PLATE 55

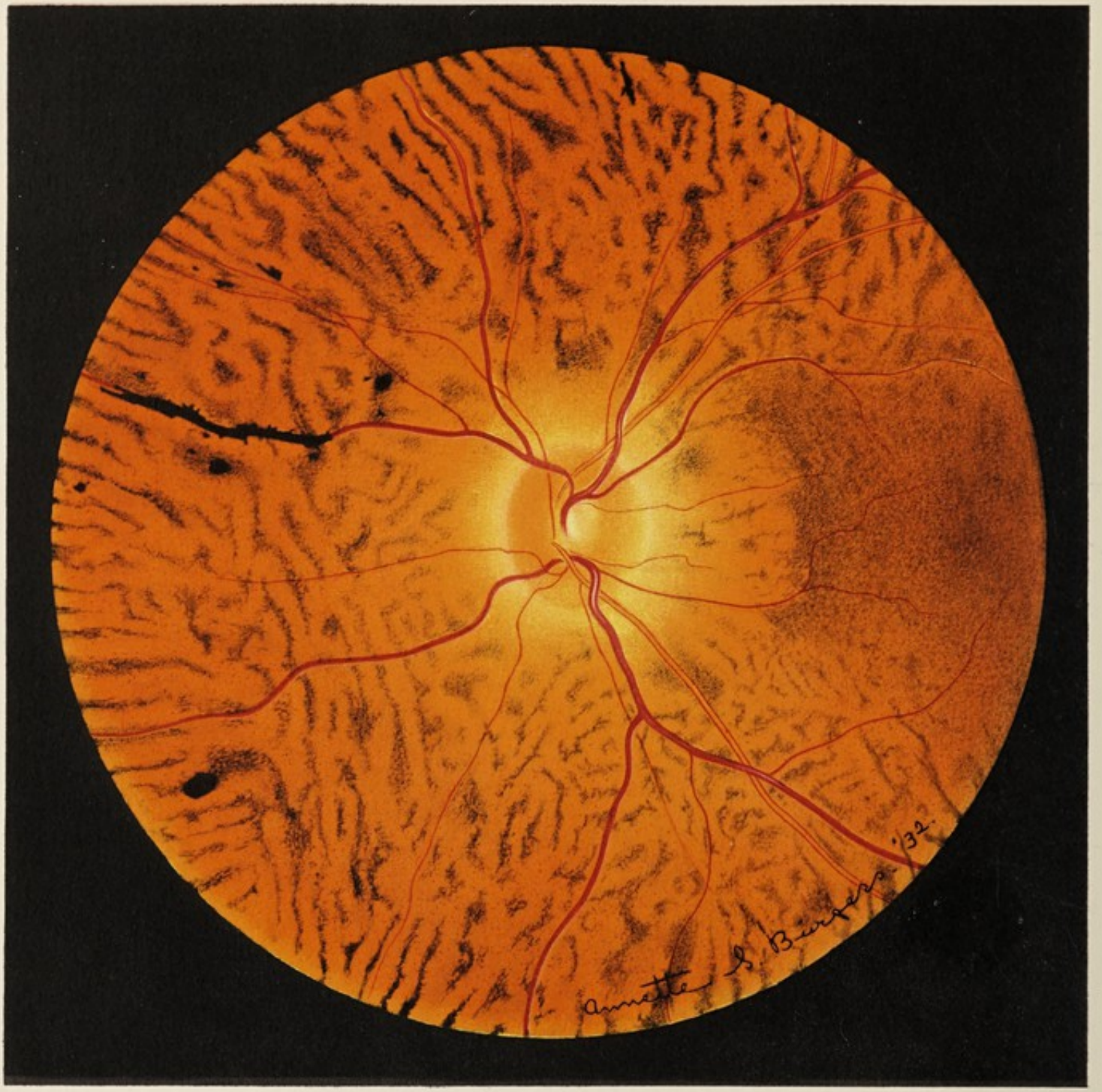

PLATE 55

Choroidoretinitis, Diffuse (Luetic), left eye of a brunette man 48 years old. Unit No. 39,612.

Family History. — Father died from Bright's disease; mother died at 75 from cancer; two brothers, from arteriosclerosis, and a third brother from "dropsy of heart"; two sisters from "kidney trouble." Four members of the same generation are still living and well. *Past History.* — Typhoid at 15; genital chancre at 18, treated locally. Married twice. Five healthy children. Neither wife had a miscarriage. *Present Illness.* — For the last seven or eight years there has been an increasing night blindness with diminution of vision and sensitiveness of the eyes to light.

Physical Examination. — Medical: generalized adenopathy; definite venous engorgement; slight precordial bulge; moderate enlargement of both heart and aorta; accentuated A^2 and P^2; edema of both ankles. Blood pressure 155/110. Nose and throat: enlarged tonsils. Dental caries. *Laboratory Reports.* — Blood Wassermann, positive. Urine, negative. X-ray: lungs clear; scoliosis. Spinal fluid: Wassermann positive; colloidal mastic test shows typical luetic curve.

Clinical Diagnosis. — Cardiac hypertrophy; slight decompensation; aortitis; syphilis of central nervous system; beginning general paralysis.

Eye Examination. — Externally, the pupils are widely dilated and inactive. Corneal sensitivity, reduced. L. E. V. = 6/15. Visual Field: contracted concentrically; a large indentation in lower field reaching to within 10° of point of fixation. Colour sense: recognition of primary colours. *Ophthalmoscopic Examination.* — Media, clear. Disk, light orange in colour; the surface, slightly cupped; margins, blurred. The scleral ring appears as a broad, ill-defined halo. The arteries are reduced in size, and their light-streaks are very marked. The inferior branch of the upper nasal vein is covered by a line of black pigment, similar to an ink mark. Scattered over the nasal side of the fundus there are a few dense masses of pigment. There is a general atrophy of choroid and retina. This atrophy is very marked about the disk, particularly on the temporal side. The whole background suggests the marking of a zebra.

There is a similar condition in the right eye.

PLATE 56

Retinal Arteriosclerosis,* right eye of man 52 years old. (Plate 26, *Jan. 1932*, illustrates this fundus after the development of glaucoma).

Family History. — Negative. *Past History.* — Seen first *Jan. 1919.* Previous to this time, there had been a nervous breakdown, with left facial paralysis, and weakness of the right hand. Vision of the right eye = 6/12; left eye = 6/9. Visual fields and intraocular tension, normal. *Present Illness.* — *Oct. 1931.* Two or three months before the present examination, the patient suffered from a "stroke" which was followed by paralysis of the upper right extremities. The vision of the right eye became markedly impaired, and that of the left eye, slightly impaired.

Physical Examination. — Medical: beginning arteriosclerosis with hypertension. Blood pressure, 190/80. *Laboratory Reports.* — Negative.

Eye Examination. — Externally, both eyes are normal, except for dilated pupils. R. E. V. = hand movement; L. E. V. = 6/9. Visual Fields: right eye, confined to small area in upper temporal quadrant; left eye, normal. *Ophthalmoscopic Examination.* — Right eye. Media, slight opacity of lens. Disk is a trifle pale and the nasal margin is blurred. On the temporal margin, there is a marked scleral ring surrounded by a thin ring of pigment. The arteries are solid-looking. Their conformation is irregular; and the light-streaks are increased in width. In the macular branches of the superior and inferior temporal arteries, there is segmentation of the blood column, with definite arterial pulsation. The veins are slightly enlarged, irregular in calibre, and compressed where crossed by the arteries. There is a small retinal hemorrhage in the macular region.

*Courtesy of Dr. C. A. Clapp.

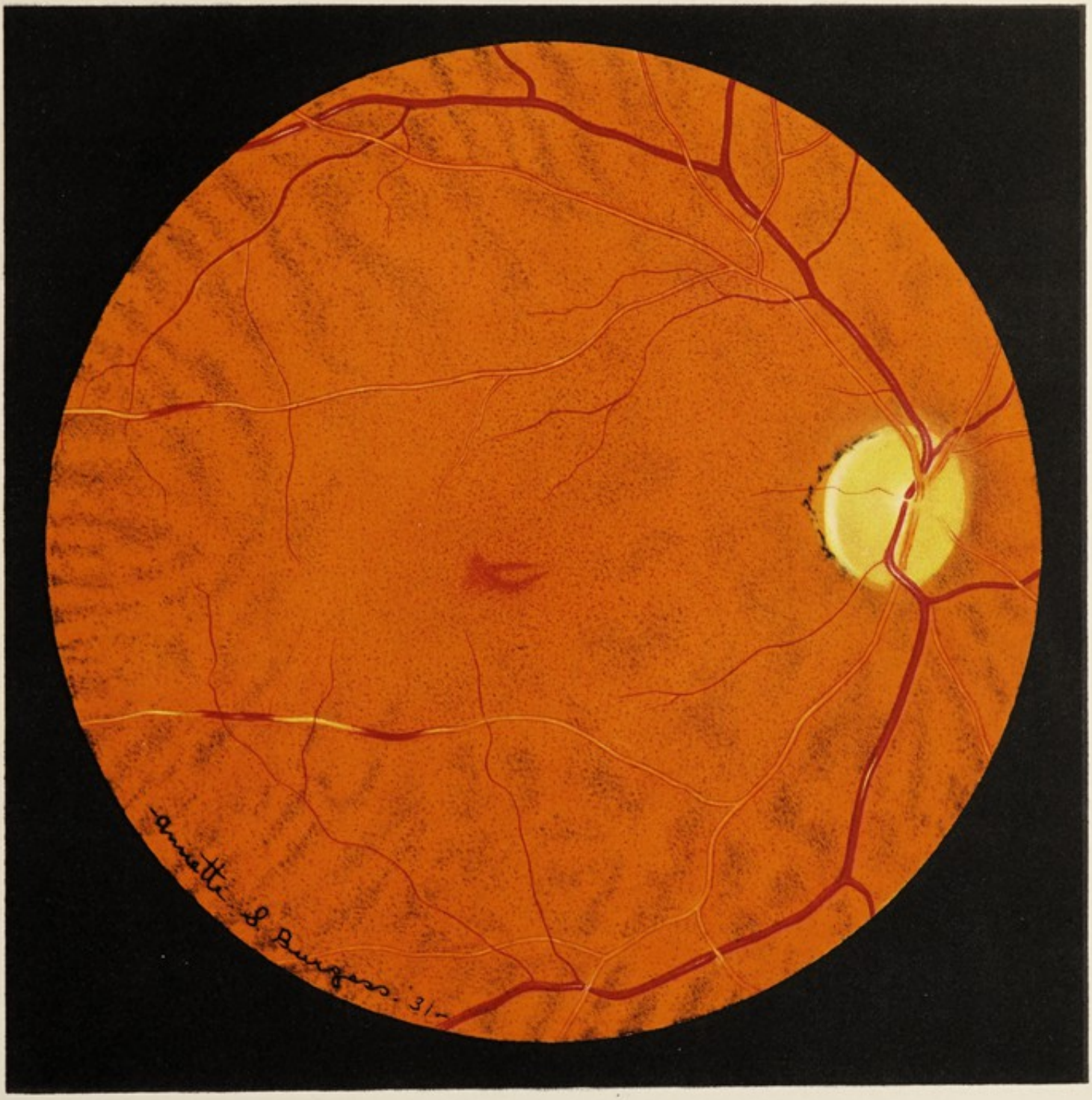

PLATE 57

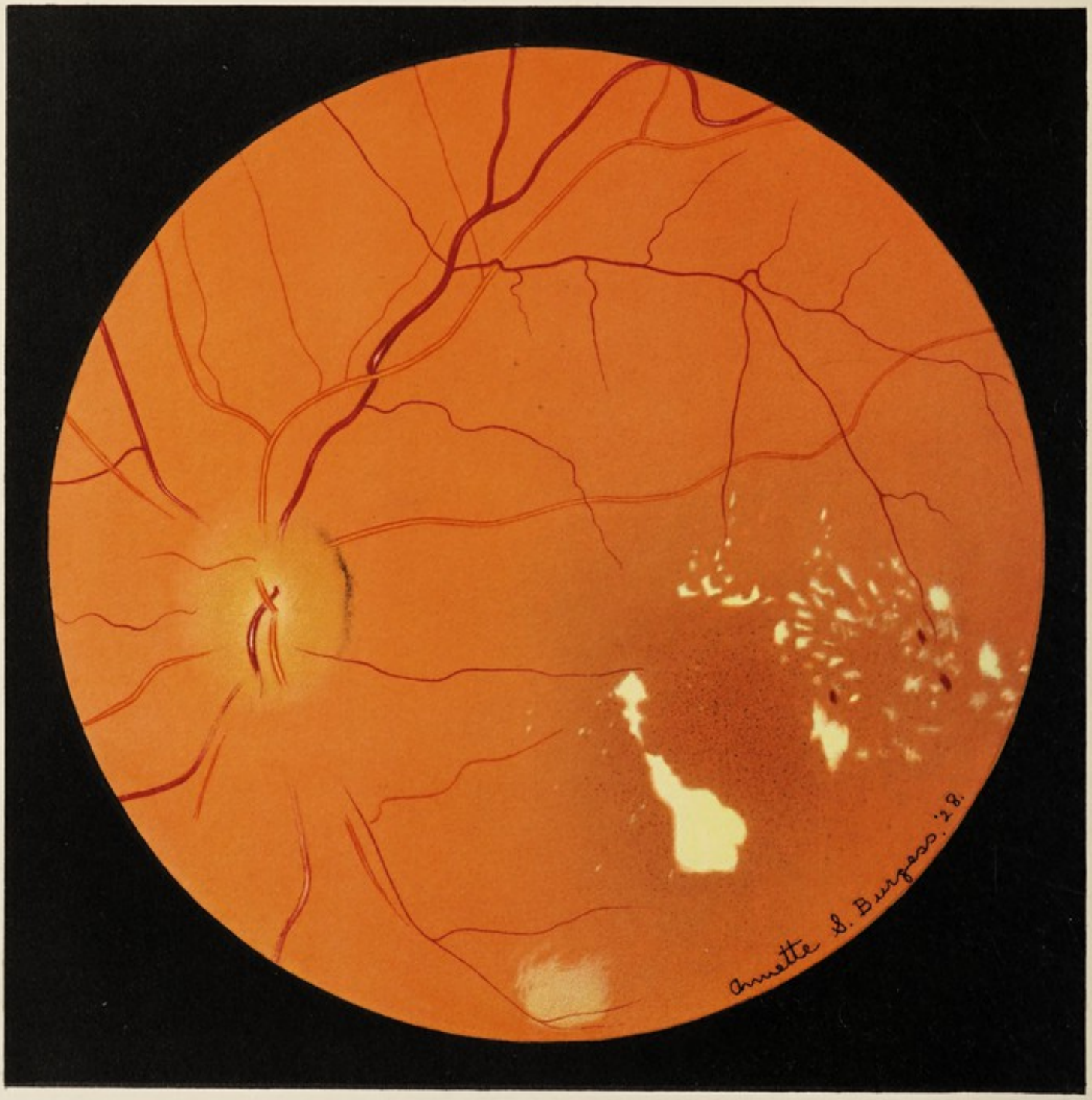

PLATE 57

Retinal Arteriosclerosis, left eye of a blond woman 54 years old. Unit No. 15,831.

Family History. — Father (blind) died of locomotor ataxia at 63; mother, of cancer of liver at 74. Of patient's generation, three died in infancy; four living, one of whom has arthritis, and one has goitre. *Past History.* — Headaches and vomiting. *Present Illness.* — For a year previous to admission, cloudy vision; flashes of light before eyes.

Physical Examination. — Medical: heart enlarged. Blood pressure, 190/130. *Laboratory Reports.* — Blood. — N. P. N., 45 mgm.%; sugar, 115 mgm.%; CO_2 combining power, 50 vol.%. Cytology, normal. Wassermann, negative. Urine: albumin, slight trace; many white blood and epithelial cells; hyaline and granular casts. Phthalein excretion, 45% in 2 hours.

Clinical Diagnosis. — Essential hypertension with arteriosclerosis.

Eye Examination. — Externally, both eyes normal. R. E. V. = 6/9; L. E. V. = 3/60. *Ophthalmoscopic Examination.* — Left eye. Media, vitreous opacities. Disk, surface hazy and slightly hyperemic; margins, blurred except on the temporal side. Above, below, and on the temporal side of the disk, the retinal vessels are entirely obscured by edema. Retinal arteries, attenuated; irregular in conformation; light-streaks, increased. The veins are irregular in calibre, and markedly compressed by superimposed arteries. Where a superior temporal artery crosses its vein at right angles, the distal portion of the vein is dilated, and its light-streak is increased at that point. A trifle farther towards the periphery, a small branch of the vein crosses the same artery, and bends over it as over a solid rod.

Around the macular region, there are many irregular, pale, waxy-looking retinal exudates. Several of these exudations are as sharply-defined and as solid-looking as though they were pieces of pale yellow cardboard pasted upon the red background. There are also some small, reddish white spots that are undergoing absorption. In the lower part of the fundus, there is a thinner spot of exudation. To the temporal side of the macular region, there are three, small, deep-seated hemorrhages.

In the right eye, there is a marked arteriosclerosis; but there are no white plaques and no hemorrhages.

PLATE 58

Retinal Arteriolosclerosis and Arteriosclerosis, (" Albuminuric," " Renal "), right eye of a negro man 30 years old. Unit No. 27,490.

Family History. — Negative. *Past History.* — Pneumonia when 21. Frequent bleeding from nose and gums. Several gonorrhoeal infections. Primary syphilitic lesion when 29 years old. *Present Illness.* — Headache for the past year. No complaint of eyes.

Physical Examination. — Medical: blood pressure increased from 210/158 to 240/160. Nose and sinuses, negative. Chronic tonsillitis. *Laboratory Reports.* — Blood. — N. P. N. rose from 38 mgm.% to 60 mgm.%; uric acid, 3.6 mgm.%; creatinin, 1.8 mgm.%; Hgb., 78%. R. B. C., 5,900,000; W. B. C., 10,900. Wassermann, positive. Urine: albumin; casts; white blood cells; culture showed no growth. Phthalein excretion decreased from 57% to 35%. X-ray: lungs, clear; heart, enlarged; aorta, dilated.

Clinical Diagnosis. — Latent syphilis; arteriolosclerosis; hypertension; cardiac hypertrophy; arteriosclerotic nephritis progressing rapidly to death in uremia.

Eye Examination. — Externally, both eyes normal. Central and peripheral vision, normal. Blind spots, normal. *Ophthalmoscopic Examination.* — Right eye. Media, clear. Disk, very hyperemic; margins well-defined; newly-formed vessels on its surface. Surrounding the disk, there are the usual retinal reflections of the dark-skinned races, which add much to the dramatic effect of the pathologic changes. Retinal arteries on the disk are paler than the disk itself; they are solid-looking with pronounced light-streaks. The arteries exhibit all stages of sclerosis, progressing from " copper-wire"* and "silver-wire" to complete "chalk-line" obliteration. The last stage is well seen in the small temporal vessels. The veins are full, irregular, and of a dark claret colour. One disk-diameter from the nasal margin of the disk, there is a small vein which runs downward, and ends in a series of coils. Scattered around the disk there are numerous white clean-cut retinal exudates of varying sizes. The macular region and extreme periphery are normal. This fundus picture is more characteristic of an arteriosclerosis than of an "albuminuric" or of a "renal retinitis."

The fundus of the left eye is similar, with the addition of a few fine hemorrhages. This plate was painted 4-1/2 months before the patient's death.

* Some authorities decry the use of "copper-wire," "silver-wire," etc. But these terms seem to serve the purpose of fixing the ophthalmoscopic picture in the minds of undergraduate students of medicine.

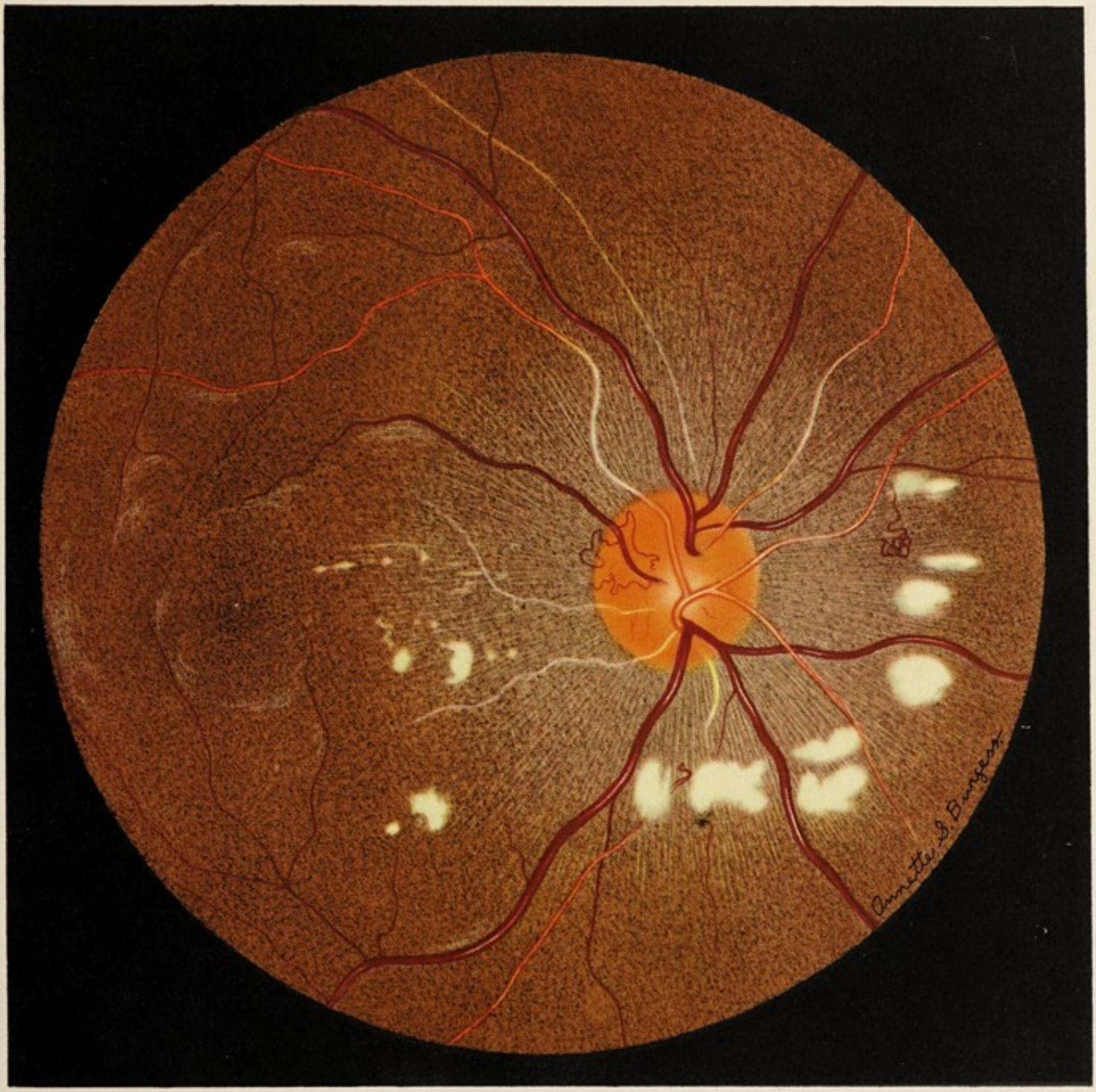
Annette B. Burgess

PLATE 59

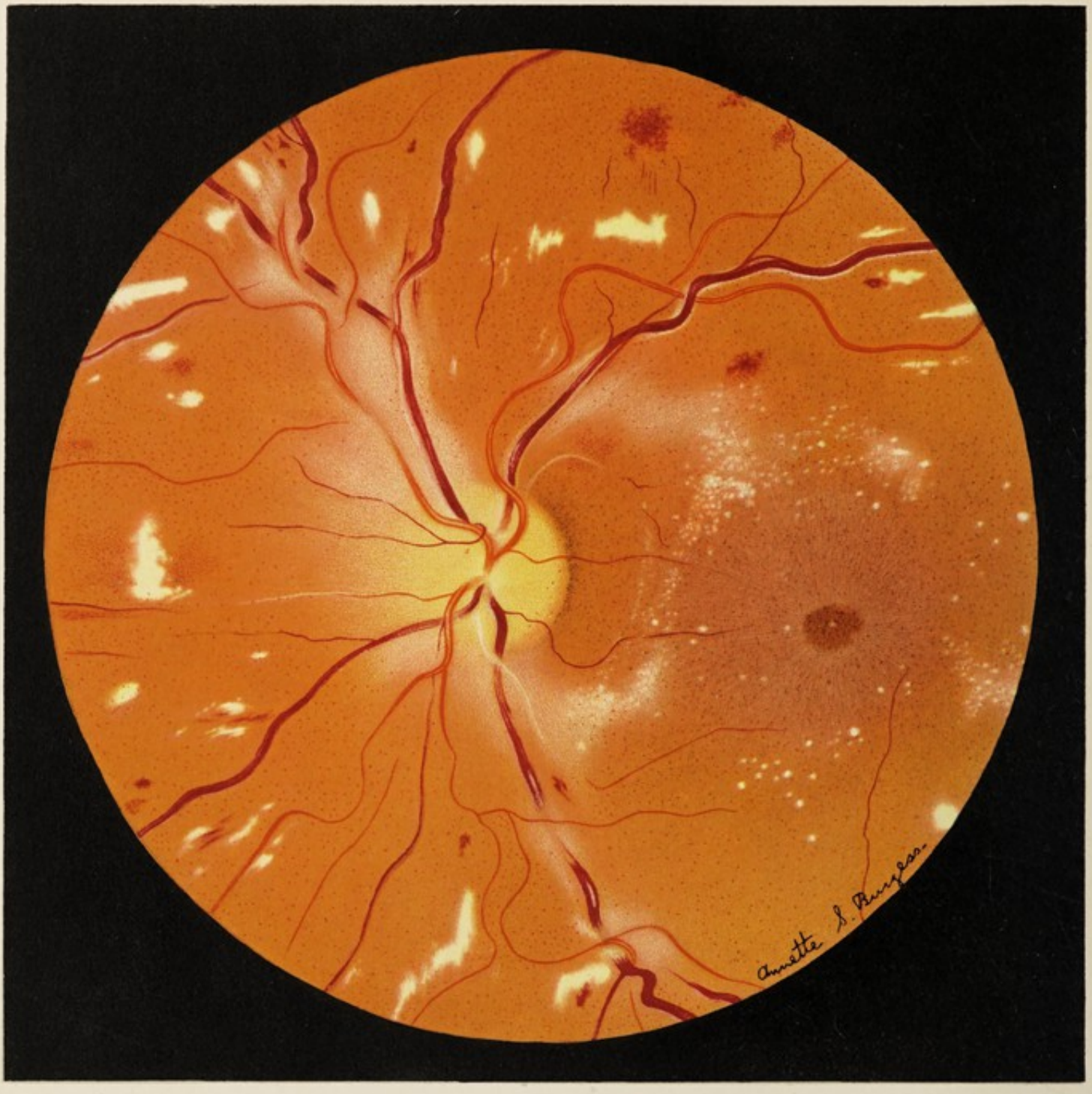

PLATE 59

Retinal Arteriolosclerosis and Arteriosclerosis (**"Albuminuric," " Renal "**), left eye of a 36 year old blond man. (Plate 60 shows fundus condition 5-1/2 months later). Unit No. 3,078.

Family History. — Negative. *Past History.* — Pain in right kidney region and chest; headaches; dizziness; discharge from right ear two weeks prior to admission. *Present Illness.* — Progressive failure of sight for the past five months.

Physical Examination. — Medical: under weight; cardiac arythmia; palpable radials; induration of right vas deferens and both seminal vesicles. Blood pressure, 240/142. Acute maxillary sinusitis, due to beta hemolytic streptococci. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Wassermann, negative. Urine: smoky red colour; blood clots; sp. gr., 1010; sugar, negative; albumin, small amount; granular casts. Phthalein excretion, 50% in 2 hours. Mosenthal test, variation of sp. gr. 1010 to 1020.

Clinical Diagnosis. — Hypertension; progressive anemia; gradual renal failure.

Eye Examination. — Externally, both eyes are normal. Patient too ill for functional tests. *Ophthalmoscopic Examination.* — Left eye. Media, clear. Disk, pale and yellowish red; margins, much blurred except on temporal side. The retinal arteries are solid-looking, tortuous, irregular in calibre, and in various stages of sclerosis. The veins are engorged, irregularly dilated, and markedly compressed by superimposed arteries. The superior temporal vein is bordered by white lines. Light-streaks are increased on the arteries, and on the anterior arches of the veins. The relatively normal fovea with its reflex resembles the so-called "hole in the macula," owing to the surrounding retinal edema.

Scattered over the fundus, there are two kinds of exudates: one pale, yellowish white, solid-looking; the other (around macula), small, superficial, white, like "powdered snow." Radiating from the disk, in the manner of opaque nerve-fibres, there are areas of retinal edema stretching far into the periphery, and in spots obscuring the blood vessels. There are many small retinal hemorrhages in various stages of absorption.

There is a similar condition in the right eye.

PLATE 60

Retinal Arteriolosclerosis and Arteriosclerosis ("Albuminuric," "Renal"), left eye of a 36 year old blond man. (Plate 59 shows fundus condition 5-1/2 months earlier). Unit No. 3,078.

Interval History. — Brief improvement after drainage of sinuses; further loss of weight; continuation of hypertension; progression of anemia; and advancement of renal failure.

Physical Examination. — Blood pressure remains high, 252/170. Urine: much albumin (5–8 grams per litre); gross hematuria; occasional casts. Phthalein excretion, 45% in 2 hours.

Ophthalmoscopic Examination. — Disk, whiter than in Plate 59; margins, well-defined; on surface, many newly-formed blood vessels. The retinal arteriosclerosis has advanced. Arteries are smaller; many branches, patent 5-1/2 months ago, are now entirely obliterated. In the superior temporal artery, the lumen is entirely closed, both at its beginning and at its termination. There are similar changes in the other arterial branches. In places, light-streaks are increased. In general, the veins are smaller and straighter. The superior temporal, and the temporal branch of the superior nasal vein (formerly beaded) are now somewhat reduced in calibre, and run through white lines. Arteriovenous compression is now very marked.

The macular region is free from edema. There is a white plaque in the fovea. The fine pigment granules in the central area are more marked than in Plate 59. Surrounding this region, there are many small, well-defined, white spots. All of the "powdered snow" exudates have disappeared; and only three larger, solid-looking plaques (above the disk) remain. This suggests that the remaining exudates are composed largely of lipoid material. The retinal edema has entirely disappeared except small areas along the superior nasal, and the inferior temporal, veins. Only a few hemorrhages remain. These two illustrations suggest a primary arteriosclerosis with increasing renal involvement (cardiovascular-renal disease).

NOTE: Six weeks after this illustration was made, glaucoma ensued; later, temperature reached 107° F, and the patient died in uremic coma. Autopsy: generalized arteriosclerosis; slight arteriolosclerotic nephritis; pyelitis; cerebral arteriolosclerosis. Histological study of eyes: retinal and choroidal arteriolosclerosis; hyalin degeneration of middle coat; thrombosis of branch of central retinal artery, with recanalization; atrophy of corresponding portion of retina; subsiding "albuminuric retinitis"; cystic degeneration of macula.

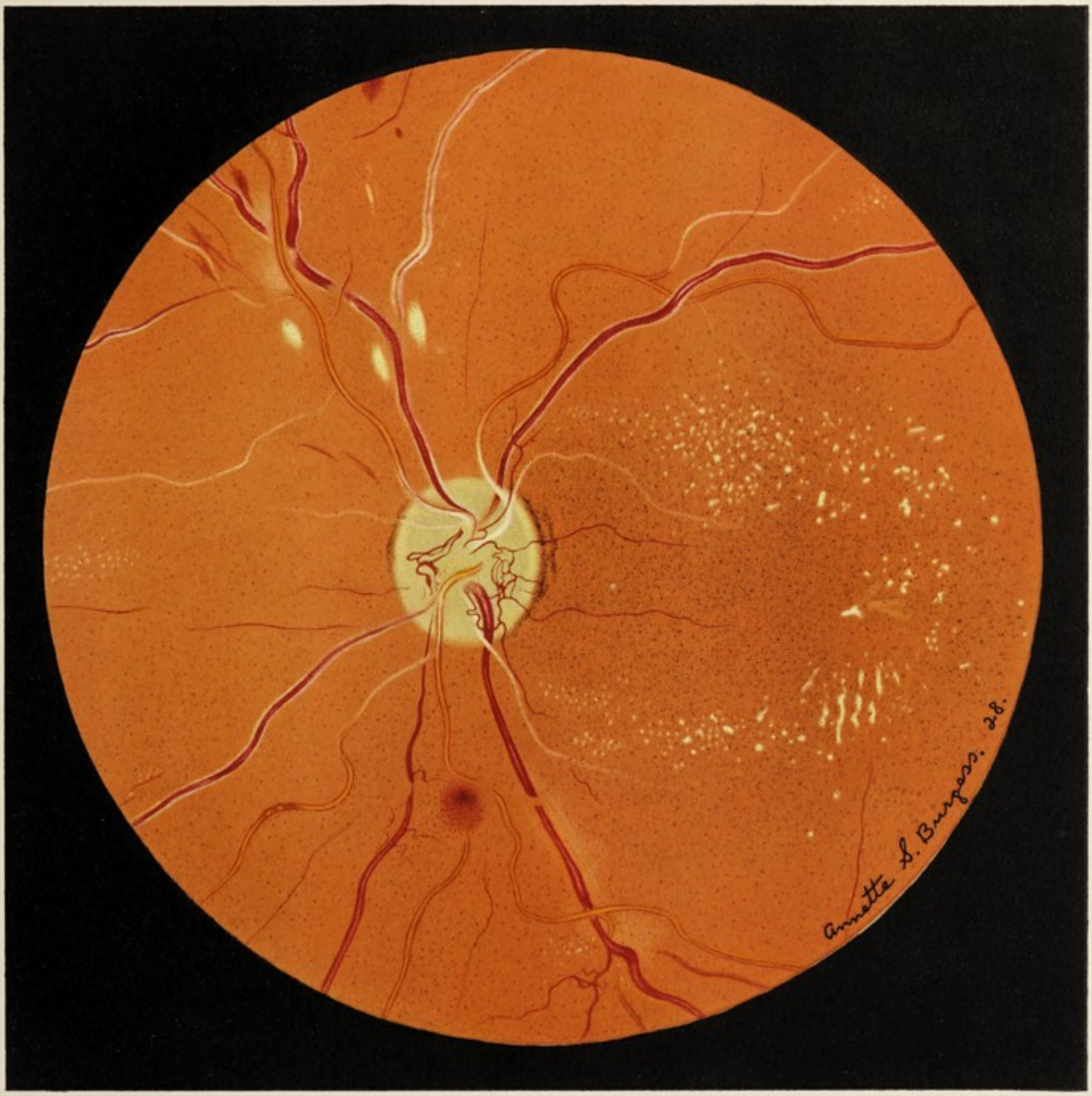
Annette L. Burgess. 28.

PLATE 61

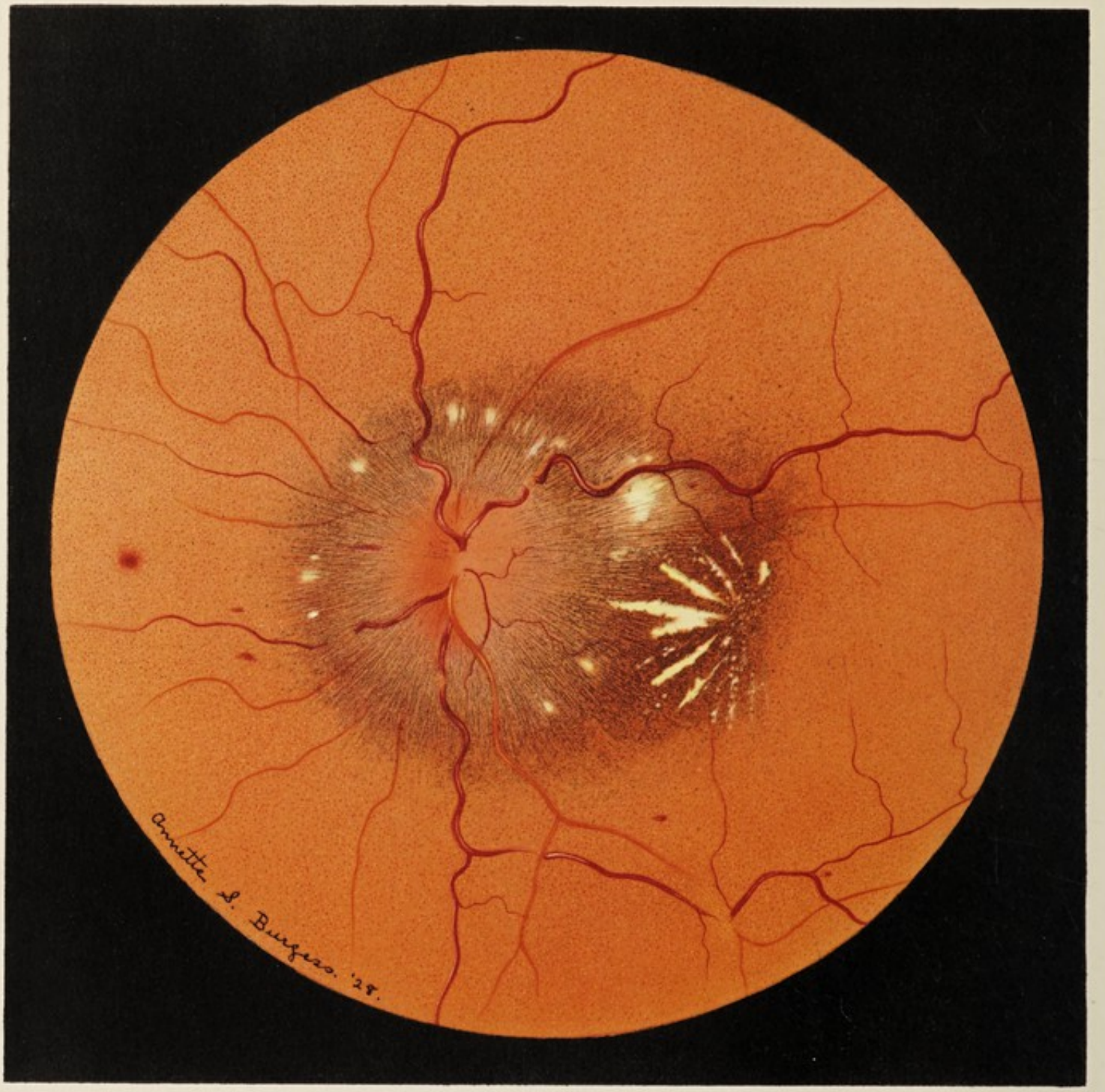

PLATE 61

Papilloretinal Arteriolosclerosis and Arteriosclerosis ("Albuminuric," "Renal"), left eye of a blond woman 46 years old. Unit No. 18,550.

Family History. — Negative. *Past History.* — For the past five years, shortness of breath; palpitation of heart; swelling of abdomen and feet; headaches; pains in back. *Present Illness.* — For one year previous to examination, impaired vision, and puffiness of lower eyelids.

Physical Examination. — Medical: heart and aorta, enlarged; signs of myocardial insufficiency. Blood pressure, 300/190. *Laboratory Reports.* — Blood. — Normal, except slight increase in N. P. N., 45 mgm.%. Wassermann, negative. Urine: clear, straw colour; sp. gr., 1,005; sugar, bile and diacetic acid, negative; albumin, ++; hyaline and granular casts; few red and white blood cells. Phthalein excretion, 45% in 2 hours. Spinal fluid: Wassermann, negative; pressure, 290 mm. H_2O.

Clinical Diagnosis. — Arteriolosclerosis; hypertension; myocardial insufficiency; chronic nephritis.

Eye Examination. — Externally, both eyes normal. L. E. V. with correction = 6/12. Visual Field: peripheral outlines, normal. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Media, clear. Disk, reddish in colour; slightly elevated; margins, obscured; cup, partially obliterated; capillaries, dilated. The edema of the disk radiates for a short distance into the surrounding retina. In appearance, it suggests the corona of a solar eclipse. In the zone surrounding the disk, there are numbers of yellowish white "cotton-wool" exudates of varying sizes. Arteries are slightly tortuous, reduced in calibre, and solid-looking. Veins are irregular in calibre, reduced in size, very tortuous, and markedly compressed by overlying arteries. In the macular branch of the inferior temporal vein, the deflection is centrifugal, and the distal portions of the vein are dilated. To the nasal side of the macular region, yellowish white radiating exudates form an imperfect star-figure. In addition, there are minute white "snowflake-like" exudations, some of which occupy the macular region proper. Scattered granules of pigment make a stippled brownish background for the white infiltrates and the retinal edema. The fundus surrounding this area has a peppered appearance. A few small, scattered, retinal hemorrhages are visible. The peripheral fundus is normal except for the vascular changes.

There is a similar condition in the right eye.

PLATE 62

Papilloretinal Arteriolosclerosis and Arteriosclerosis ("Albuminuric," "Renal"), right eye of a blond man 32 years old. Unit No. 23,557.

Family History. — Negative. *Past History.* — During the year prior to admission, there have been frequent urination, weakness, shortness of breath, diarrhoea, vomiting, jaundice. *Present Illness.* — Vision has been failing for past three months.

Physical Examination. — Medical: dyspnea; edema of legs; enlargement of liver and heart. Blood pressure, 190/130. Infected teeth and tonsils have been removed. Cultures from throat, negative. *Laboratory Reports.* — Blood. — N. P. N., 87 mgm.%; CO_2 combining power, 23.0 vol.%. R. B. C., 3,270,000; W. B. C., 12,240; Hgb., 50%. Wassermann, negative. Urine: albumin, ++++; many red blood cells; white blood cells; casts. Phthalein excretion, trace in 2 hours. X-ray: heart, enlarged; area of partial consolidation in each lung; sinuses, clear.

Clinical Diagnosis. — Arteriolosclerosis; hypertension; myocardial insufficiency; uremia.

Eye Examination. — Patient too ill for functional tests. *Ophthalmoscopic Examination.* — Right eye. Media, clear. Disk is uniformly red in colour except for the cup, which is a trifle paler. There is practically no elevation. The margins are blurred by a feathery zone of edema about 1/4 disk-diameter in width and slightly elevated — in contour like a "life preserver." Numerous small, white exudates of varying sizes powder the surrounding area — like the Milky Way on a clear night. Retinal arteries are thickened and solid-looking. On the disk, and in portions of the retina, the arteries run through a sheath of white lines which are well shown where a branch of the superior temporal artery compresses its vein. The lines suggest infiltration in the vessel sheaths and thickening of the adventitia, or a sclerosis of the perivascularis — as described by Pines.[38] On the disk, the lumen of the superior nasal branch is closed, but becomes patent farther on. Veins are irregular, slightly compressed; distal enlargement, not marked. The arteriovenous crossings are oblique without deflection. Branch of inferior nasal vein accompanied by white lines. In the macula there are numerous, small, white spots. Between the macula and the disk, long, white radiating lines and small, white exudations form a fan-like figure. There is increased pigmentation around the macular region. A few hemorrhages around the disk are somewhat veiled by the retinal edema. There is a similar condition in the left eye.

Note: While in hospital, patient's condition grew worse. Blood pressure increased to 210/130; blood N. P. N. rose to 137 mgm.%.

[38] Pines, N. — Vide No. 9.

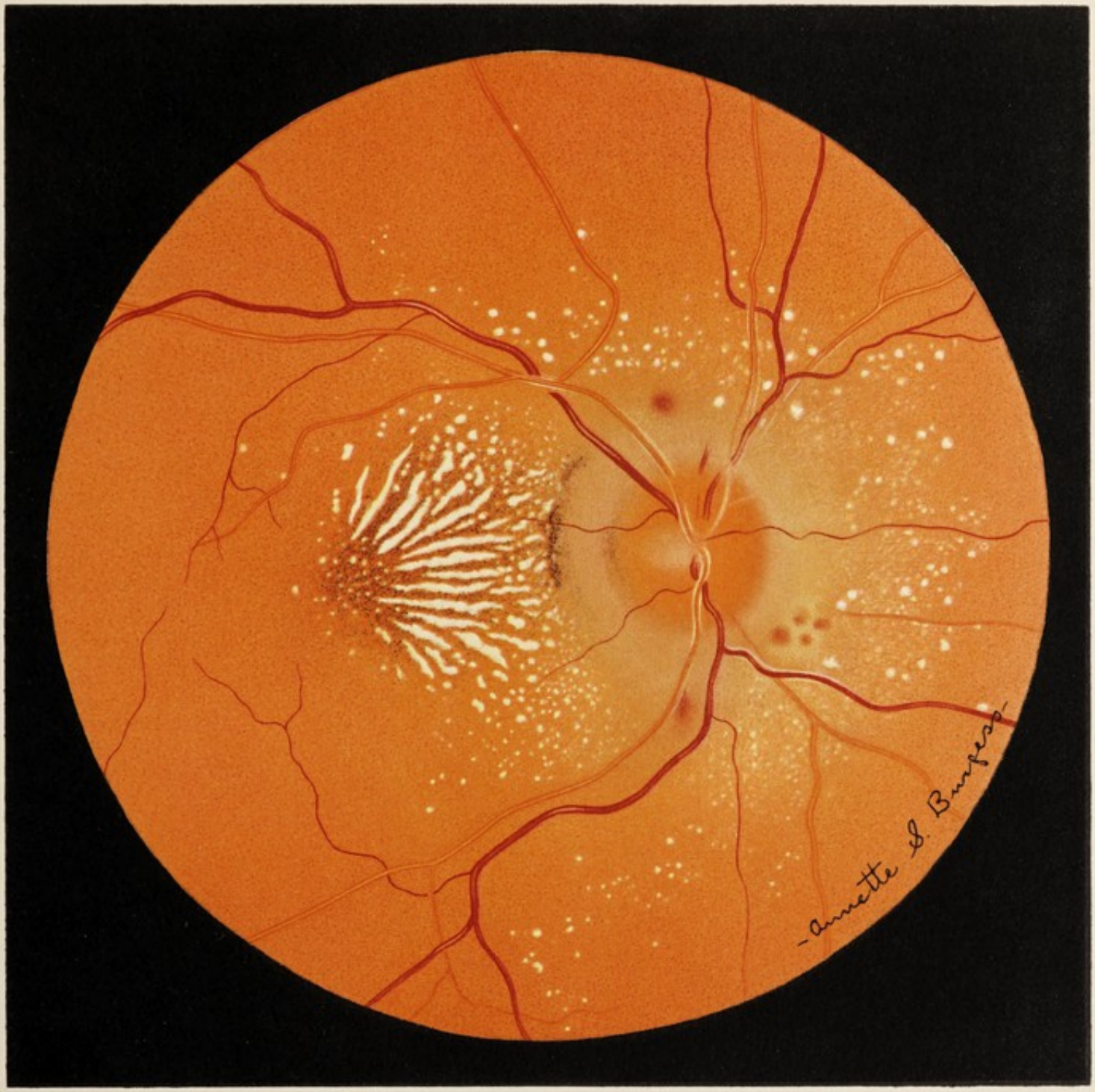
Annette L. Burpee

PLATE 63

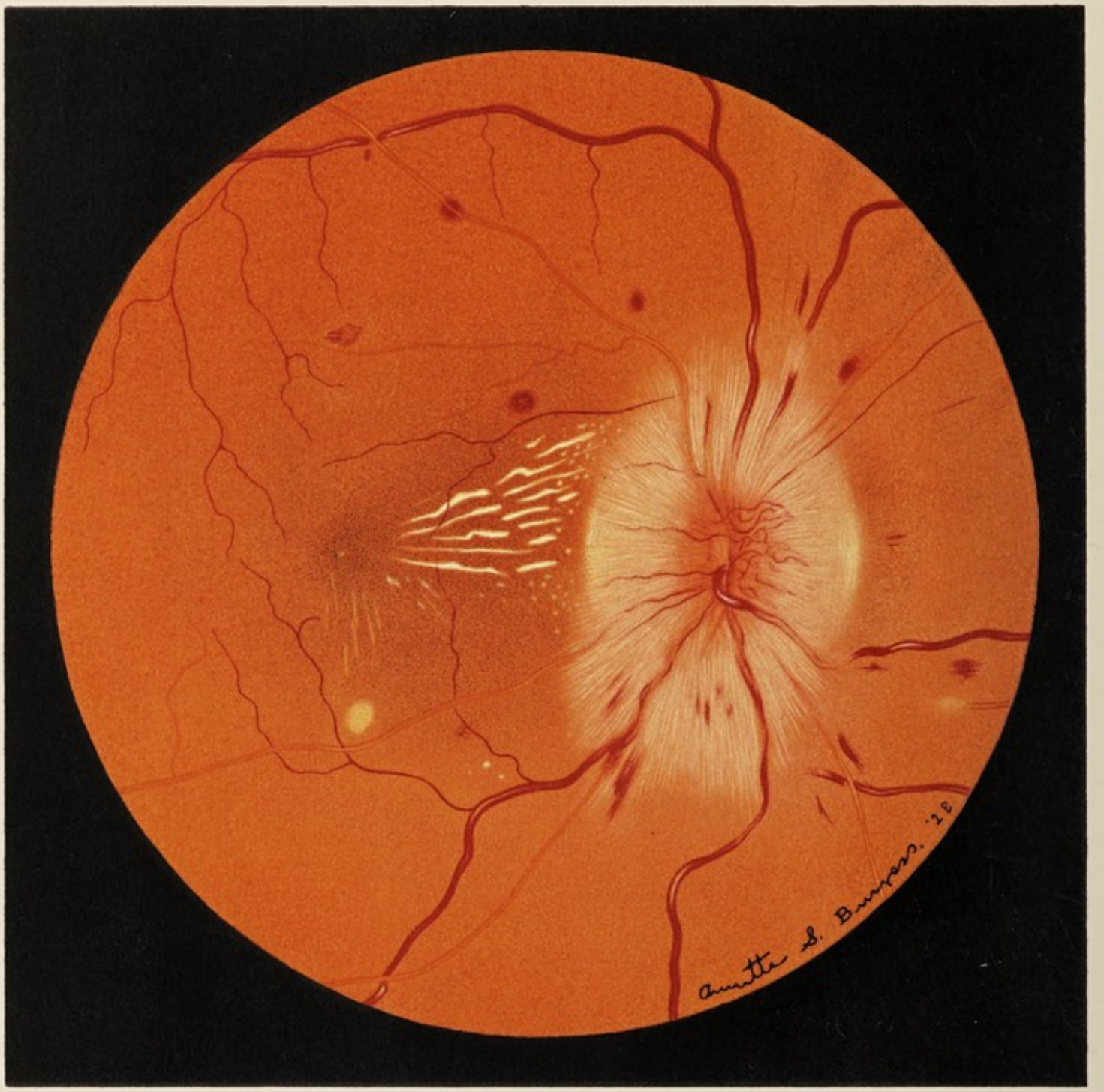

PLATE 63

Papilledema in Papilloretinal Arteriolosclerosis ("Albuminuric," "Renal"), right eye of a 35 year old blond woman. Unit No. 21,347.

Family History. — Negative. *Past History.* — For nine months, has had severe headache and precordial pains. *Present Illness.* — Just before admission, developed diplopia and dimness of vision.

Physical Examination. — Medical: heart, enlarged. Blood pressure, 220/145. *Laboratory Reports.* — Blood: Normal, except N. P. N., 48 mgm.%; CO_2 combining power, 50 vol.%. Wassermann, negative. Urine: albumin, 2–6.5 gm. per litre; hyaline and granular casts; Mosenthal test, sp. gr. fixed. Phthalein excretion, 10% in 2 hours. X-ray: heart and aorta, enlarged; changes at base of lungs secondary to heart condition. Spinal fluid: Wassermann, negative; pressure, 270 mm. H_2O; cells, 30 per cc.

Clinical Diagnosis. — Arteriolosclerosis; hypertension; cardiac hypertrophy; nephritis with advancing renal insufficiency.

Eye Examination. — Externally, both eyes normal. Intraocular tension, normal. Patient too ill for functional tests. *Ophthalmoscopic Examination.* — Right eye. Media, clear. Disk, elevated 3.0 D. on temporal side, and 5.0 D. on nasal side; margins, blurred by edema and yellowish white exudation, which is feathery above and below, but more solid-looking on nasal and temporal sides. Optic cup, distorted. There are many newly-formed blood vessels on the disk, where the arteries are scarcely visible, and the veins are blurred except one small loop of the upper branch of the inferior nasal vein. Arteries are solid-looking and attenuated. Veins are irregular in calibre, tortuous, compressed by superimposed arteries. Their light-streaks are marked on their anterior arches. Except the inferior temporal, the distal and proximal portions of compressed veins are distended equally. Fovea and its light-reflex, normal. Many pigment granules in central area. To temporal side of disk, numerous small, round, yellowish white spots. White lines radiate between macula and disk, and combine with five or six fainter yellowish streamers below the macula to form an incomplete star-figure. At the lower end of the streamers, there is a rather solid-looking yellowish white exudation. Three small similar spots lie just above the inferior temporal vein. Scattered over the fundus, there are numerous hemorrhages of varying sizes, shapes, and ages.

Apart from changes in the blood vessels, the peripheral retina is normal in appearance.

The condition in the left eye is similar, but more pronounced.

PLATE 64

Retinal Changes in Diabetes Mellitus (Mild), right eye of a man 47 years old. Unit No. H–62,791

Family History. — Negative. *Past History.* — For six years, has been a patient in the Metabolic Division of the Medical Clinic. *Present Illness.* — There had been no complaint about eyes, and the lesions were found during routine examination.

Physical Examination. — Medical, obesity. Blood pressure, 140/95. Nose and throat, negative. Several infected teeth have been removed. *Laboratory Reports.* — Blood. — Chemistry, normal, except sugar which averaged 226 mgm.%. Cytology, normal. Urine: slight trace of albumin at times; sugar +++; trace of acetone. X-ray: sinuses and chest, negative.

Clinical Diagnosis. — Diabetes mellitus of moderate severity.

Eye Examination. — The left eye is normal in all respects. Externally, the right eye is normal. R. E. V. = 6/6. Visual field, normal. Slit lamp, normal. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Right eye. Media, clear. Disk, slightly hyperemic; margins, blurred, especially on the nasal side; physiological cup, insignificant. The arteries and veins are practically normal, and there is no arteriovenous compression. The fundus is normal with the exception of a small area to the upper, temporal side of the macular region, where there are a few exudations. These exudates are small, clean-cut, yellowish white, and fatty-looking.

NOTE: The patient was given diabetic diet, but there was no change in the eye lesions while he remained under observation. The left eye has remained normal.

In diabetes, the eye lesions do not usually increase when the proper treatment is instituted. But the reverse is true when the diabetes is neglected.

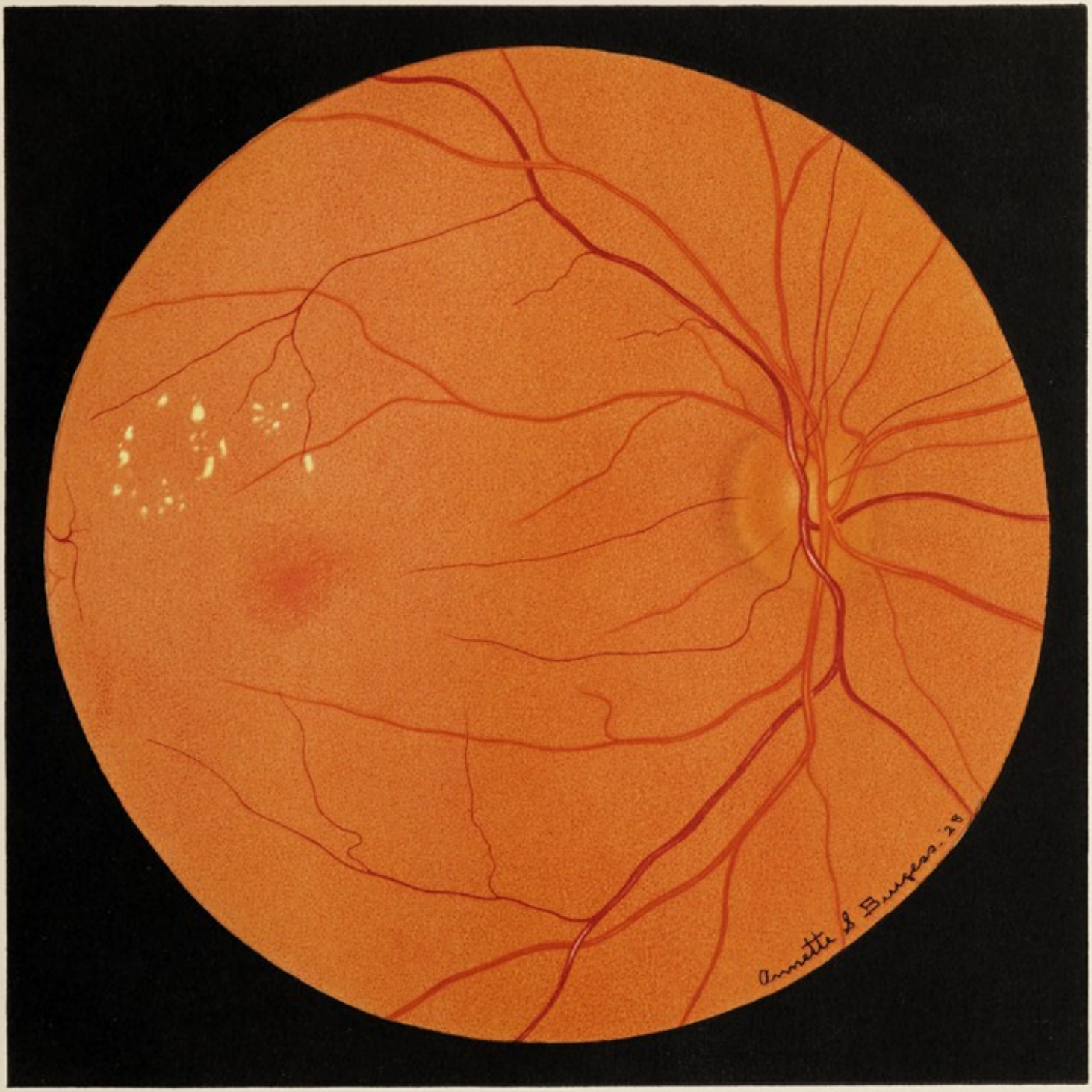
Annette L Burgess '38

PLATE 65

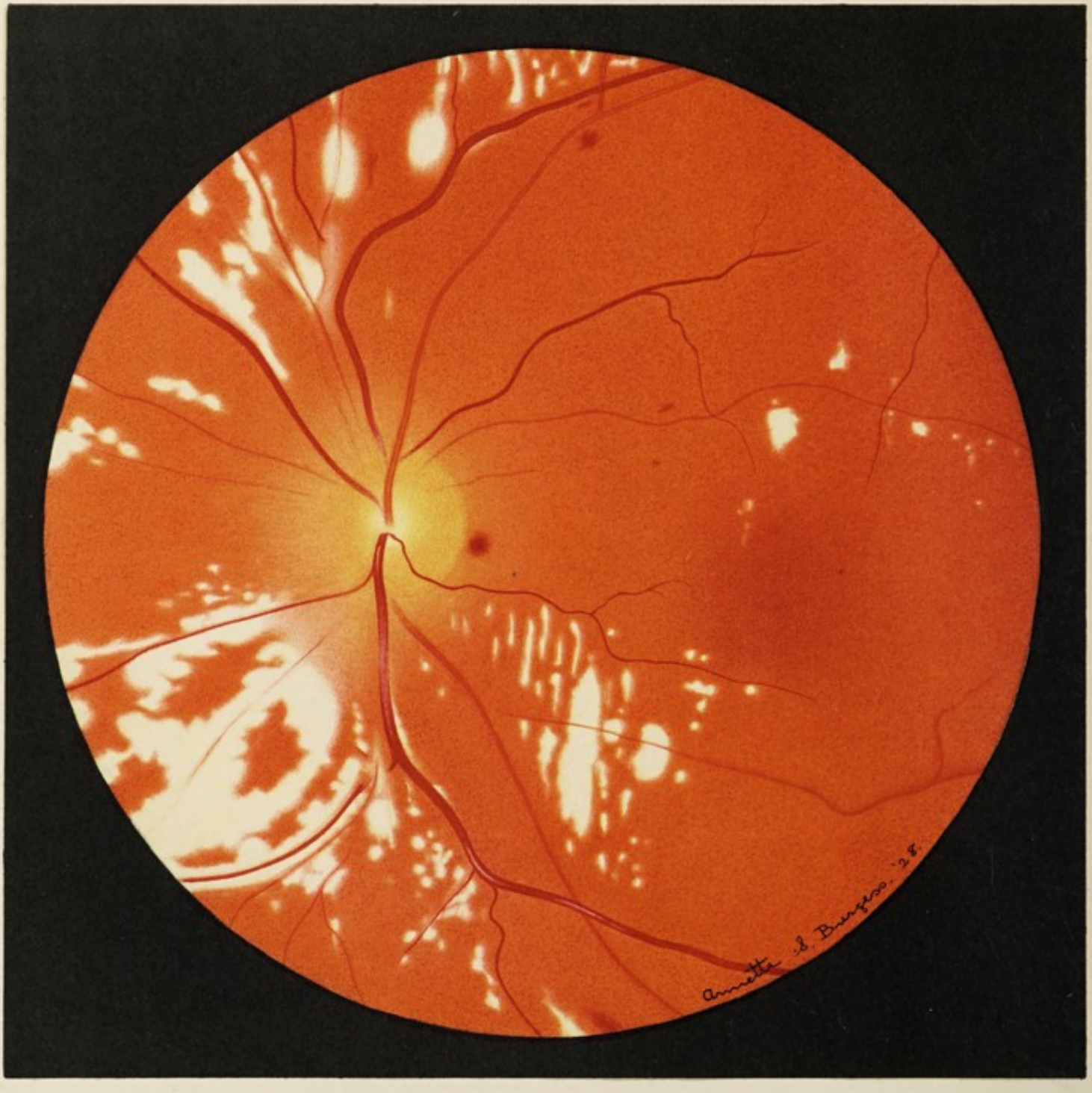

PLATE 65

Retinal Changes in Diabetes Mellitus (Severe),[39] left eye of a man 47 years old. Unit No. 17,479.

Family History. — Negative. *Past History.* — At 41 years of age, suffered from severe diabetes mellitus, with a blood sugar of 480 mgm.%. Under diet, the diabetes improved. Four years later, developed weakness, loss of appetite, jaundice, enlargement of liver. One year before admission, the diabetic symptoms had disappeared, but ascites ensued. Tapped six times. *Present Illness.* — Admitted to hospital with diagnosis of cirrhosis of liver. Omentopexy has been performed.

Physical Examination. — Medical: slight cardiac hypertrophy; edema of lower extremities; enlarged liver; prominent abdomen. Blood pressure, 140/78. Sugar tolerance test: no sugar appeared in urine; normal in blood. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Wassermann, negative. Urine: straw colour; acid; sp. gr., 1020; sugar, O; albumin, ++; occasional R. B. C.; a few W. B. C.; scattered hyaline, granular, and fatty casts. Phthalein excretion, 50% in 2 hours.

Clinical Diagnosis. — Diabetes mellitus; cirrhosis of liver; arteriolosclerosis with nephritis.

Eye Examination. — Externally, both eyes normal. L. E. V. = 6/20. Visual Field: slightly contracted. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Media, clear. Disk, blurred; yellowish red in colour; not elevated. The fine striate edema around the disk has the appearance of a ring around the moon on a misty night. Arteries, somewhat attenuated. Veins are slightly dilated; and some of the smaller twigs are lost in the exudations. Scattered over the fundus, there are many large, yellowish white plaques, and several faint, roundish hemorrhages. There is one hemorrhage at the temporal margin of the disk. Similar condition in right eye.

NOTE: In spite of the present low blood sugar and its absence in the urine, the plate is entitled "Retinal Changes in Diabetes Mellitus" because of the past history of diabetes, and the typical, solid, waxy appearance of the plaques. The edema of the disk may be associated with the later renal involvement.

[39] Bordley, James III. "Disappearance of Diabetes Mellitus During the Development of Cirrhosis of the Liver." Bull. Johns Hopkins Hospital. Vol. XLVII. p. 113. Aug. 1930.

PLATE 66

Thrombosis of Central Retinal Vein, left eye of a blond woman 52 years old. Unit No. 69, 160.

Family History. — Father died from nephritis at 75. Mother, 77, living and well. *Past History.* — At 6 years of age, chorea. For thirty years, varicose veins of both legs. For fifteen years, increased blood pressure. At 45 years of age, hysterectomy for cancer of uterus. Occasional nose bleed. *Present Illness.* — One week prior to admission, a black cloud appeared before the left eye.

Physical Examination. — Medical: 97 pounds overweight. Blood pressure, 224/126. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Wassermann, negative. Urine: albumin, slight trace.

Clinical Diagnosis. — Arteriosclerosis with hypertension.

Eye Examination. — Right eye, normal throughout. Externally, left eye, normal. L. E. V. = 2/60. Slit lamp and intraocular tension, normal. *Ophthalmoscopic Examination.* — Media, clear. Disk, edematous; slightly protruding; yellowish red; margins, indistinguishable. On the disk, the arteries are broad; indistinct, reddish yellow; light-streaks, faint. Veins are engorged, dark red, and arch strongly forward. There is a light-streak on the superior nasal vein.

In the periphery, the only two arterial branches clearly visible are slightly attenuated and solid-looking, but relatively normal in appearance. Veins are deep red, extremely tortuous, irregularly distended, with breaks in their continuity. Their anterior loops, with light-streaks, are plainly visible; their concave portions are lost in the extravasated blood and retinal edema. Hemorrhages, like dark red splashes, are scattered over the fundus, particularly around the disk. They are chiefly striated, but there are a few denser blood masses. The macula is indistinguishable. Above the disk, there is a yellowish white patch with soft edges and remains of blood in the centre. There are three smaller patches of the same colour below the disk; one has a red centre. These are probably the remains of old hemorrhages. There are two minute white flecks in the fundus: one above, and to the nasal side of the disk, and the other below, and to the temporal side of the macula.

NOTE: A year later, intraocular tension was still normal; the edema had disappeared, and the sites of the hemorrhages were occupied by white plaques.


- Annette L. Burgess - '30 -

PLATE 67

PLATE 67

Thrombosis of Central Retinal Vein,[40] right eye of a brunette woman 56 years old. Unit No. 40,905.

Family History. — Father died of pneumonia at 68; mother of tuberculosis at 26; brother from same cause at 30; three sisters, living and well. *Past History.* — At 54 years of age, suffered from severe headaches, followed later by pain in neck and lumbar region, and great irritability. Recently, pain in right shoulder and arm; bleeding from nose and gums. Symptoms in hands suggested Raynaud's syndrome. *Present Illness.* — Three months before admission, failure of vision in right eye; one month later, left eye similarly affected.

Physical Examination. — Medical: blood oozing from nose and gums; purpura; enlargement of spleen and liver; rarefaction of bones of spine and right shoulder. Blood pressure, 170/100. *Laboratory Reports.* — Blood. — Foreign protein isolated from plasma (nature not determined). R. B. C., 3,290,000; W. B. C., 3,500. Platelets, 146,000; Hgb., 63%; clotting time, 3 min.; bleeding time, 10 min. Wassermann, negative. Urine: albumin, occasional trace; no Bence-Jones bodies; many R. B. C. Stool, benzidene test, ++++. X-ray: multiple tumours of skull, scapula, humerus, and ilium. Spinal fluid, negative.

Clinical Diagnosis. — Hyperproteinemia with multiple myeloma.

Eye Examination. — Externally, both eyes, normal. Pupillary reactions, sluggish. R. E. V. = 3/60. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Media, clear. Disk, light yellow; elevated; margins, indistinguishable. A thin, flame-shaped hemorrhage extends temporally from entrance of vessels out into the retina. On the surface of the disk, no arteries can be seen. Two enlarged veins are barely visible at their point of origin; but as they approach the margins of the disk, they are markedly beaded. The few arteries seen in the fundus are slightly attenuated, with marked light-streak. Veins are thrombosed and hugely and irregularly dilated. They resemble links of sausage. Their colour varies from a light greyish red to a deep brownish red. The light-streaks on their convolutions are broad and pronounced. Many flame-shaped hemorrhages are scattered over the fundus, and radiate from the disk; but others appear as dark red blotches. The unaffected portion of the retina is normal in appearance. Left eye is similarly affected.

NOTE: Patient died six months later. Autopsy: multiple myeloma, involving many of the bones.

[40] Wintrobe, M. M., and Buell, M. V., "Hyperproteinemia Associated With Multiple Myeloma." Bull. Johns Hopkins Hospital. 52. p. 156. February, 1933.

PLATE 68

Embolism of Central Retinal Artery, right eye of a light brown negro woman 33 years old. (Plate 69 shows same eye two years later). Unit No. 20,508.

Family History. — Negative. *Past History.* — Six normal deliveries; but some of the pregnancies were complicated by albumin in the urine; and by slight elevation in blood pressure. Admitted to hospital four days after an abortion that had been followed by profuse and persistent bleeding. *Present Illness.* — The morning after admission, awoke blind in right eye.

Physical Examination. — Medical: slight elevation of temperature, pulse and respiration; heart, enlarged; loud systolic murmur at apex, transmitted to axilla; no valvular lesion discoverable. Blood pressure, 140/100. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal; Hgb., 73%. Wassermann, negative. Urine: trace of albumin.

Clinical Diagnosis. — Incomplete abortion.

Eye Examination. — Left eye, normal in all respects. Externally, right eye, pupil dilated; direct and consensual reaction, lost. R. E. V. = hand movement in small portion of temporal field. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Media, clear. Disk, pinkish yellow except physiological cup, which is clean-cut, and greyish white; margins, blurred except on temporal side, where there is a pigment ring. Arteries and veins, irregularly attenuated, particularly around disk; light-streaks, insignificant; many smaller twigs, invisible. In the large branches of both arteries and veins, the blood column is broken into small segments with clear plasma between (so-called "cattle-train" appearance). The blood moves in direction of the normal current with an irregular, jerky motion. The dark negroid fundus and the edematous, greyish milky retina present a dramatic contrast to the "cherry-red" fovea with its brilliant light-reflex. In the early stage, the foggy appearance of the fundus is due to retinal edema; but later there is coagulation necrosis. The absence of the edematous retinal layers in the fovea permits the red choroid to appear very plainly in contrast to its greyish white background.

NOTE: During stay of eight days in hospital, the circulation in the retinal vessels improved; but the retina remained milky-looking, and the vision unchanged.

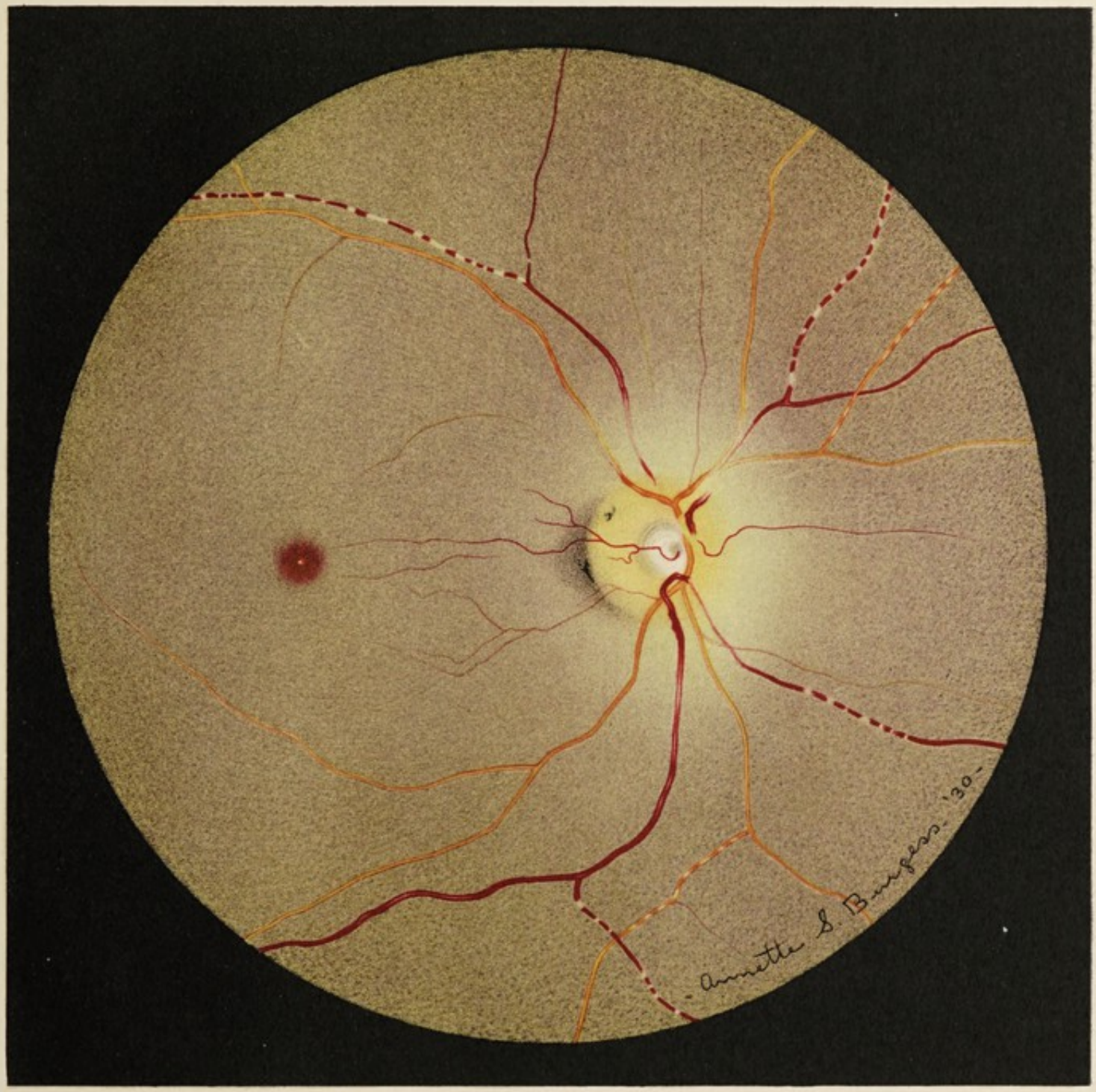
Annette S. Burgess '30

PLATE 69

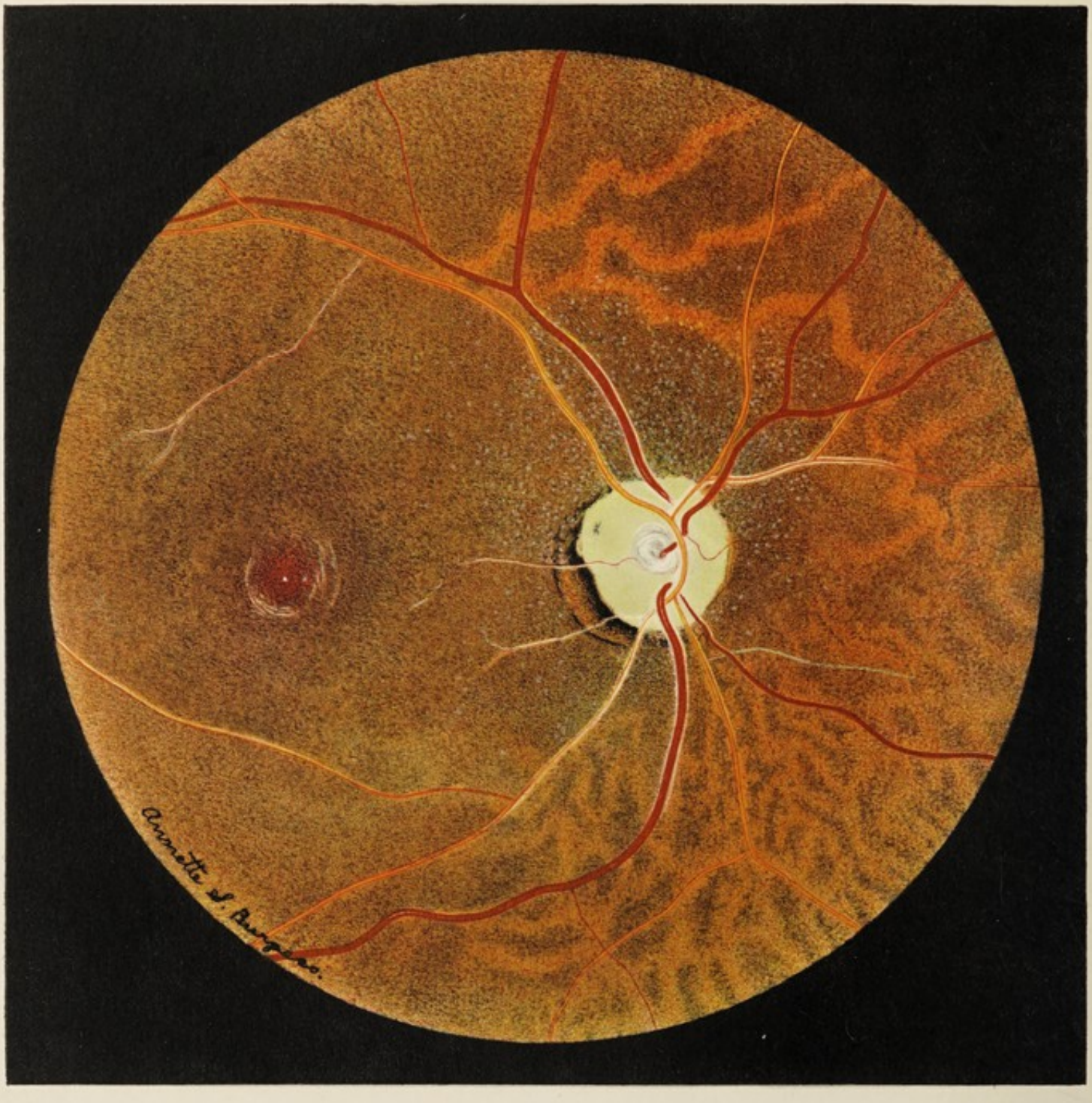

PLATE 69

Optic Nerve Atrophy, Following Embolism of Central Retinal Artery, right eye of a light brown negro woman 35 years old. (Plate 68 shows the same fundus two years earlier). Unit No. 20,508.

Family History and *Past History.* — Plate 68. *Interval History.* — Patient's health has been good; the eye, comfortable; but no improvement in vision.

Physical Examination. — Medical; general condition, good. Blood pressure, 130/90. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Hgb., 73%. Wassermann, negative. Urine: trace of albumin; many R. B. C.; a few W. B. C. X-ray: head, chest, lungs, negative.

Eye Examination. — Left eye remains normal. R. E. V. = light perception. *Ophthalmoscopic Examination.* — Media, clear. Disk, yellowish white; margins, sharply-defined. The faint, pigmented area on the temporal side of the disk in Plate 68 has now given place to two pigmented crescents, with a strip of normal-appearing fundus between them. The optic cup is clean-cut, and greyish white. The retinal arteries are reduced in size and accompanied by white lines. At the beginning of the inferior temporal and the superior nasal arteries, the blood current is reduced to a fine, red thread, which produces the appearance of the "pipe-stem" vessel. Some of the finer vascular twigs are completely obliterated. The temporal veins have to a certain extent recovered their normal size; but they run, during a part of their course, through fine, white boundaries. The nasal venous branches remain small. The macular region with its foveal and macular reflexes is quite normal. Around the disk, where the edema was so pronounced two years ago, there are now many minute, greyish white flecks. Owing to the retinal atrophy, the choroidal details in the periphery have become plainly visible. In the upper nasal quadrant, many of the choroidal vessels resemble broad, reddish, ribbon-shaped streamers. In the lower, nasal portion, the fundus has a very distinct tessellated appearance.

The contrast between Plates 68 and 69 is very marked.

PLATE 70

Retinal Hemorrhages in Bacterial Endocarditis, left eye of a 22 year old blond woman. Unit No. 36,101.

Family History. — Negative. *Past History.* — Typhoid at 5. Health has been good until seven weeks before admission, when severe cold developed. In spite of remissions, condition grew worse. Two weeks later, patient had pain in left arm, leg, and finger tips; one week later, severe occipital headache; two weeks before admission, great thirst, chills, and fever. *Present Illness.* — A few days before admission, eyes became red and the vision blurred.

Physical Examination. — Medical: malnutrition; great number of petechiae in skin and mucous membranes; enlarged spleen and heart; mitral stenosis; cardiac insufficiency; evidence of embolism of spleen and kidneys. Blood pressure, 105/60. *Laboratory Reports.* — Blood. — N. P. N., 30 mgm.%; culture, streptococcus viridans; R. B. C., 2,680,000; W. B. C., 5,400; Hgb., 48%. Wassermann, negative. Urine, negative.

Clinical Diagnosis. — Subacute endocarditis due to streptococcus viridans.

Eye Examination. — Externally, both eyes normal except for conjunctival hyperemia. Intraocular tension, normal. Patient too ill for functional tests. *Ophthalmoscopic Examination.* — Left eye. Media, clear. Disk and blood vessels, practically normal. The whole fundus, however, is slightly paler than the healthy eyeground. The retinal hemorrhages are the interesting features of this fundus. The hemorrhage to the nasal side of the disk is superficial and flame-shaped. Near the macula, there is a similar, but larger, blood extravasation with a marked white centre. To the temporal side of this spot, there is a round, solid-looking hemorrhage with a minute, white speck in the middle. It appears to be preretinal. Below these extravasations, there is another small, superficial, flame-like hemorrhage.

There is a similar condition in the right eye.

The patient died fourteen days after admission. Autopsy verified the clinical diagnosis.

NOTE: Hemorrhages with white centres (Roth's [41] spots) are characteristic of this lesion. However, white-centred hemorrhages occur in pernicious anemia and are common in leukemia; but in the latter disease the fundus is pale; the vessels engorged; arteries and veins alike in appearance; and the disk more or less edematous. (Plates 74, 75 and 76).

[41] Roth, M. "Beitrage sur Kenntniss der Varicosen Hypertrophie der Nervenfasern." Virchow's Arch. f. Path. Anat. Vol. 55. p. 197. 1872.

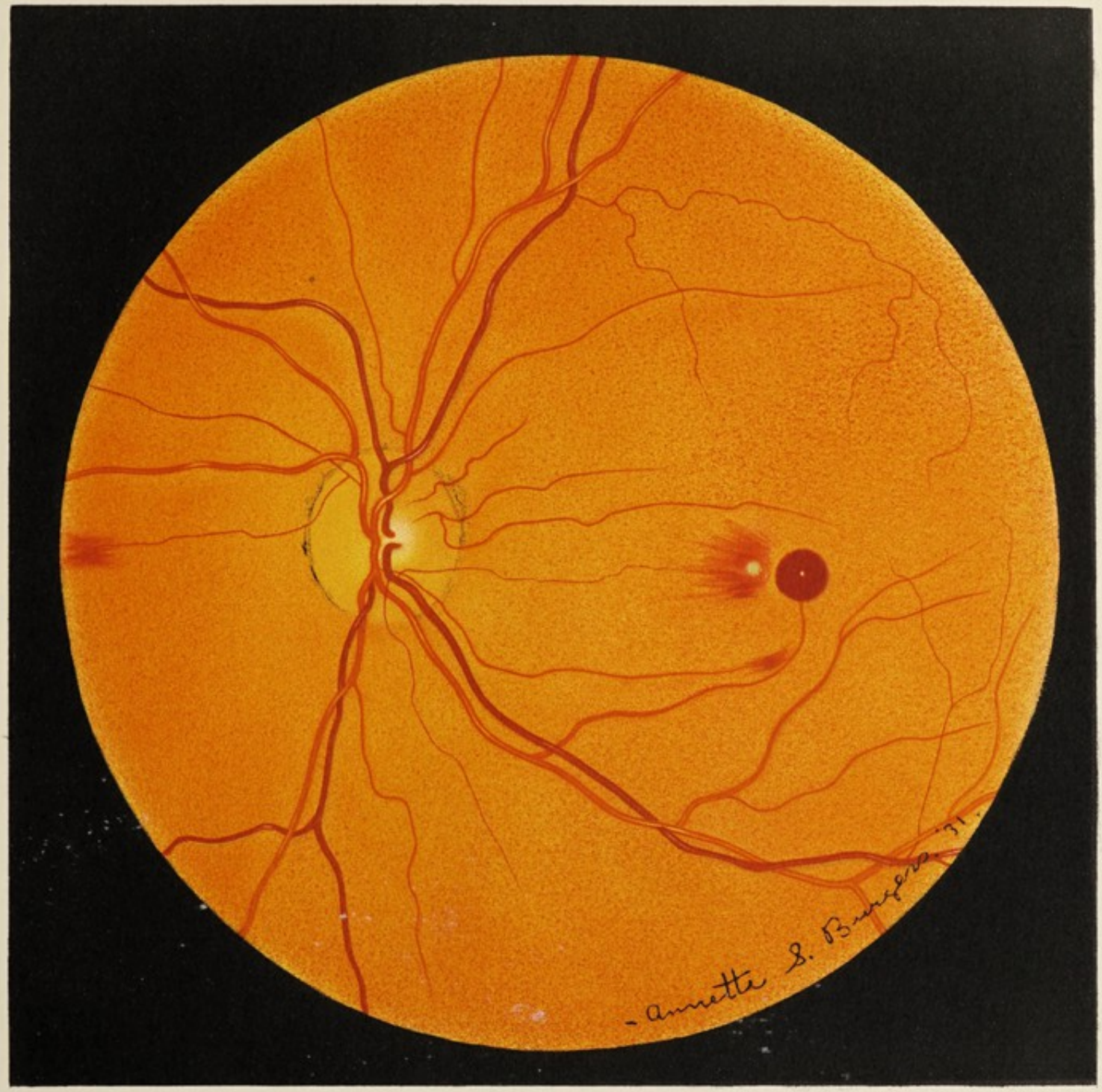
- Annette S. Burgess '31.

PLATE 71

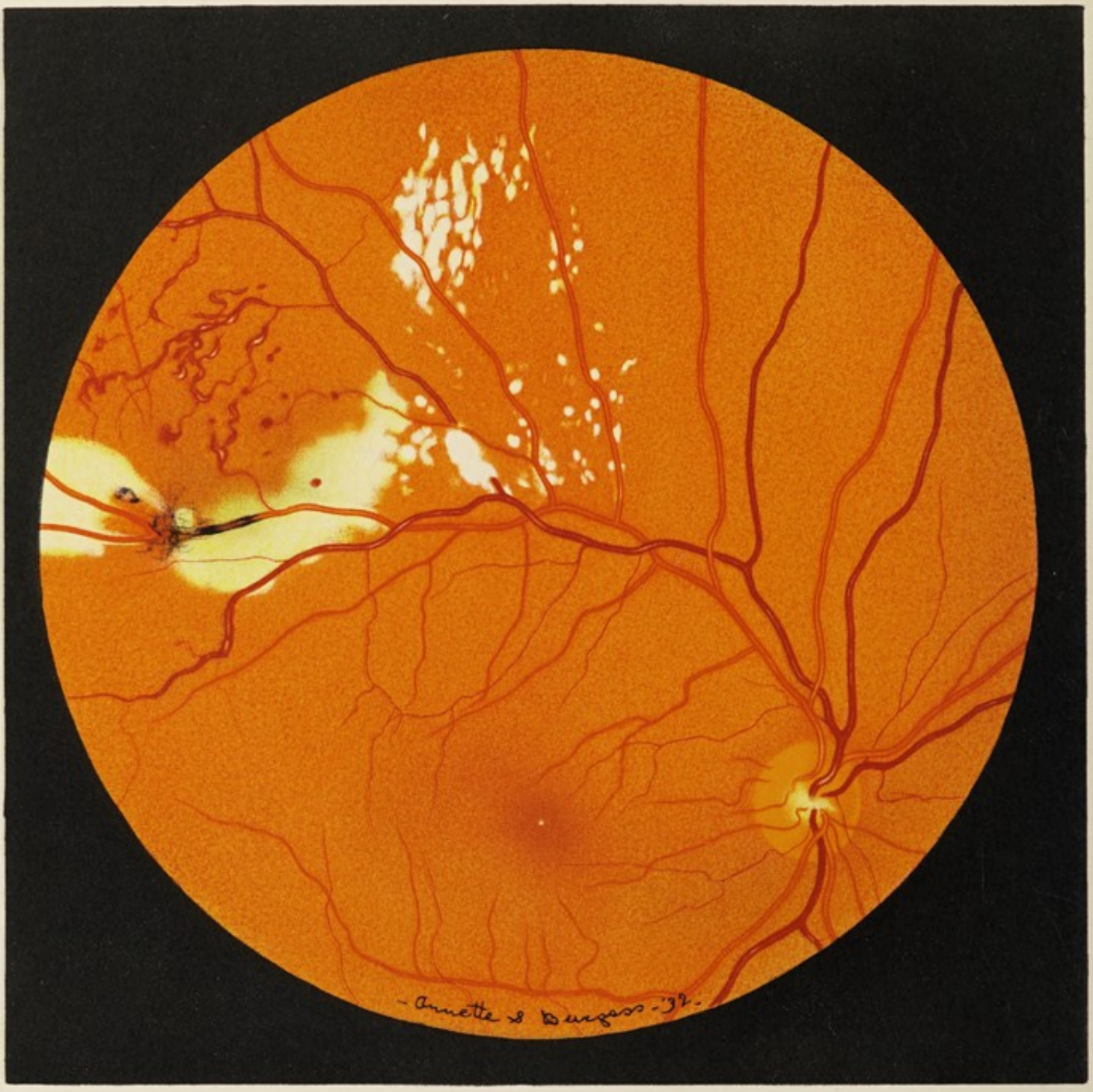

PLATE 71

Aneurysmal Dilatation of Retinal Blood Vessels, Following Exudative Retinitis, right eye of a blond man 27 years old.*

Family History. — Negative. *Past History.* — Right eye has always been amblyopic; and glasses have been worn since the age of 13. *Present Illness.* — For the week preceding this examination, the right eye has been uncomfortable.

Physical Examination. — Medical, negative. *Laboratory Reports.* — (Including Wassermann and Tuberculin), negative.

Eye Examination. — Left eye, normal in all respects. Externally, right eye, normal. R. E. V. with correction = 6/60. Visual fields, normal. Blind spot, normal. Colour sense, slit lamp, intraocular tension, normal. *Ophthalmoscopic Examination.* — Media, small remains of hyaloid artery. Fundus, normal, except periphery of the upper, outer quadrant, where there are many white, glistening scars of varying sizes, contours, and positions in the retina; some are isolated; others conglomerate. One fibrous mass completely obscures a portion of a secondary branch of the superior, temporal vein, without interrupting the blood current. In all other positions, the white spots are posterior to the retinal vessels. Above the macular branch of the beaded, superior, temporal vein, there are two large, yellowish white patches, which are posterior to a branch of the superior, temporal artery. The outer one is about 1 disk-diameter in size; the other, with its long axis oblique, is irregular in shape, 1 disk-diameter in width, and 2-3/4 in length. The upper, outer portion of this patch is a dirty, greyish yellow colour and it fades gradually into the retina. The other margins are clean-cut. The fibrous plaques are not elevated. Between the two large, yellowish white areas, there is an accumulation of pigment in the anterior part of the retina, which in places covers the lower branch of the superior, temporal artery. The most interesting feature of this fundus is the aneurysmal dilatations of some of the retinal arteries and veins. The majority of these enlargements are fusiform, but others are circular. The spindle-shaped dilatations show marked light-reflexes on the anterior surface. These varicosities are seemingly the result of an old exudative, retinal inflammation.

NOTE: This plate is reduced to 3/4 of the size of the original painting in order to bring the lesions into the ophthalmoscopic field of view.

* Courtesy of Dr. Benjamin Rones.

PLATE 72

Retinal Hemorrhages in Pernicious Anemia, left eye of a brunette woman 25 years old. Unit No. 27,215.

Family History. — Negative. *Past History.* — Bronchitis for the past fifteen years; frequent attacks of laryngitis. After birth of last child, three years before admission, tongue red, swollen, blistered; eighteen months later, nausea, vomiting, and abdominal pains after eating. Amenorrhoea for last nine months; dietary deficiency, irregular diarrhoea. Two weeks before admission, muscle cramps, tingling in toes and fingers, edema over thighs, legs, and back. *Present Illness.* — Patient has not complained about eyes.

Physical Examination. — Medical: pallor; severe anemia; edema of face and legs; glossitis; bleeding from gums; tachycardia; abdominal distention. Blood pressure, 110/70. Nose and throat: chronic tonsillitis. Teeth, negative. Neurological, negative. After admission, signs of tetany developed. *Laboratory Reports.* — Blood. — N. P. N., 16 mgm.%; phos., 2.6 mgm.%; calcium, 6.8 mgm.%; uric acid, 1.3 mgm.%; NaCl., 640 mgm.%; total protein, 5.23 grams %. R. B. C., 850,000; W. B. C., 1,200; Hgb., 27%; colour index, 1.5; platelets, 36,000; clotting time, 14 minutes. Van Den Bergh's test, indirect action, 0.3 mgm.%. Icteric index, 9 units. Wassermann, negative. Gastric analysis: no free HCL. Stool: few red blood cells. Urine, negative. Phthalein excretion, 65% in 2 hours. X-ray: chest and sinuses, negative. B. M. R., − 15.

Clinical Diagnosis. — Pernicious anemia.

Eye Examination. — Externally, both eyes, conjunctiva, pale. Functional tests, normal. *Ophthalmoscopic Examination.* — Left eye. Media, clear. The whole fundus is pale (for a brunette), with a slightly veiled effect. Disk, somewhat lighter than background; margins slightly blurred, except on temporal side where there is a small pigment ring. Arteries are fairly normal. Veins are a trifle full. Macular region and foveal reflex are normal. Below, and to the temporal side of the disk, there are two retinal hemorrhages. The lower and fainter one is crossed by a branch of the inferior, temporal artery. The larger, and more recent hemorrhage obscures a portion of the inferior, temporal vein. There is a similar condition in the right eye.

NOTE: Patient improved rapidly under treatment.

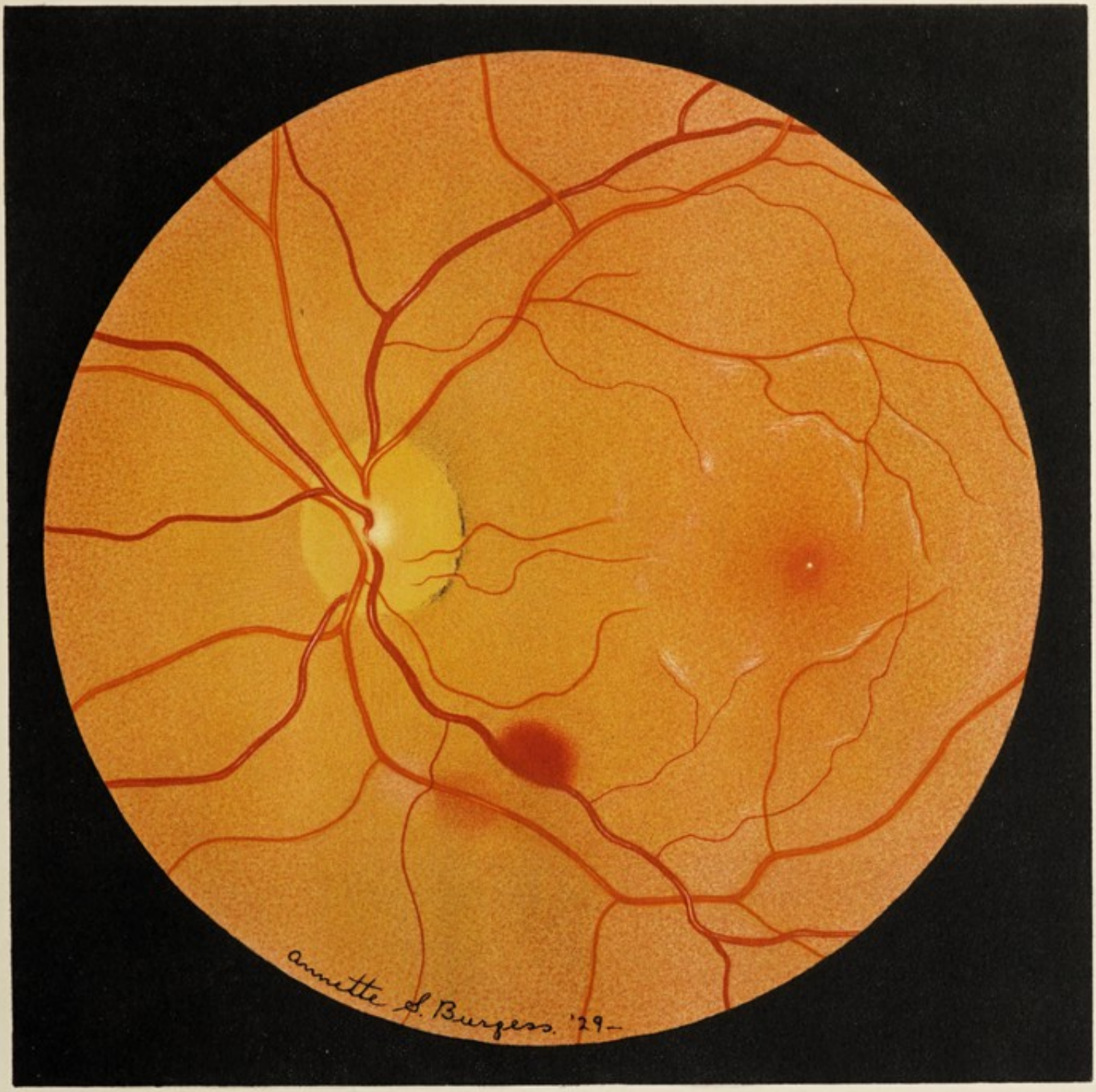
Annette L. Burgess. '29

PLATE 73

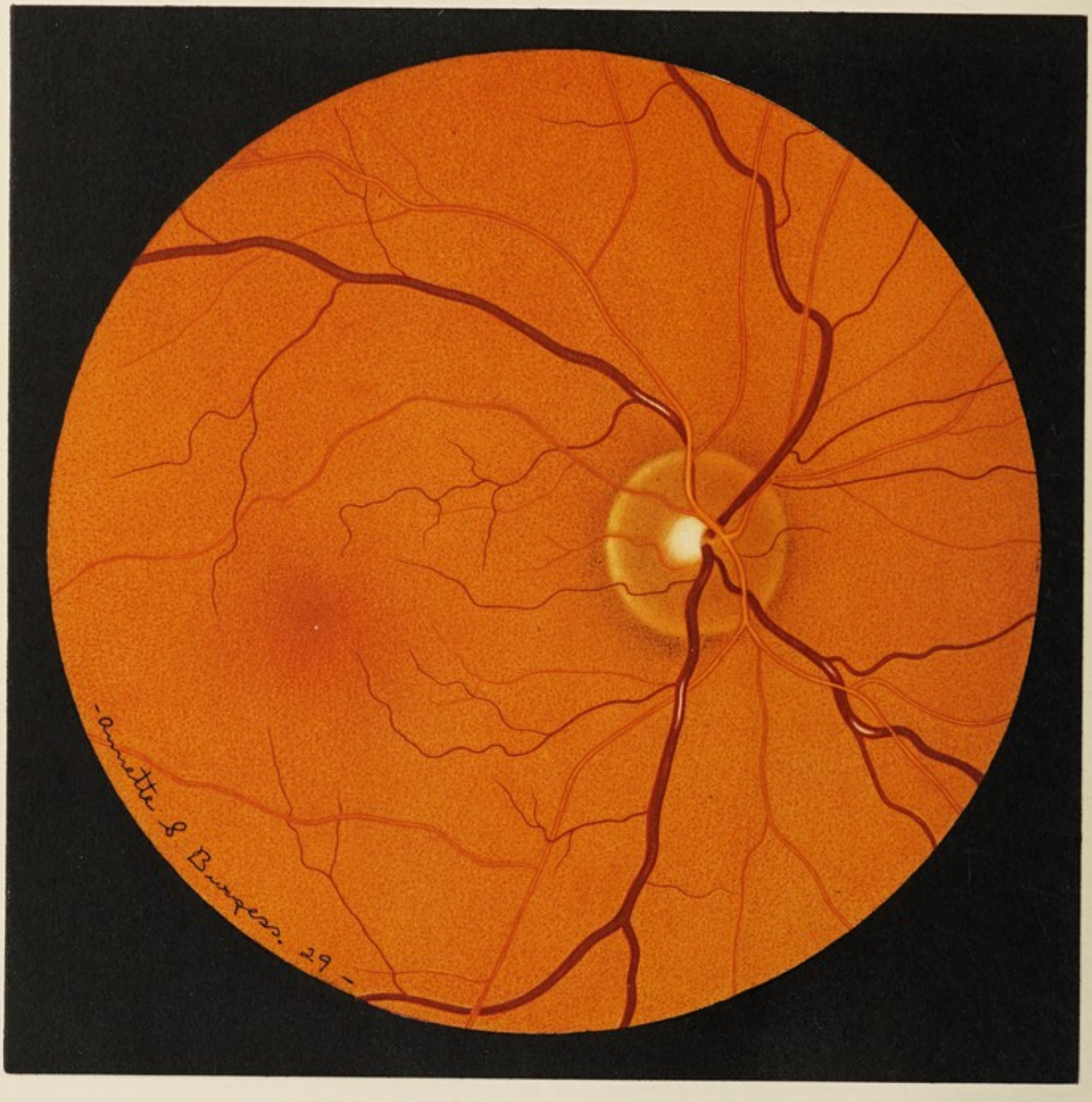

PLATE 73

Retina in Polycythemia Vera, right eye of a brunette woman 64 years old. Unit No. 14,244.

Family History. — Father and mother died from cerebral lesions. *Past History.* — Admitted to hospital on nine different occasions. Three years before last admission, a small painful mass developed in the left side of abdomen. This has gradually increased in size. Later the patient was operated upon, first for acute appendicitis, and then for pericoecal abscess. *Present Illness.* — Dizzy spells. No complaint of eyes.

Physical Examination. — Medical: mucous membranes, purple; vessels on face, dilated; thyroid and liver, palpable; moderate enlargement of heart, with precordial, systolic murmur; spleen, enlarged; varicose veins. Blood pressure, 135/80. *Laboratory Reports.* — Blood. — N. P. N., 38 mgm.%; sugar, 90 mgm.%; uric acid, 3.0 mgm.%; R. B. C., 8,490,000; W. B. C., 10,840; Hgb., 134%. Wassermann, negative. Urine, negative.

Clinical Diagnosis. — Polycythemia vera.

Eye Examination. — Externally, both eyes normal. Functional tests, normal. *Ophthalmoscopic Examination.* — Right eye. Media, clear. The slightly hazy margins of the disk form a yellowish red ring around its tawny red surface, and the white physiologic cup contrasts markedly with its deeply-toned environment. The retinal arteries are fairly normal, though somewhat solid-looking; with pronounced light-streaks. The dark, claret coloured veins are dilated; moderately compressed at the arterial crossings; and their light-streaks are marked where they bulge forward. The twigs are tortuous. The macular region and periphery are normal. The whole fundus gives the impression of being a darker red, and the vessels more prominent, than usual.

The condition of the left eye is similar except for the presence of incipient cataract.

NOTE: The contrast between this plate and Plate 72 is interesting.

PLATE 74

Retinal Changes in Acute Lymphatic Leukemia, left eye of a negro boy 10 years old. Unit No. 6,021.

Family History. — Both father and mother have received anti-syphilitic treatment. Patient, only child. *Past History.* — Mumps, measles, pertussis, varicella. Subject to epistaxis. *Present Illness.* — Four months previous to admission, had pain in knees, chest, and head; fever; weakness; dyspnea; and for past week, there has been watery epistaxis.

Physical Examination. — Medical: apathetic; anemic; undernourished; dyspneic; slight, general, glandular enlargement; soft systolic murmur at cardiac apex; sinus arythmia; electrocardiograph, first degree block; liver and spleen, enlarged. Blood pressure, 92/40. *Laboratory Reports.* — Blood. — Chemistry, normal. R. B. C., 2,020,000; W. B. C., 25,000. Differential count, P. M. N., 4%; lymphoblasts, 96%. Platelets, much reduced. Hgb., 15%. Wassermann, negative. Urine, negative. X-ray: chest and extremities, negative. Tuberculin, negative.

Clinical Diagnosis. — Acute lymphatic leukemia.

Eye Examination. — Externally, both eyes, conjunctiva pale. Patient too ill for functional tests. *Ophthalmoscopic Examination.* — Left eye. Media, clear. Disk, red; elevated, 1.0 D.; margins, blurred; physiologic cup, obliterated. The edema extends into the retina, and it is striated in appearance. Retinal vessels are irregularly engorged, extremely tortuous, light in colour, with very pronounced light-streaks. The arteries and veins differ very little in their colour and size. There are three large, and several smaller, superficial hemorrhages. The shield-shaped preretinal blood extravasation below the macula, is very recent; the one just above the disk, is slightly older. The one in front of the superior temporal vessels, has a marked white centre. The white centres — so common in this disease — are due to the presence of the large number of white blood cells. The small white spots surrounding the disk, are probably the remains of old hemorrhages. The fovea, with its light-reflex, is unchanged. The zone around the macula presents the normal stippled appearance of the negroid fundus. The rest of the background is edematous, and paler than the central area. There is a similar condition in the right eye.

NOTE: Patient died shortly after this illustration was made. Autopsy: acute lymphatic leukemia; infiltration of all organs with lymphoid cells; acute infiltration of the myocardium by fat.

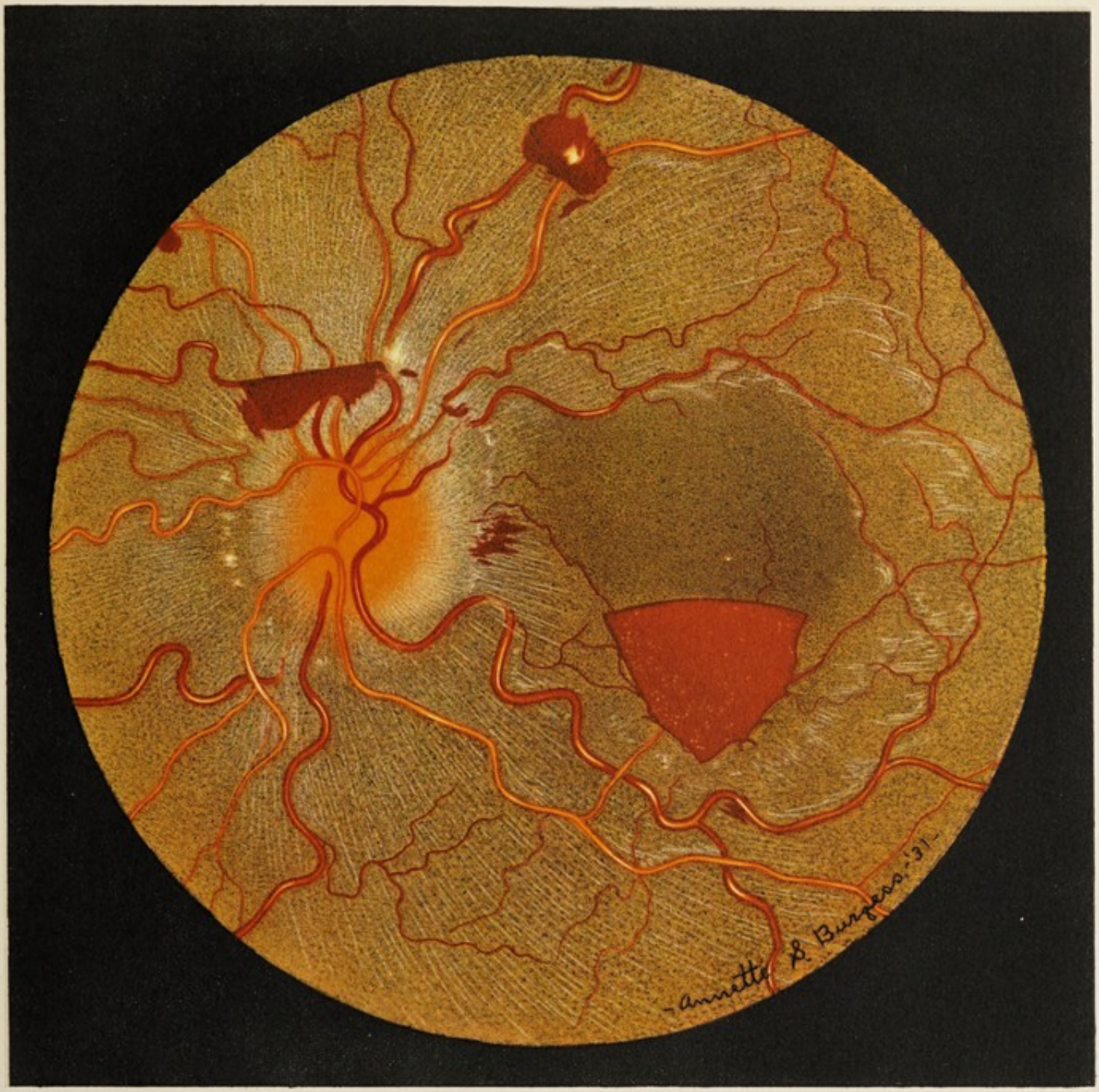
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PLATE 75

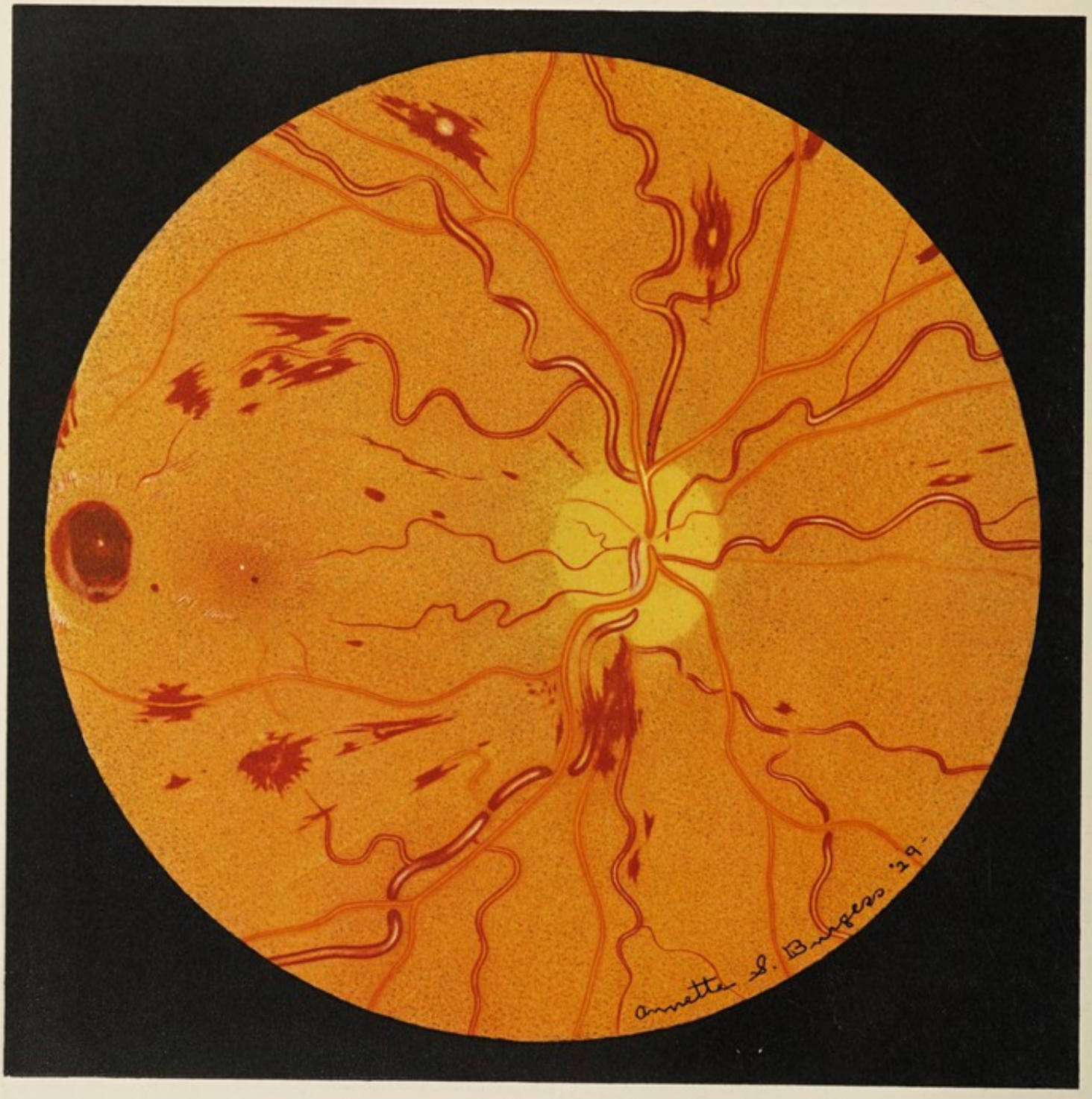


PLATE 75

Retinal Changes in Chronic, Lymphatic Leukemia,* right eye of a 28 year old woman. Unit No. 38,895. (Sinai Hospital).

Family History. — Negative. *Past History.* — Five months prior to last admission, developed purpuric spots on skin; also cough, with blood-stained sputum. About one month later, pneumonic consolidation, base of right lung. Three months after pneumonia, readmitted on account of painless lumps on neck and body, and markedly enlarged spleen. Discharged unimproved. *Present Illness.* — Returned one week after discharge, because of increased weakness.

Physical Examination. — Medical: bluish discoloration of skin of forehead at roots of hair; general glandular enlargement; tonsils, spleen, liver, enlarged; painless lumps on neck and body. Heart, diastolic gallop, soft systolic murmur at apex. Chest, consolidation of entire right side. Abdomen distended. Blood pressure, 126/60. Nose and throat: paralysis of left vocal chord; smears show long-chained diplococci. Gynecological, negative. *Laboratory Reports.* — Blood. — Urea nitrogen, 19.6 mgm.%; urea 41.9 mgm.%; uric acid, 10.52 mgm.%. During four months' observation in hospital, R. B. C. varied from 3,100,000 to 1,520,000; W. B. C. from 10,000 to 424,000; Hgb. from 58% to 34%. Differential count: P. M. N., 6%; small lymph., 80%; large lymph., 8%; transit., 3%; large mono., 3%. Repeated blood cultures, negative. Wassermann, negative. Urine: albumin and urobilin. Phthalein excretion, 50% in 2 hours. X-ray: mass in upper mediastinum; bones and sinuses, negative. B. M. R. varied from + 32 to + 80.

Clinical Diagnosis. — Chronic lymphatic leukemia.

Eye Examination. — Externally, both eyes, conjunctiva pale; subconjunctival hemorrhages. Patient too ill for functional tests. *Ophthalmoscopic Examination.* — Right eye. Media, clear. Disk, pale yellow; margins, slightly indistinct; elevation, insignificant; vessel entrance, not obliterated. Retinal arteries are pale and somewhat enlarged. Veins are light in colour; extensively and irregularly distended; very tortuous; markedly compressed without deflection; in places, sausage-like; light-streaks on their anterior convolutions, increased. There are many hemorrhages of different sizes, shapes, and colours. Three flame-like blood extravasations in upper part of fundus have elliptical white centres. A dense, solid-looking hemorrhage external to macula has a minute white fleck in the middle. The whole fundus is paler than normal, and there is a yellowish creamy tinge to its red colour. There is a similar condition in the left eye.

NOTE: Patient died two months after this illustration was made.

* Courtesy of Dr. Jonas Friedenwald.

PLATE 76

Retinal Changes in Chronic Myeloid Leukemia,* right eye of a negro boy 12 years old. Unit No. 65,824.

Family History. — Father, 69, hypertension; mother, 50, heart trouble. *Past History.* — Frequent colds; at 10 years of age, attack of rheumatic fever, followed by great lassitude. Six months later, abdominal pain; swollen ankles; dyspnea; palpitation. *Present Illness.* — Three days before admission, frontal headache; dizziness; pain in left eye.

Physical Examination. — Medical: pale; undernourished; lymph glands, small and shotty. Hemic systolic murmur. Liver, 2 cm. below costal margin. Spleen extends to anterior superior spine of ilium. Subcutaneous nodules over tibiae. Blood pressure, 102/70. *Laboratory Reports.* — Blood. — N. P. N., 27 mgm.%; uric acid, 2.9 mgm.%; calcium, 9.9 mgm.%; sugar, 46 mgm.% (fasting). R. B. C., 2,410,000; W. B. C., 510,000. Colour index, 0.9. Differential count, P. M. N., 24%; premyelocytes, 16%; myeloblasts, 11%; small lymphoblasts, 0.30%; monocytes, 5%; smudges, 3.30%. 5 normoblasts in 300 W. B. C. Hgb. 43%. Wassermann, negative. Urine, negative. B. M. R., + 50. X-ray: chest and head, negative. Tuberculin, negative.

Clinical Diagnosis. — Chronic myeloid leukemia.

Eye Examination. — Externally, both eyes, normal. R. E. V. = 6/6 +. Visual field, normal. *Ophthalmoscopic Examination.* — Media, clear. Disk, red; elevated 3.0 D.; margins, indistinct and lighter colour; optic cup, abolished. The edema radiates slightly into the adjacent retina. Retinal arteries and veins are similar in colour. These vessels are dilated, very tortuous, with broad and brilliant light-streaks on their anterior loops. No venous compression. In the extreme upper periphery, the vessels show a perivascular infiltration which forms broad, white lines without reducing the size of the blood stream. Between these vessels, there are three white spots — two oval in shape, one round. They are surrounded by thin red rims — remains of former hemorrhages. Macular region, normal. The entire eyeground is paler, and more yellow than the usual negro fundus.

The fundus of the left eye presents a similar appearance.

NOTE: The boy has been kept alive by treatment with radium and arsenic. W. B. C. decreased from 510,000 to 15,000; myeloid forms from 64% to 1%. Hgb. rose from 43% to 62%.

* Courtesy of Dr. Paul Shipley.

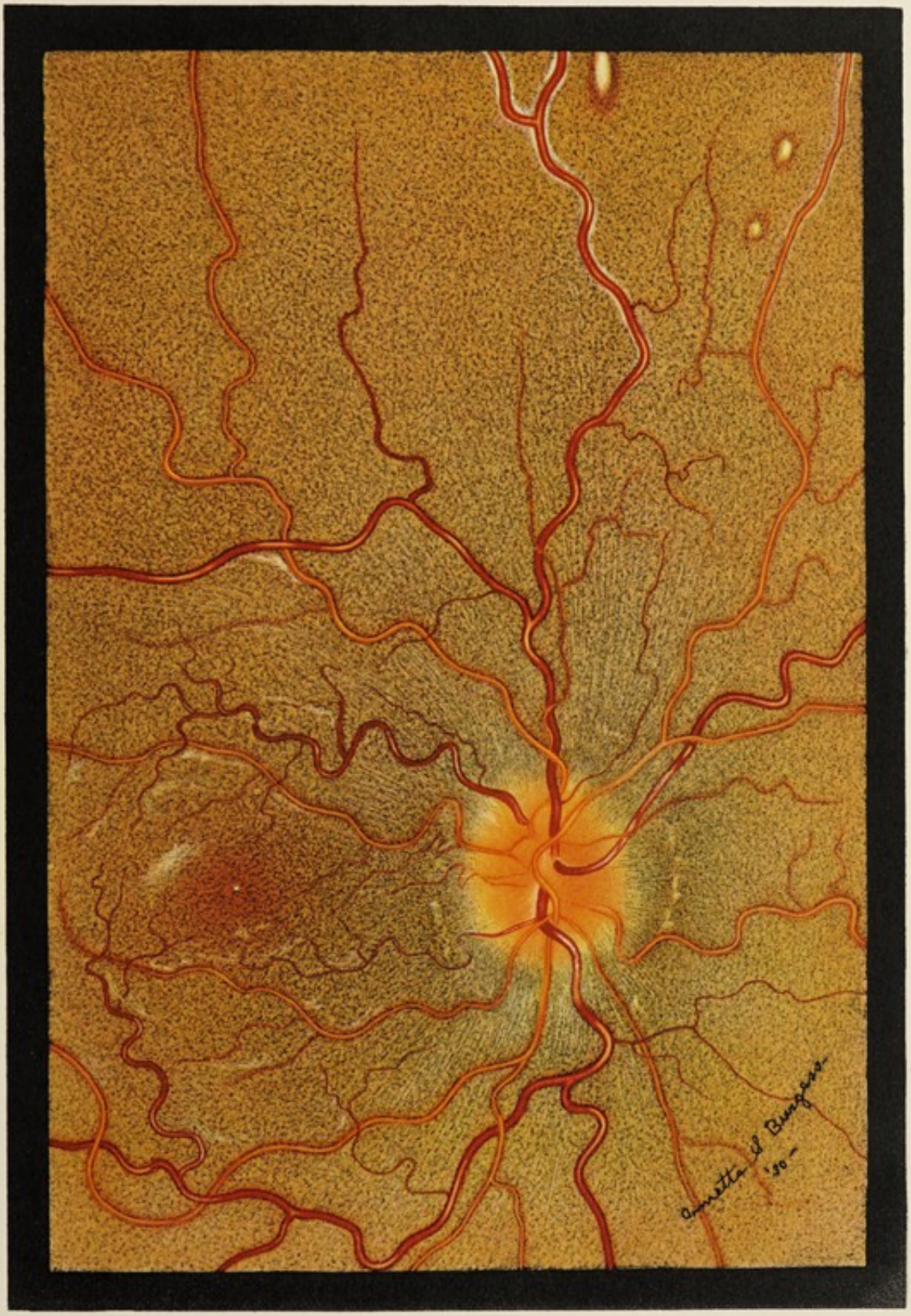


PLATE 77

PLATE 77

Retinal Pigmentary Degeneration (" Retinitis Pigmentosa "), right eye of a negro woman 47 years old. W. O. I. No. 3,753.

Family History. — No reliable data obtainable. *Past History.* — At 42 years of age, the vision began to fail, and it has become steadily worse. An operation for cataract has been performed on each eye. *Present Illness.* — Sight has now become very poor; and the patient has great difficulty in getting about.

Physical Examination. — Medical: general condition, good. Blood pressure, 135/85. Nose and throat, negative. Teeth, pyorrhoea. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Hgb., 90%; clotting time, 4 minutes. Wassermann, negative. Urine, negative. X-ray: sinuses, clear. Tuberculin, positive to 1/100 mgm.

Eye Examination. — Externally, both eyes are slightly prominent, and there is an operative coloboma of the iris in each eye. R. E. V. = hand movement at 4 ft. Visual Field: extreme concentric contraction. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Media, remains of lens capsule; vitreous, clear. Disk, yellowish red, somewhat lighter than the surrounding fundus; margins, partially covered by accumulation of pigment masses; physiologic cup, yellowish white. The calibre of the retinal vessels is much reduced; and the arteries and veins are practically the same size. The whole fundus, especially the periphery, is covered with pigment accumulations. Most of these clumps have the bone-corpuscle form typical of this disease. But some of these masses, especially in the central region, are circular and rather solid-looking. All of these accumulations of pigment are anterior to the retinal vessels. The retinal atrophy renders the details of the choroidal vessels around the disk very visible. In this area these vessels appear as irregular, radiating, light red streamers.

The fundus of the left eye presents a similar appearance.

PLATE 78

Retinal Pigmentary Degeneration (**" Retinitis Pigmentosa "**), left eye of a brunette man 31 years old. Unit No. 85,824.

Family History. — Father died from " sleeping sickness " at 57; mother 54, living and well; two brothers and two sisters are normal. A third brother at 16 years of age developed eye symptoms similar to the patient's. *Past History.* — In childhood, measles, typhus fever, diphtheria. At 17, noticed that vision was poor in dim light, and that peripheral vision was reduced. For the next ten years, the vision steadily grew worse. *Present Illness.* — During the four years just prior to admission, there has been very little change in the sight.

Physical Examination. — Medical, negative. Blood pressure, 126/80. Nose, throat, neurological, negative. *Laboratory Reports.* — Blood. — Chemistry, normal. Levulose tolerance test, normal. R. B. C., 3,100,000; W. B. C., 10,000. Differential count, normal. Hgb., 68%. Bleeding, and clotting time, normal. Icteric index, not increased. Van Den Bergh test, normal. Wassermann, negative. Urine, negative. Phthalein excretion, 60% in 2 hours. Tuberculin, negative. Uveal pigment test, negative.

Eye Examination. — Externally, both eyes are normal. L. E. V., with correction, = 6/21. Visual Field: contracted to within 5° of fixation point. Colour sense, normal. Light sense: during dark adaptation, sensitivity increases unusually slowly; at beginning of test, sensitivity 1/10, and at end of 20 minutes, 1/500, of normal. Slit lamp, negative except lenticular opacities. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Media, lenticular opacities; vitreous, clear. Disk, light reddish yellow; waxy-looking; slightly oval with long axis vertical; margins, a trifle blurred; irregular scleral ring; thin, incomplete pigment ring. The retinal vessels, especially the arteries, are attenuated. Macular region, fairly normal. In the intermediate periphery, there are many pigment patches, bone-corpuscle in shape, and anterior to the retinal vessels. In the extreme periphery, the retinal atrophy is more marked, which gives the fundus the appearance of thin strips of bacon, in which the choroidal vessels represent the lean, and the intervascular spaces, the fat. There are irregular patches of pigment scattered over these atrophic areas, but only a small portion can be shown in the illustration.

There is a similar condition in the right eye.

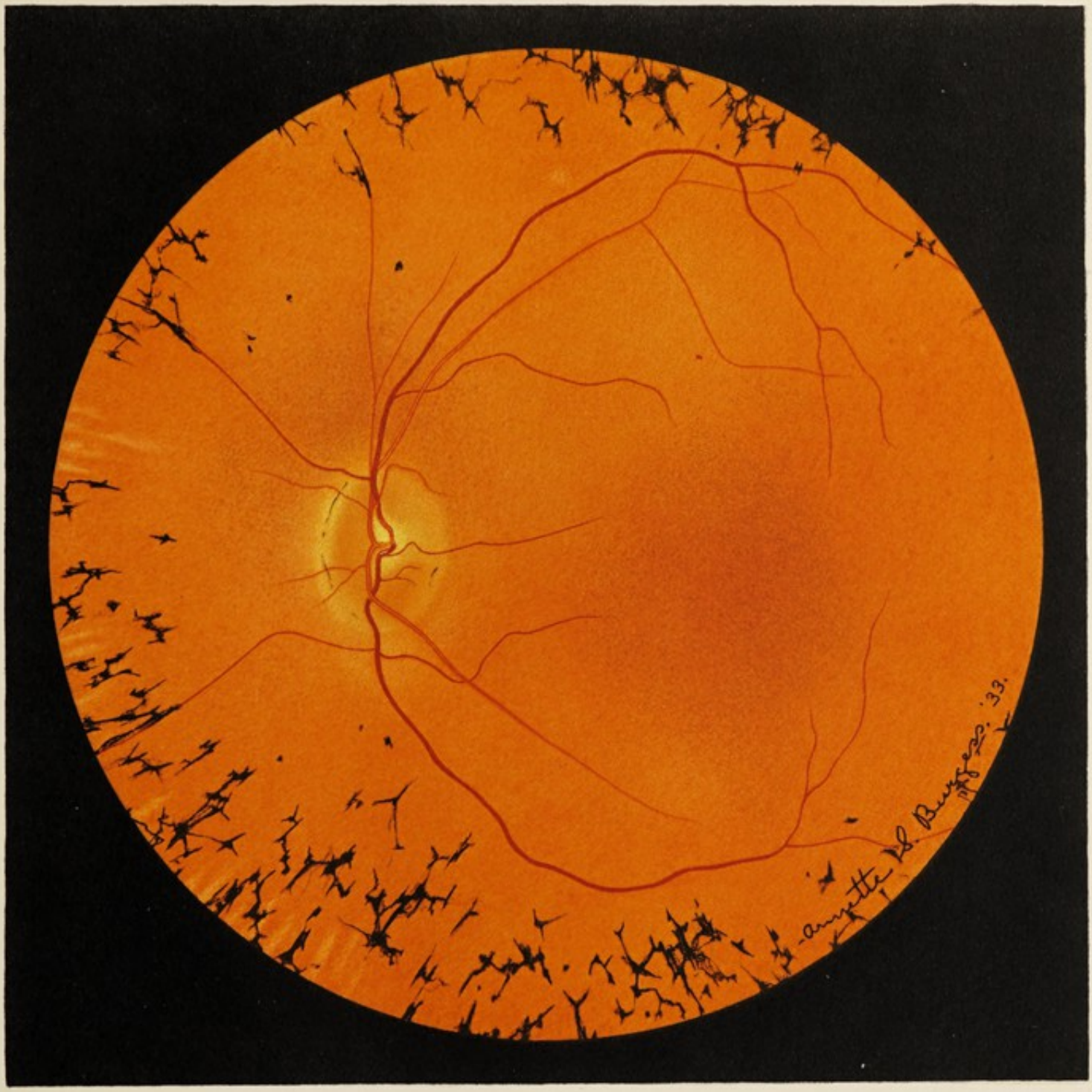

Annette M. Burgess. '33.

PLATE 79

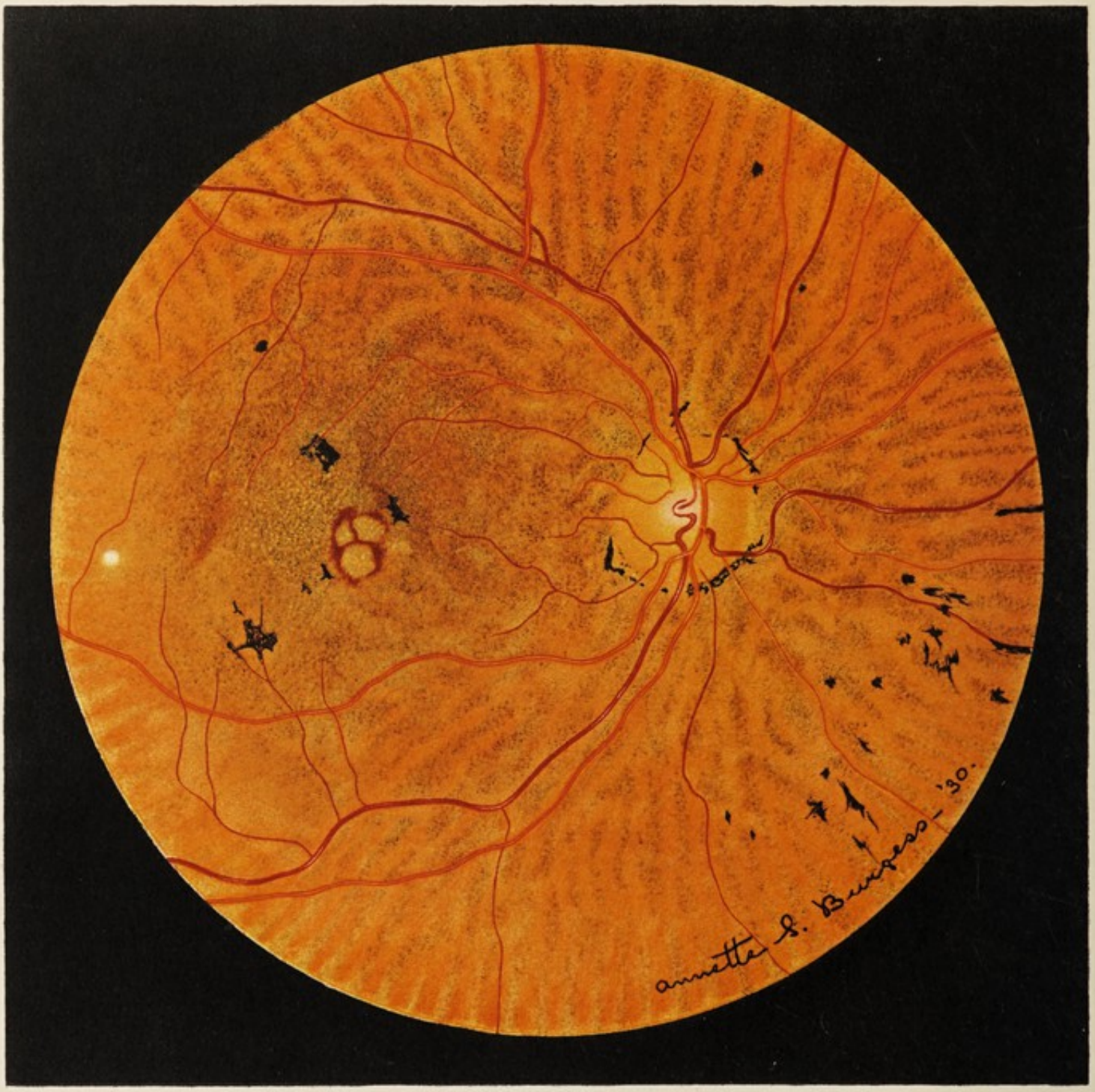


PLATE 79

Tapetoretinal Degeneration, right eye of a brunette woman 36 years old. Unit No. 5,347.

Family History. — No accurate data obtainable. *Past History.* — At 11, blurring of print. At 16, oculist pronounced the retinal lesion to be familial. When 33 years of age, this diagnosis was confirmed by another ophthalmologist. *Present Illness.* — Day and night vision have been growing worse, and peripheral vision more contracted.

Physical Examination. — Medical, negative. Blood pressure, 134/76. Gastro-intestinal tract, nose, throat, negative. One infected tooth extracted. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Wassermann, negative. Urine, negative. X-ray: sinuses, remains of old infection in left antrum; chest, negative. B. M. R., + 7. Spinal Wassermann, negative. Tuberculin, positive to 1/10 mgm.

Eye Examination. — Externally, alternating divergent squint. R. E. V. with correction = 3/60. Visual Field: large, annular, paracentral scotoma. *Ophthalmoscopic Examination.* — Media, clear. Disk, yellowish red; margins, well-defined, with incomplete scleral and pigment rings; physiologic cup, insignificant. Arteries and veins, attenuated. In the macular region, there are three, roundish, golden yellow spots surrounded by superficial hemorrhages, which form thin, red rims. This group suggests the gold mosaics of medieval times. In addition to these circlets, there are numerous, golden yellow flecks, especially to the temporal side of the macula. All of these yellow deposits seem to consist of cholesterol. One small, round, white spot in the temporal periphery, is similar to those seen in retinal, apigmentary, punctate degeneration; while the numerous, superficial, branching pigment groups in the macular region, and in the periphery (especially lower nasal), resemble the pigmented type of retinal degeneration. The retinal vessels and the choroidal details are very distinct, due to retinal atrophy.

The left eye presents a similar appearance.

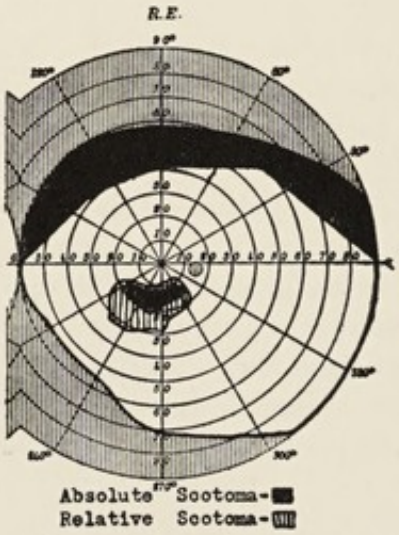
PLATE 80

Retinal, Apigmentary, Punctate Degeneration ("Retinitis Punctata Albescens"), right eye of a blond man 47 years old. W. O. I. No. 3,540.

Family History. — No reliable data obtainable. *Past History.* — Deaf mute. Married; three normal children. *Present Illness.* — For one year before admission, vision had been failing.

Physical Examination. — Medical, negative except hypospadia and underweight. Blood pressure, 138/70. Nose and throat, negative. Ear, auditory aphasia. Teeth, five infected. Neurological: deaf mutism; low intelligence. *Laboratory Reports.* — Blood, including Wassermann, negative. Urine, negative. X-ray: sinuses, old infection of both antra; chest, bronchitis; mastoid processes and spine, negative. B. M. R., −23. Spinal fluid, negative. Tuberculin, positive to 1/10 mgm.

Eye Examination. — Externally, both eyes normal. R. E. V. with correction = 6/9. Visual Field. — Fig. Colour sense: Ishihara plates, 7 out of 11, correct. Light sense: dark adaptation curve slow; normal at end of test. Slit lamp, negative. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Media, clear. Disk, colour, normal; margins, fairly well-defined; small pigment crescent on upper temporal border. Retinal vessels, practically normal.



VISUAL FIELD, RIGHT EYE

Scattered over the fundus, particularly in the upper and lower periphery, there are numerous small, white, paint-like spots, posterior to the retinal vessels. The smaller ones resemble druses. To the upper nasal side of the disk, at 2 o'clock, there is a larger greyish white area, with a pigmented lower border. In the upper outer quadrant of the fundus, and anterior to the retinal vessels, there are several pigment clumps of various sizes. In the extreme periphery, the choroidal details are very distinct. In the left eye, there is a similar condition.

In addition to the retinal lesion, the patient presents three congenital stigmata — deaf mutism, hypospadia, low intelligence.

NOTE: Four years later, fine vitreous opacities; no change in disk or retinal vessels; retinal atrophy, increased; entire retina, paler; large white spot at 2 o'clock, more atrophic. Far out in the periphery, at 10 o'clock, there is a new, large greyish yellow atrophic spot; and there are two new specks of pigment along the superior temporal vein. There are many, new, white spots, some of which are closer to the fovea. The old white spots are now faded in colour, and the margins are less well-defined.

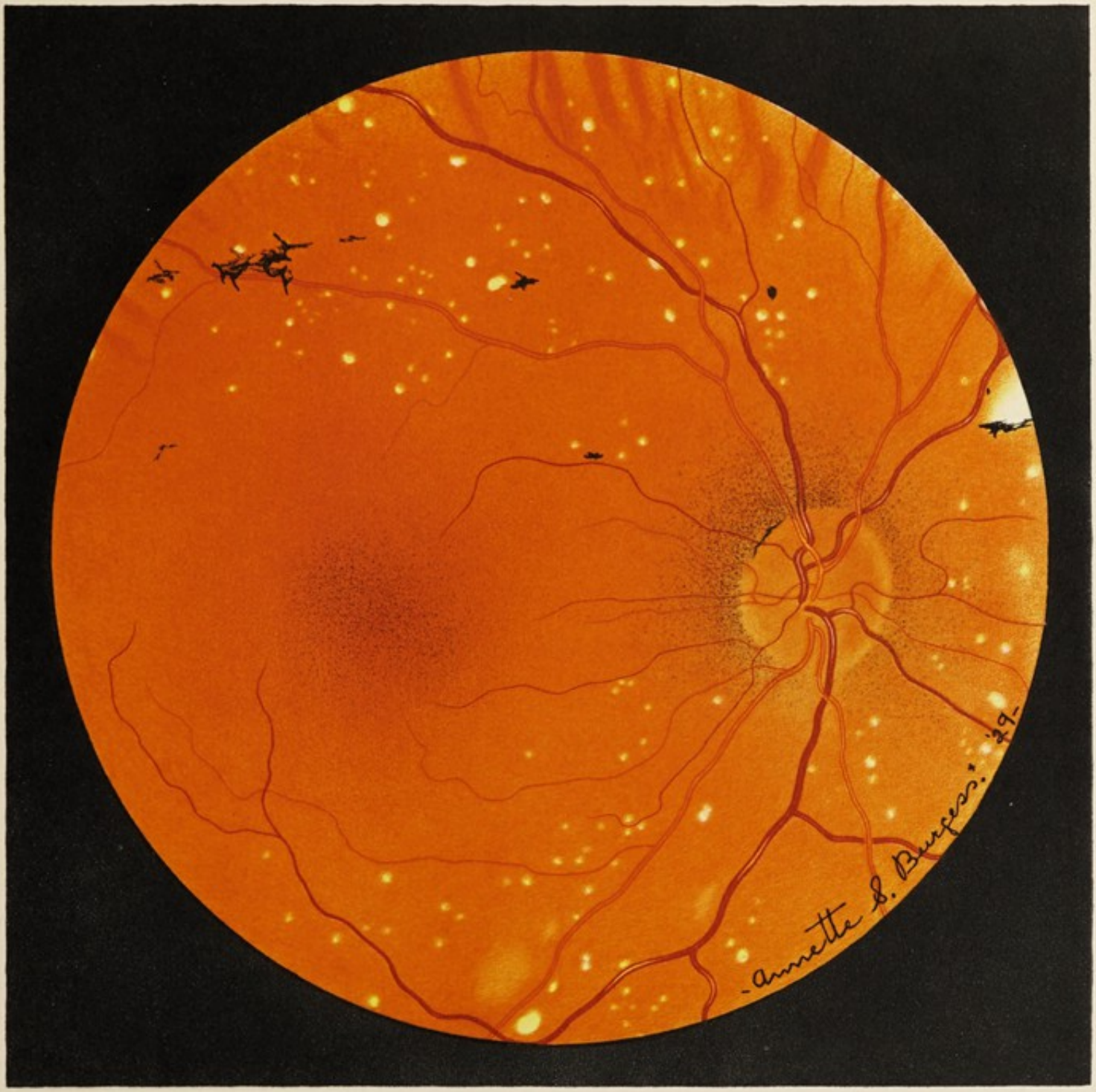

Annette S. Burgess '29

PLATE 81

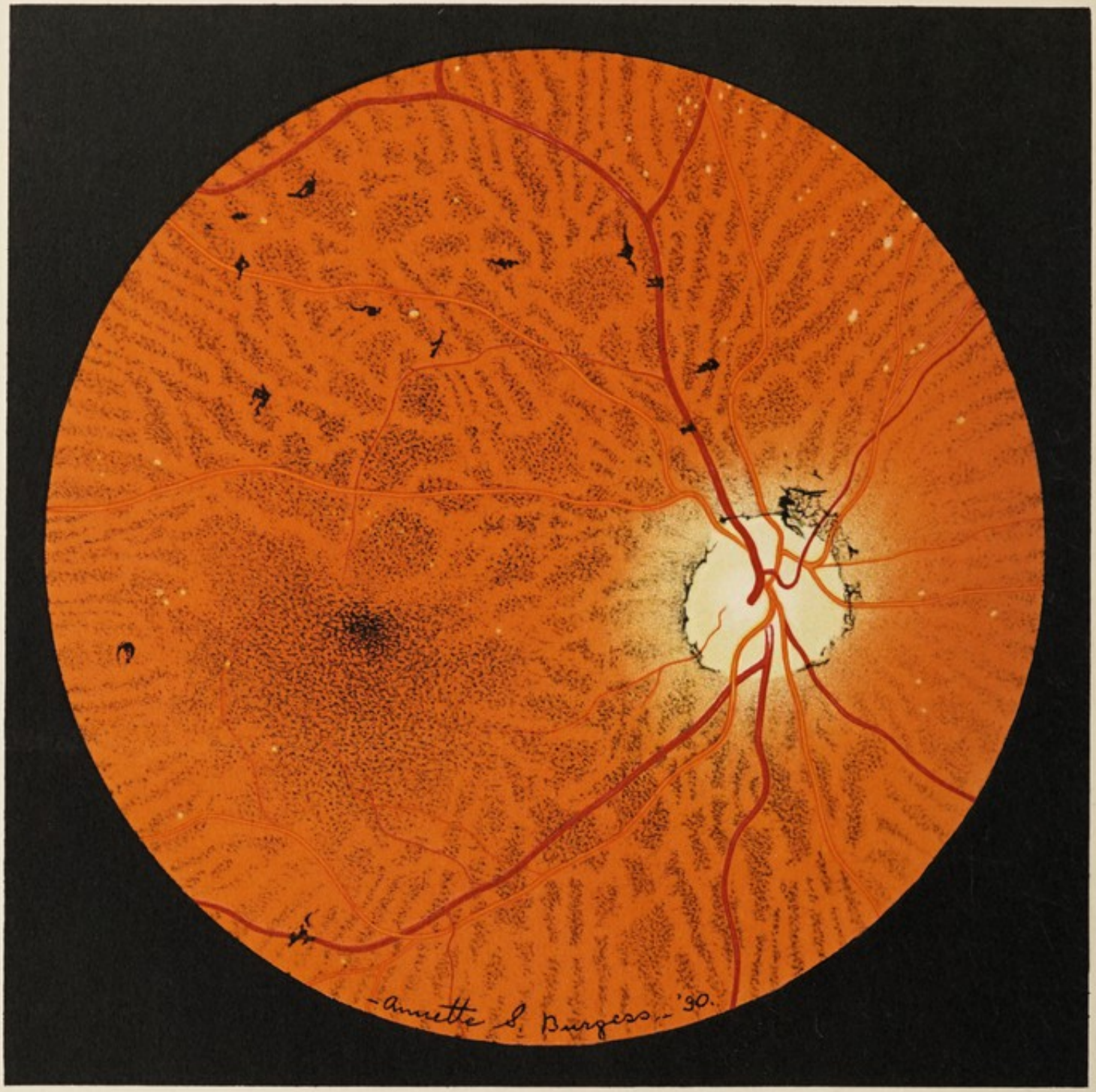


PLATE 81

Retinal, Pigmentary Degeneration in Neurosyphilis,[42] right eye of a man 48 years old. (Fundus drawn four years after the first examination).

Family History. — Negative. *Past History.* — There has been loss of weight; depression; and for the last year, failing vision. *Present Illness.* — Six months previous to this examination, the right eye became totally blind. One month later, a diagnosis of tabes with optic atrophy was made.

Physical Examination. — Medical: analgesia about nose; deaf in one ear; loss of knee and ankle jerks; tabetic gait; tremor of head and hands; Romberg sign, positive. *Laboratory Reports.* — Blood Wassermann and spinal fluid Wassermann, positive. Spinal fluid: 126 cells per cu. mm.

Eye Examination. — Externally, there is ptosis of the right eyelid. The pupils are unequally dilated, and they react slightly during accommodation; but not at all to light. R. E. V. = 0. L. E. V. = 6/9. *Ophthalmoscopic Examination.* — Right eye. Media, clear. Disk, pale greenish grey; complete atrophy; margins, irregular, well-defined, with accumulation of pigment, especially on the upper nasal side. The retinal arteries are somewhat attenuated. The veins are only slightly reduced in size.

Scattered through the fundus, there are "numerous irregular masses of pigment, some of typical crescentic form overlying the blood vessels." In addition, the fundus is peppered with fine pigment granules, and there are many, small, whitish dots which resemble in form those of retinal, apigmentary, punctate degeneration. They appear to lie beneath the retina. The choroidal details are abnormally distinct. The choroidal blood vessels appear as light red bands between the granular pigment.

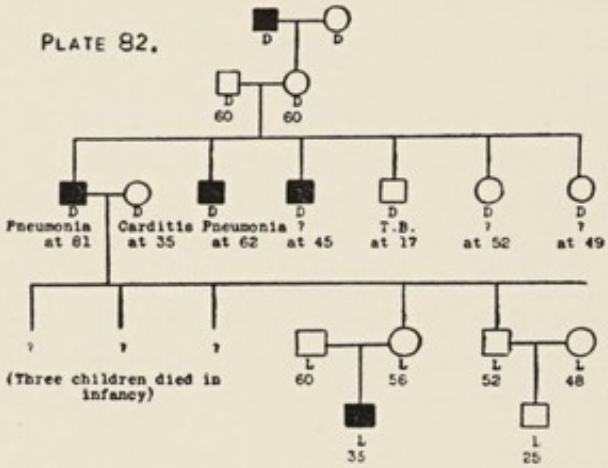
The condition of the left eye is similar, but not so advanced.

NOTE: After four years of vigorous, antiluetic treatment, Wassermann reactions were entirely negative; cell count and globulin, normal; no increase in tabetic symptoms; decrease in amount of retinal pigment in fundus. The vision and the visual field of the left eye were unchanged.

[42] Friedenwald, Jonas S. "Pigmentary Degeneration of the Retina in Cerebrospinal Syphilis." A. J. O. Vol. 13. p. 943. Nov. 1930.

Sclerosis of Choroidal Vessels, with Pigmentary Degeneration of Retina, right eye of a man 35 years old. W. O. I. No. 398.

Family History. — Record of "Retinitis Pigmentosa" for four generations on maternal side. (Fig.) No history of consanguinity; of early deafness, or other stigmata. *Past History.* — During childhood, typhoid fever, pneumonia, digestive disturbances. Later, frequent colds; sinusitis. Excellent record in school and business. *Present Illness.* — At the age of 8, noticed "night blindness" and constricted peripheral vision. These symptoms have increased very slowly. At 27, ulcer of cornea, left eye.



GENETIC CHART

Physical Examination. — Medical, negative. Blood pressure, 120/80. Gastro-intestinal tract, negative. Chronic tonsillitis. Possible ethmoidal infection. Pyorrhoea. *Laboratory Reports.* — Blood. — Negative, except N. P. N. 48 mgm.%, and cholesterol 226 mgm.%. Wassermann, negative. Urine, negative. B. M. R., O. Tuberculin, positive to 1/10 mgm. Uveal pigment test, negative.

Eye Examination. — Externally, right eye, normal; left eye, leucoma of cornea. R. E. V. with correction = 6/6. Visual Field: concentric constriction to within 10° of fixation point. Colour sense, normal. Light sense: 1/10 of normal before dark adaption; 1/1000 of normal after 20 minutes. *Ophthalmoscopic Examination.* — Media, clear. Disk, pale; margins, well-defined. The retinal vessels are somewhat reduced in size, and so distinct that they appear to be suspended in front of the background. Light-streaks, insignificant. The macular region is the only portion of the fundus with normal colour. There is no foveal reflex. To the upper, outer side of the fovea, there is a rather solid pigment mass in the anterior part of the retina. The vast numbers of visible choroidal vessels exhibit all degrees of sclerosis — diminution of lumen; reduction of blood stream to a narrow, central, red thread; conversion of vessels into broad, white bands. The choroidal pigment between these white, chalk-like bands is granular in appearance, and greenish grey in colour. A number of comparatively normal choroidal vessels radiate from the macular region to the periphery. On the retina, there are a few isolated deposits of pigment, which are superficial and rather solid-looking. This dramatic picture extends from around the disk to the limit of ophthalmoscopic examination.

NOTE: During ten years' observation, vision, visual field, and colour sense of right eye have remained unchanged; vision of left eye improved owing to thinning of corneal scar.

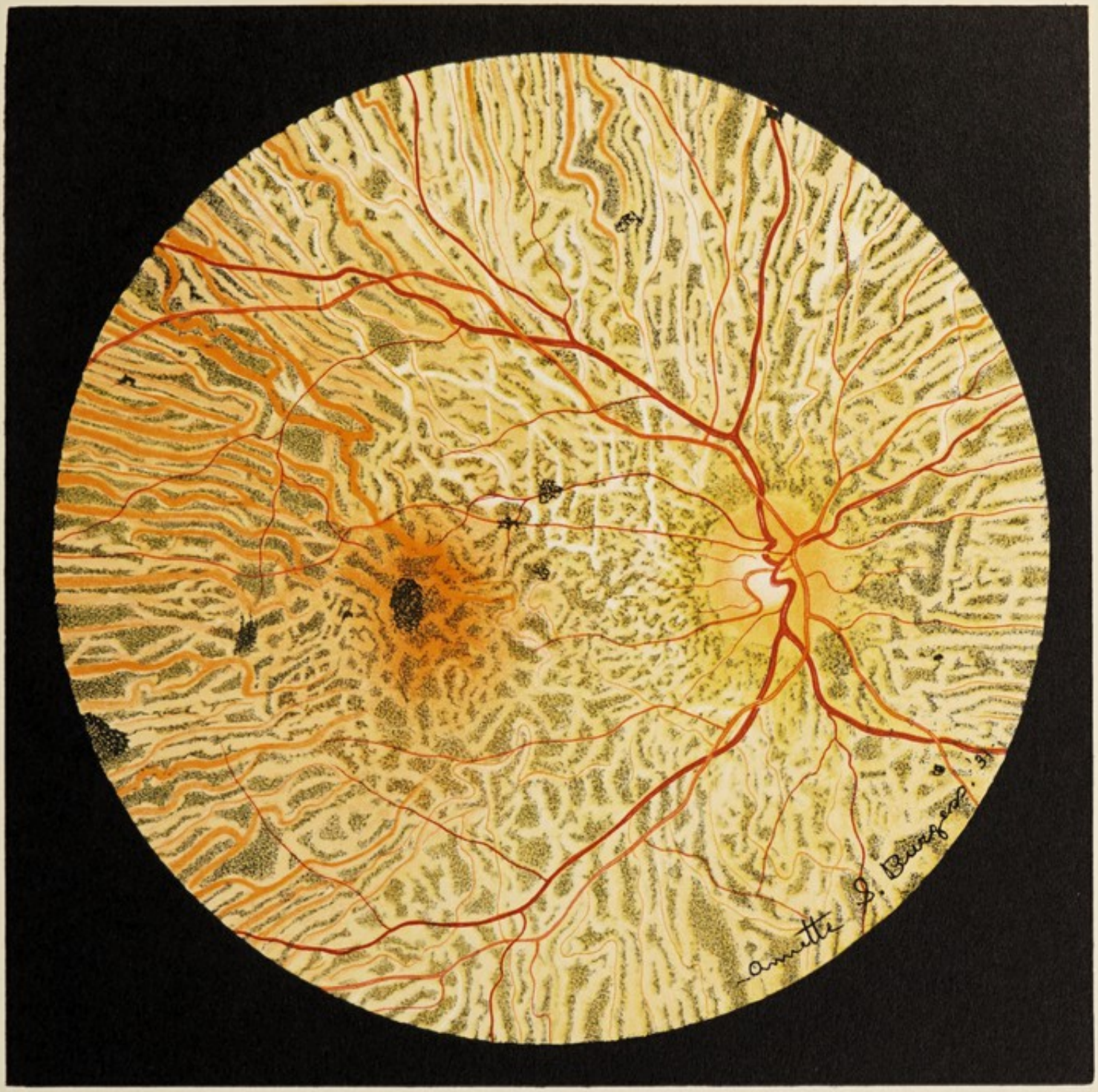

Annette L. Burford

PLATE 83

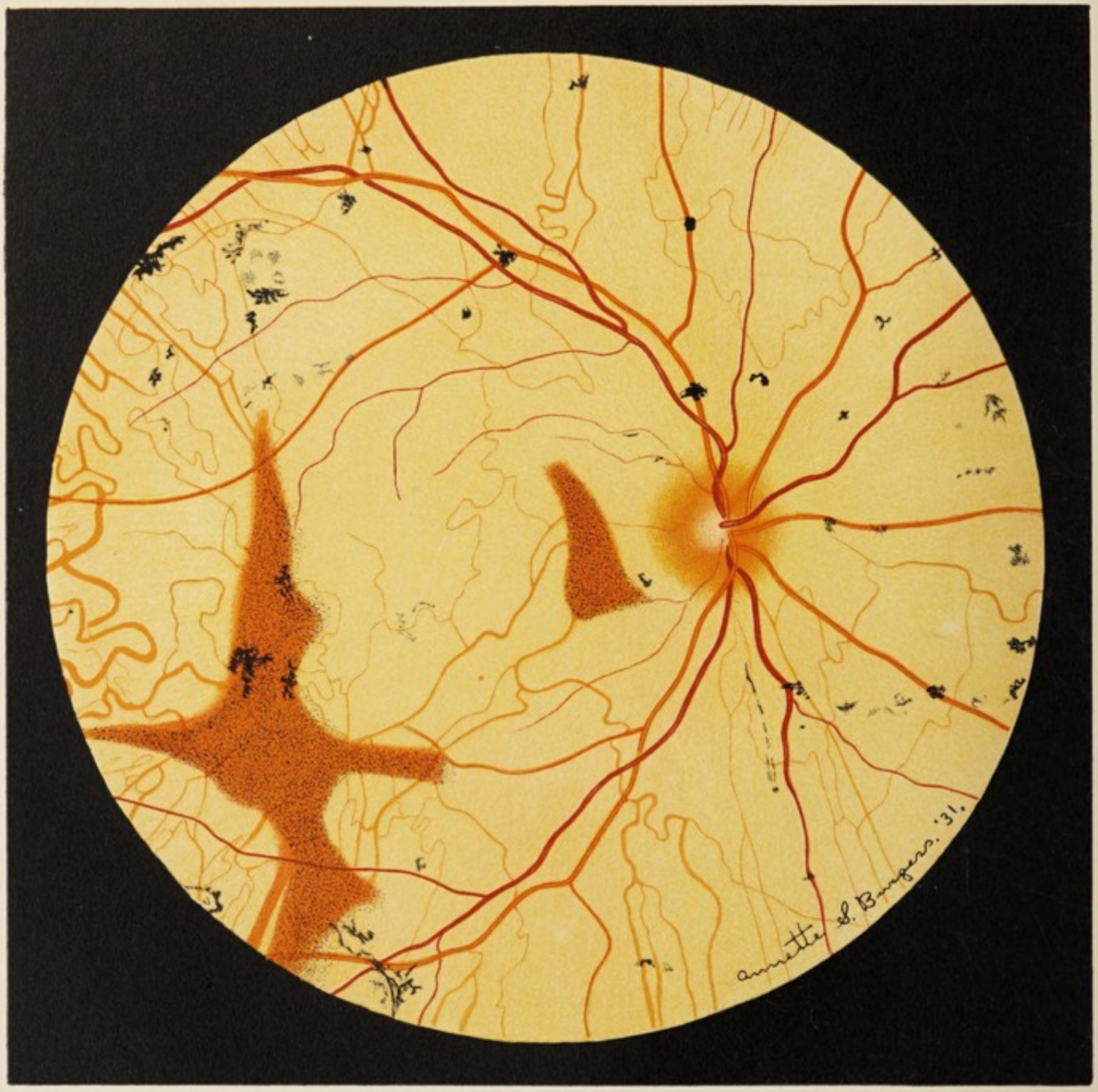


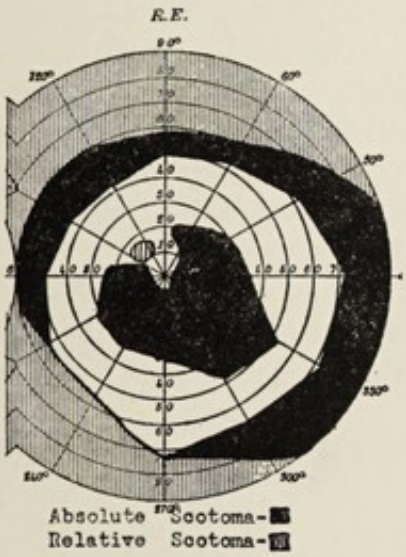
PLATE 83

Choroideremia, Acquired, right eye of a man 65 years old. W. O. I. No. 3,612.

Family History. — Tuberculosis in mother's family. *Past History.* — At 19 years of age, iridochoroiditis in left eye. Despite anti-luetic treatment, the vision became impaired. When 50 years old, there was another attack in both eyes, variously diagnosed as iritis, choroiditis, "retinitis pigmentosa." In spite of a negative Wassermann, anti-luetic treatment was again administered; but the vision continued to diminish and the night-blindness to increase. *Present Illness.* — Progressive failure of vision.

Physical Examination. — Medical, negative. Blood pressure, 130/78. Nose, throat, genito-urinary tract, negative. Teeth: one infected. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Wassermann, negative. Urine, negative. Phthalein excretion, 65% in 2 hours. X-ray: sinuses and chest, clear. B. M. R., − 23. Spinal fluid, negative. Tuberculin, positive to 1/100 mgm.

Eye Examination. — By transmitted light, both eyes have the red-reflex of the albino. R. E. V. with correction = 6/9. Visual Field: (Fig.) Colour sense: recognition of primary colours. Light sense: 1/1000 of normal before dark adaptation; 1/10,000 of normal after 20 minutes. Slit lamp: depigmentation of pupillary border; pigment deposits on posterior surface of cornea and anterior capsule of lens; increased visibility of aqueous ray; posterior synechiae. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Media: posterior cortical opacity of lens; vitreous, clear. Disk, not atrophic; orange-red in colour; deeper shade than background; margins, blurred. Retinal vessels, especially arteries, slightly reduced in size; light-streaks, insignificant. Choroid, absent except for small spot near disk and large one at macular region; partially atrophic at extreme periphery (not shown in plate). Three, short, posterior, ciliary arteries emerge from under the smaller patch of normal choroid. One branch goes down to the periphery as far as can be followed, and three others go to the patch of choroid at the macular region. The spot of intact choroid at the macular region is irregular in shape and normal in appearance, except for a few pigment deposits on the surface. Below, and to the temporal side of this spot, there are numerous vessels that resemble the large choroidal veins. Rest of fundus, pale lemon-yellow, overlaid with blood vessels, and with irregular patches of pigment. The retinal vessels seem to be entirely suspended in front of the yellow background. Fundus of left eye, similar, but lesion more advanced. Patient was put upon thyroid and tuberculin therapy.



VISUAL FIELD, RIGHT EYE

NOTE: Eight years later, vision, unchanged. Slit lamp, aqueous ray, normal. Lens opacities have not increased; but there are a few atrophic patches in the two areas of normal choroid.

PLATE 84

Colloid Excrescences of the Choroid (Druses), right eye of a negro woman 47 years old. W. O. I. No. 2,430.

Family History. — Negative. *Past History.* — Headaches; loss of weight. *Present Illness.* — On admission, complained of chills, fever, and aching all over body. Eyes have given no trouble.

Physical Examination. — Medical: poorly nourished; palpable glands in axillae and side of neck; heart, systolic murmur at apex; abdomen distended with fluid, and tender on pressure; liver enlarged; clubbing of fingers; perirectal abscess. Blood pressure, 146/82. *Laboratory Reports.* — Blood. — Chemistry, normal. R. B. C., 1,360,000; W. B. C., 6,920; Hgb., 34%. Wassermann, doubtful positive. Urine: turbid; sp. gr. 1015; acid; albumin +; occasional R. B. C.; few W. B. C.; many epithelial cells; occasional cast. Phthalein excretion, 65% in 2 hours. X-ray: calcified nodules throughout chest; abdomen, calcified nodules in right upper quadrant, probably calcified glands; sinuses, clear.

Eye Examination. — Externally, both eyes normal. Vision, visual fields, blind spots, intraocular tension, normal. *Ophthalmoscopic Examination.* — Right eye. Media, clear. Disk, normal, except slight neuroglial veil over vessel entrance. The retinal vessels are practically normal; but they have the marked light-streaks and the solid appearance, so characteristic of the deeply pigmented fundus. The general background is of the normal negroid type. Scattered over the fundus, and posterior to the retinal vessels, there are numbers of small, regular, round, solid-looking, white bodies, and a few small pale yellow spots. They are especially numerous in, and around, the macular region. The diameter of many of these bodies is less than that of the arteries. But in the macular region, they have coalesced and formed larger masses. The proliferated retinal epithelium has advanced in places, and it appears in front of the druses, and in front of the vascular twigs. The left eye presents a similar appearance.

The retention of normal ocular functions, and the absence of all signs of inflammation, suggest the degenerative nature of this lesion.

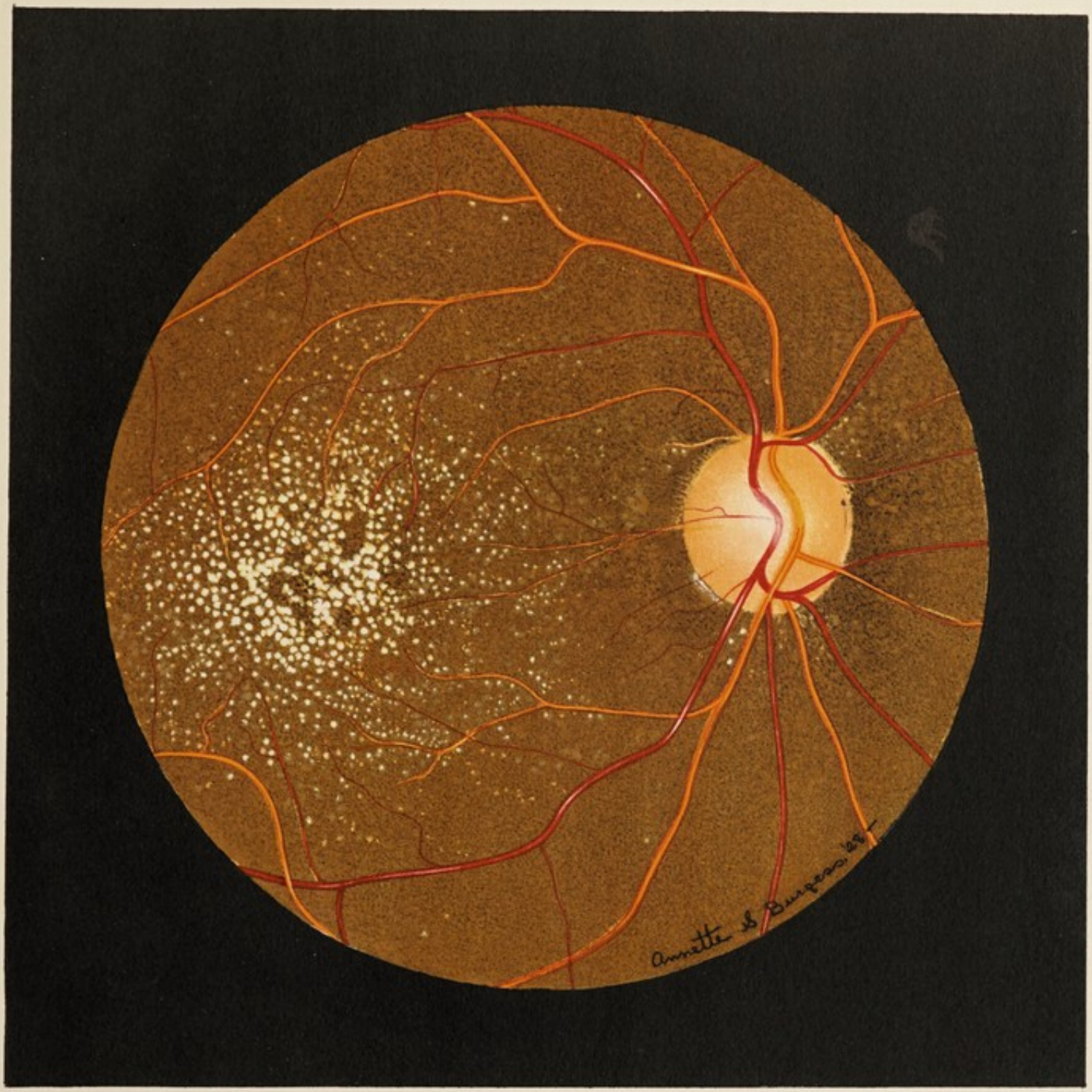

Annette S Burgess '28

PLATE 85

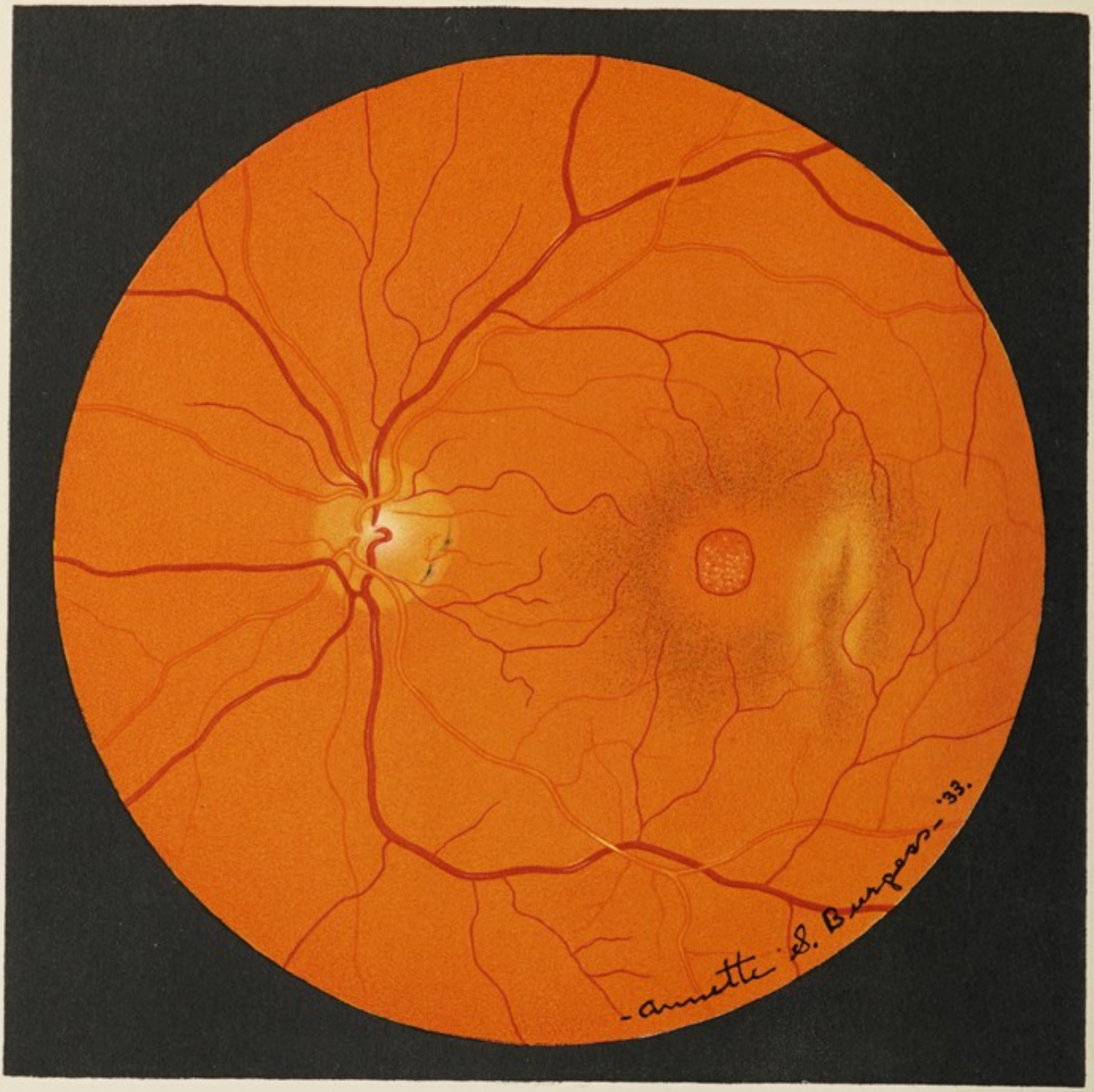


PLATE 85

Rupture of Choroid, and " Hole in Macula," left eye of a woman 29 years old. W. O. I. No. 8,591.

Family History. — Negative. *Past History.* — Twenty-two months before admission, had a severe fall, striking left side of head, which resulted in a fracture of the jaw and in numerous fractures through the sinuses of that side. For several weeks, she was critically ill, and unconscious at intervals. Seventeen months previous to fall, eyes had been examined and found normal. Four months after accident, patient was told that the vision was 6/30, and that there was macular degeneration of the left eye. *Present Illness.* — Complained that the left eye appeared small and sunken, though the vision had improved a trifle.

Physical Examination. — Medical, negative. Blood pressure, 108/68. *Laboratory Reports.* — Blood. — Chemistry, normal. R. B. C., 4,100,000; W. B. C., 10,000; Hgb., 75%. Wassermann, negative. Urine, negative. Phthalein excretion, 81% in 2 hours. B. M. R., − 10.

Eye Examination. — Right eye, normal in all respects. Externally, left eye, slight enophthalmos; drooping of upper lid; motion upward limited. L. E. V. = 6/20 +. Visual Field: for white, normal; definite contraction in upper nasal quadrant for blue, and to less degree for red; central scotoma. Blind spot, colour sense, light sense, slit lamp, intraocular tension, normal. Exophthalmometer: right eye = 20 mm.; left eye = 17 mm. *Ophthalmoscopic Examination.* — Media, clear. Disk, retinal vessels, and periphery, normal. The macular region proper presents the appearance of "hole in the macula," with the vertical axis a trifle longer than the horizontal. It has a reddish, granular appearance with many highly refracting white spots, which suggest cholesterol, and which are particularly well seen by red-free light. Surrounding the macula, there is a rim of lighter red colour. To the temporal side, there is a faint, irregular, V-shaped spot of choroidal and retinal atrophy. This marks the site of the former rupture of the choroid. Around the macular region and the scar, the fundus has a stippled appearance from the accumulation of pigment granules.

PLATE 86

Choroidoretinitis, Central, with Colloid Excrescences, right eye of a blond woman 60 years old. W. O. I. No. 3,495.

Family History. — Negative. *Past History.* — General health has always been good. *Present Illness.* — Complained of slight blurring of vision, especially marked in the left eye.

Physical Examination. — Medical, negative. Blood pressure, 158/85. Gastro-intestinal tract, negative. Tonsils, infected. Teeth, pyorrhoea. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Hgb., 78%. Wassermann, negative. Urine, negative. Phthalein excretion, 55% in 2 hours. X-ray: chest, emphysematous; sinuses, clear. B. M. R., − 5. Tuberculin, positive to 1/1000 mgm.

Eye Examination. — Externally, both eyes normal. Right eye. Vision, visual fields, blind spot, intraocular tension, normal. *Ophthalmoscopic Examination.* — Media, clear. Disk is normal, and around it there are faint, striate light reflections. The retinal arteries are somewhat solid-looking. The veins are faintly ribbon-like; and their macular twigs are slightly tortuous. The fovea is partially surrounded by a thin, red ring of extravasated blood, which gives the appearance of a very faint "hole in the macula." There are also some minute pin-point hemorrhages, especially above, and to the temporal side of the fovea. Below, and also to the nasal side of the macula, there are a few yellowish, mosaic-like spots, varying in size, and containing very fine cholesterol crystals. These crystals do not show very clearly in the plate. Below the macula, there is a slight disturbance of the retinal pigment. In contrast to the mosaic-like spots, there are scattered over the fundus — especially above the macula — many well-defined, round, yellowish white excrescences, posterior to the retinal vessels. These colloid masses are homogeneous in appearance, and generally greater in diameter than the retinal vessels. But some of them are very small. Others have exceedingly fine pigment rims.

The condition in the left eye is similar, but more marked.

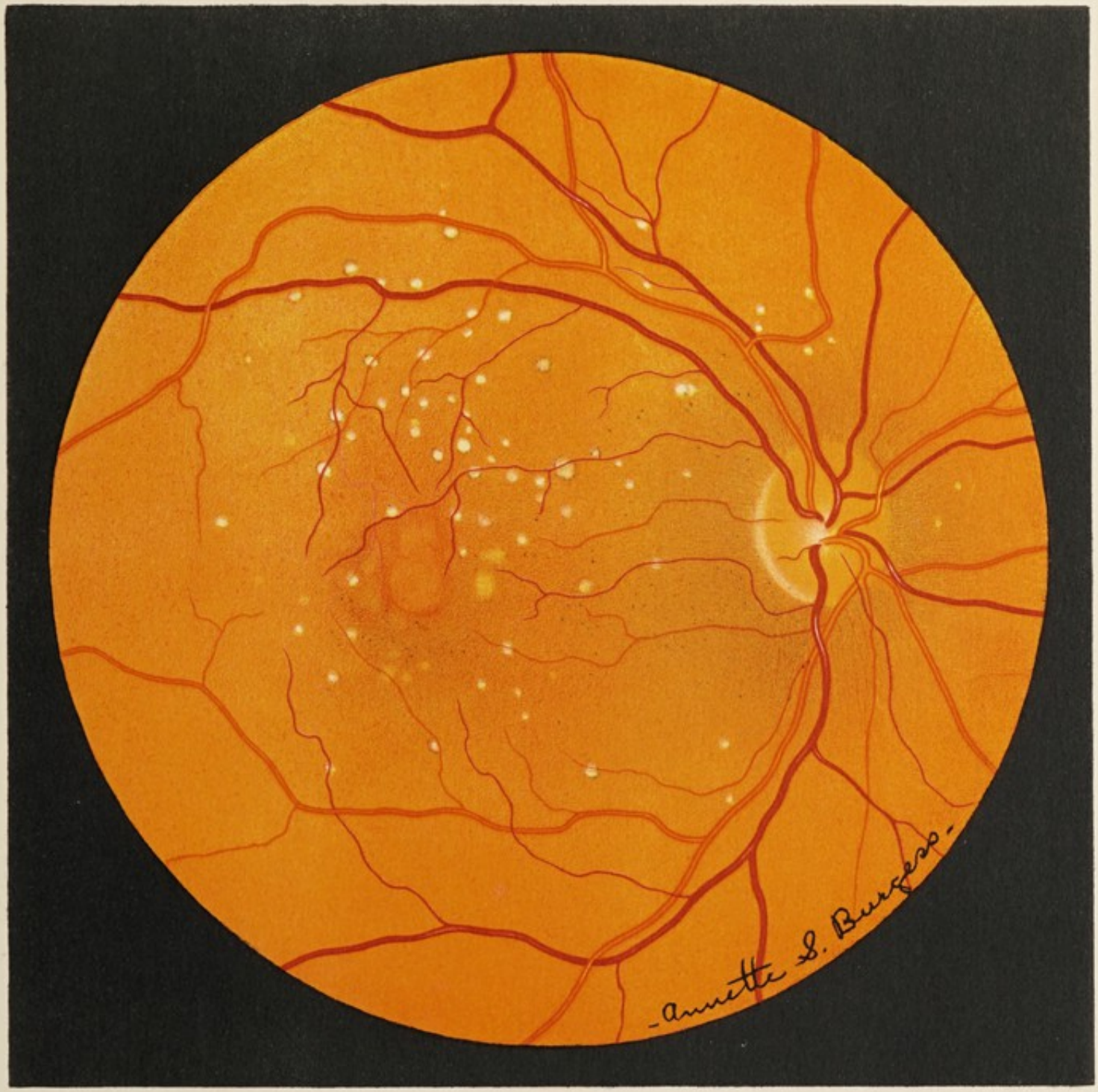

Annette S. Burgess

PLATE 87

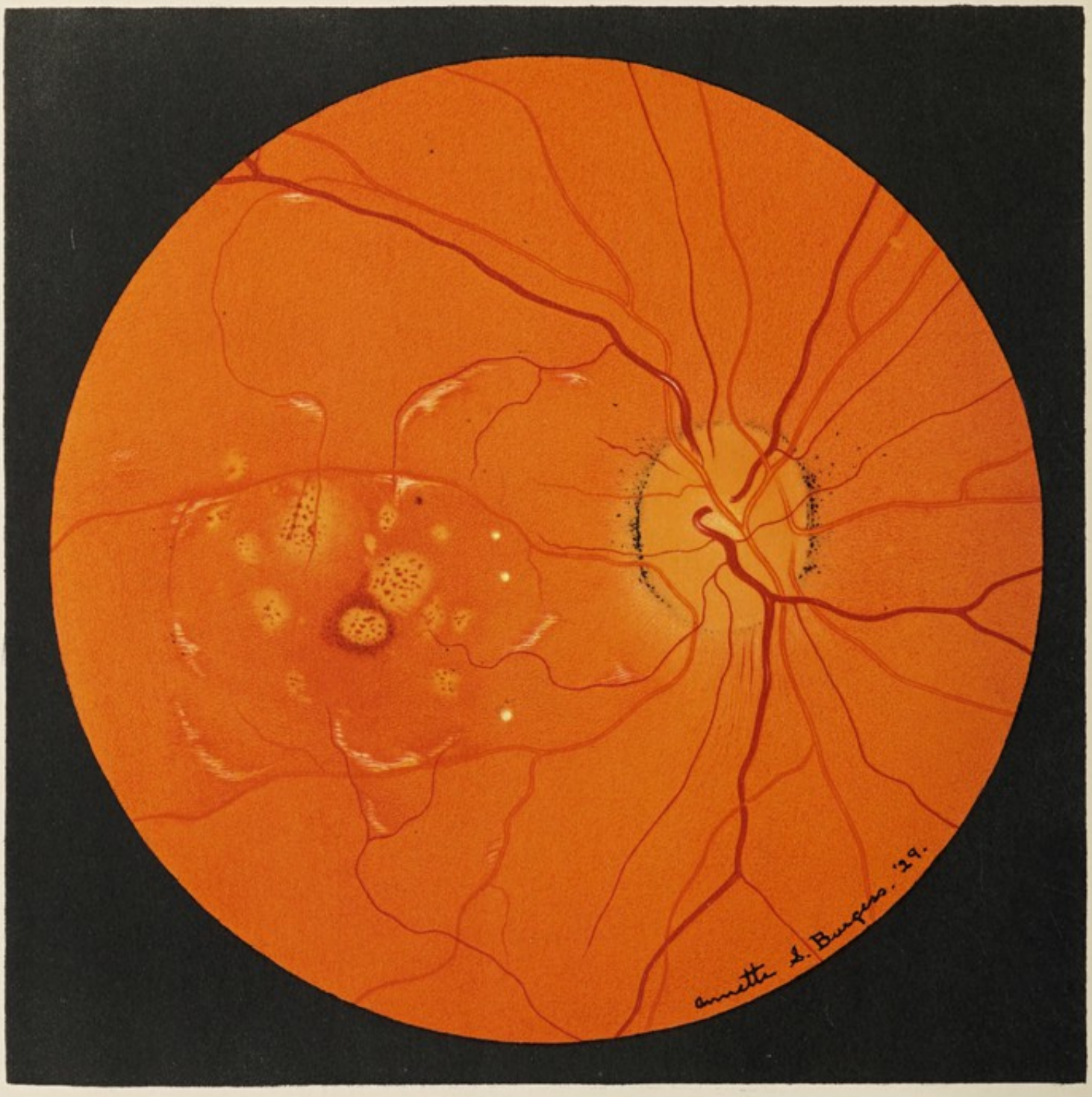


PLATE 87

Choroidoretinitis, Central, Degenerative, right eye of a man 30 years old. W. O. I. No. 3,696. *Family History.* — Negative. *Past History.* — Vision has always been poor. Diagnosis of inactive, tuberculous choroiditis has been made on several occasions. Has received treatment for luetic choroidoretinitis. *Present Illness.* — Sight has been slowly but steadily growing worse.

Physical Examination. — Medical, negative. Blood pressure, 110/70. Gastro-intestinal tract, nose, throat, teeth, negative. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Hgb., 86%. Wassermann, negative. Urine, negative. Phthalein excretion, 65% in 2 hours. X-ray: sinuses, chest, gall bladder, negative. B. M. R., — 8. Tuberculin, positive to 1/1000 mgm.

Eye Examination. — Externally, both eyes are normal. R. E. V. = 5/50 eccentric. Visual Field: periphery, normal; large central scotoma. Blind spot, enlarged. Slit lamp, negative. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Media, clear. Disk, normal colour; well-defined pigment ring around margins; faint retinal edema below. At the lower outer margin of the disk, there is a large cilioretinal artery which sends a branch above, and another below, the macula. The retinal vessels and the fundus periphery are normal. In the region of the macula, there are about twelve slightly elevated, golden coloured spots of varying sizes and shapes. These are speckled with highly refracting cholesterol crystals and minute pin-point hemorrhages. One of these patches is surrounded by a thin band of blood; and there is one minute retinal hemorrhage just below the upper branch of the cilioretinal artery. Between these golden coloured areas and the disk, there are three small, round, white dots similar to druses. Along the macular vessels, there are very pronounced, retinal light-reflexes.

The fundus of the left eye presents a similar appearance.

PLATE 88

"Hole in Macula" (Traumatic) with Papillitis, left eye of a negro man 47 years old. Unit No. 28,725.

Family History. — Negative. *Past History.* — Has suffered from cough; spitting of blood; pain over heart; shortness of breath. Twelve years before admission, was struck in left eye. *Present Illness.* — Since the injury, vision in left eye has been very poor.

Physical Examination. — Medical: heart enlarged; dilatation of arch of aorta; aortic insufficiency; sputum, tinged with blood; respirations of Cheyne-Stokes type. Blood pressure, 170/96. Infected tonsils. Pyorrhea. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Hgb., 70%; culture, negative. Wassermann, doubtful positive. Urine, negative. Phthalein excretion, 40% in 2 hours. Mosenthal test, negative. X-ray: heart and aorta enlarged. Spinal fluid, negative.

Clinical Diagnosis. — Syphilitic aortitis, and aortic insufficiency.

Eye Examination. — Externally, sluggish pupillary reactions, especially in left eye. L. E. V. = 6/60. Visual Field: slightly contracted; central scotoma. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Media, clear. Disk, salmon-red; margins, blurred; vessel entrance, obscured; one exudation at upper, nasal margin of disk. Another larger one extends from the vessel entrance, down and beyond the border of the disk. Retinal arteries, unchanged in size; solid-looking; width and brightness of light-streak, increased. Veins, a trifle full; small twigs, tortuous; light-streaks, marked on anterior arches. Surrounding the macular region, there is a light red halo. Within this band, there is a zone of about the same width as the outer ring, and like the rest of the fundus in colour. Distributed through this zone, there are half a dozen rather faint, white spots similar to druses. Around these spots, there is a slight disturbance of the retinal pigment. The space within this zone is occupied by a blood-red, crater-like spot more than 1/2 disk-diameter in width. This red spot contains a number of very minute, brilliant, white dots and small clumps of pigment granules. It is depressed below the surface of the retina, and no extravasation of blood or exudates are visible. Periphery of fundus, normal — apart from the slight arteriosclerosis. This fundus presents the picture of a traumatic "hole in the macula," to which has been added recently a mild papillitis.

In the right eye, there is a similar papillitis, but the macular region is normal.

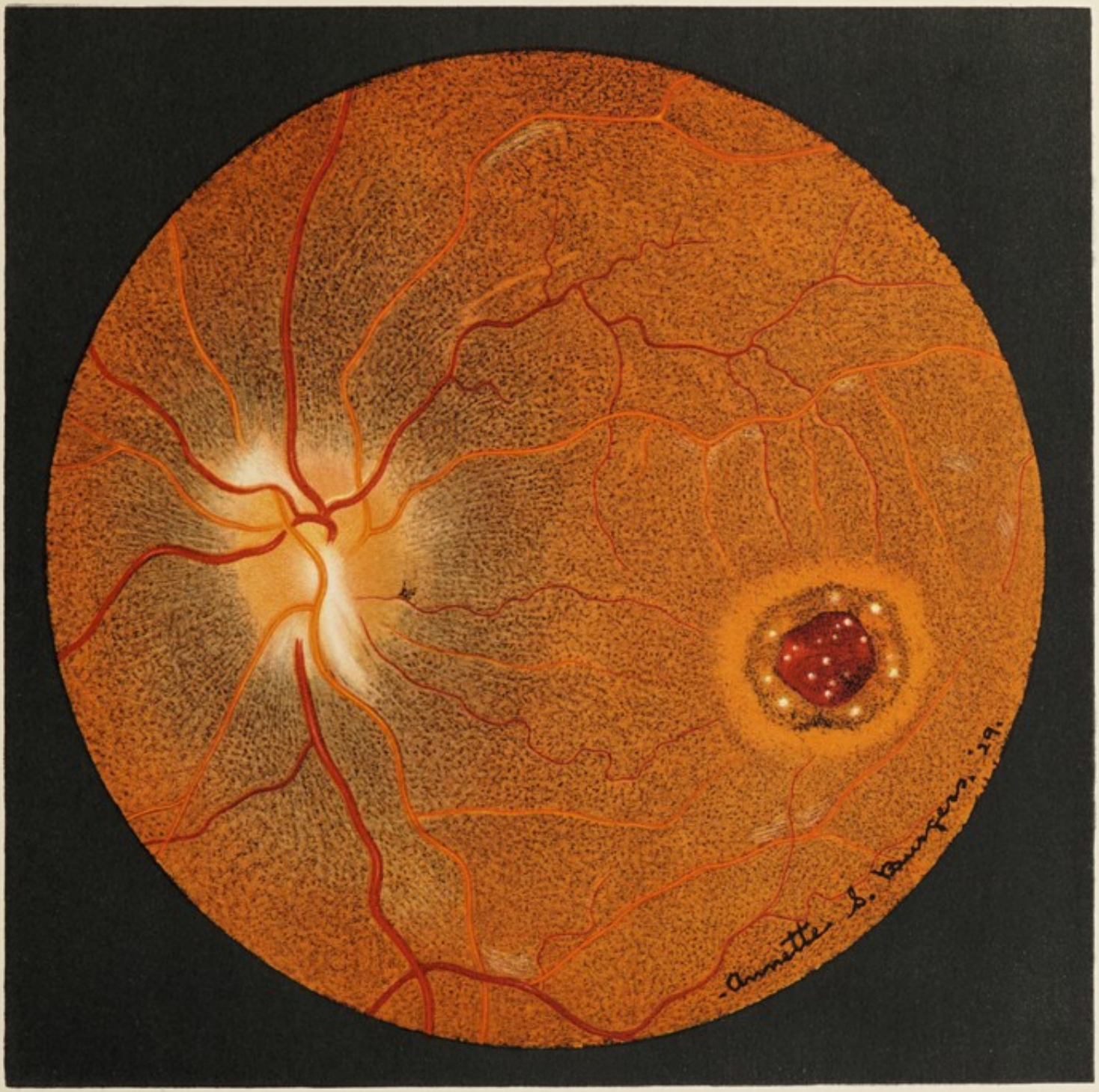

Annette S. Burpee, '29.

PLATE 89

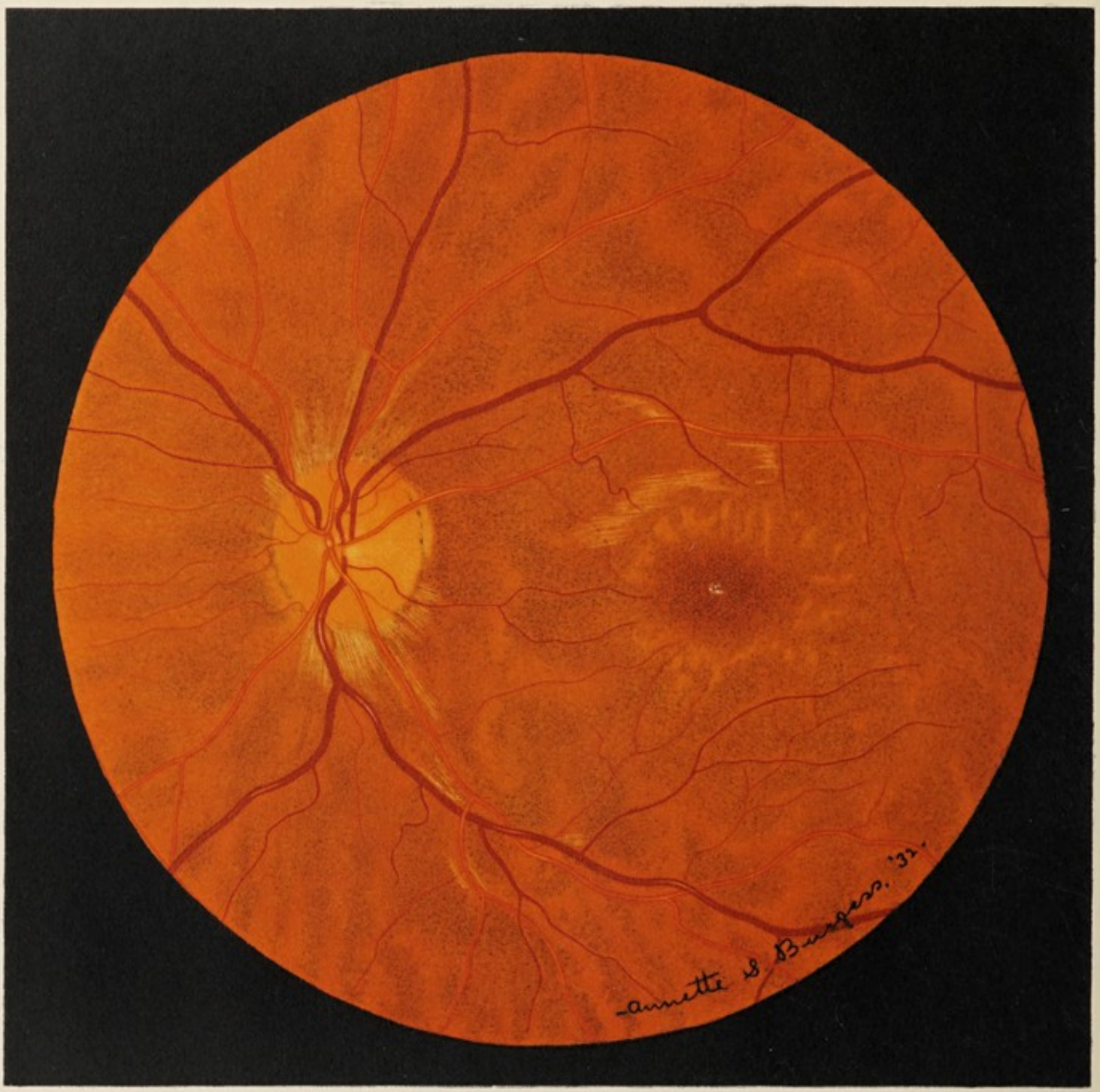


PLATE 89

Macular Degeneration, Juvenile,* Bilateral (Early Stage), left eye of a brunette youth 17 years old. W. O. I. No. 7,542.

Family History. — Father's sight has been poor; possibly condition is similar to patient's. *Past History.* — Delicate child. At five, tonsillectomy; at thirteen, appendectomy. *Present Illness.* — For one year prior to admission, sight has been blurred.

Physical Examination. — Medical, negative. Blood pressure, 120/58. Nose, throat, teeth, neurological, negative. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Hgb., 90%. Clotting time, 2 min. Wassermann, negative. Urine, negative. Phthalein excretion, 50% in 2 hours. X-ray, negative. B. M. R., − 9. Spinal fluid, negative. Tuberculin, positive to 1/10 mgm.

Eye Examination. — Externally, both eyes, normal. L. E. V., with correction, = 6/16. Visual Field: peripheral, normal; pericentral scotomata. Blind spot, colour sense, light sense, slit lamp, and intraocular tension, normal. *Ophthalmoscopic Examination.* — Media, clear. Disk, retinal vessels, and peripheral fundus, normal. Foveal light-reflex, linear, horizontal, brilliant, with five minute white spots above it. The adjacent retinal pigment has a slightly granular appearance. Surrounding the macular region, there is a discontinuous ring of very faint, irregular, radiating, yellowish red spots. With the Friedenwald ophthalmoscope, red filter, and proximal illumination, there are three small, dense, pigment spots, above, and to the nasal side of the fovea. Each of these is surrounded by a thin atrophic halo. The pigment deposits are not shown in the plate, because they are not visible with the ordinary illumination. By direct red light, the minute spots in the fovea shine with crystalline brilliance.

The right eye presents a similar appearance.

Plate 90 illustrates the fundus of another youth in whose case the degenerative process is of longer duration, and the pigmentary deposits more marked.

NOTE: Eighteen months later, the sight and other ocular functions remain unchanged. The perimacular spots seem fainter. The foveal reflex is very marked. With every motion of the mirror, it dances about in a plane anterior to the reflections from the white spots. In the fovea these spots are a trifle more visible than a year ago, and they shine with crystalline brilliance in all types of illumination.

* Courtesy of Dr. D. H. O'Rourke.

PLATE 90

Macular Degeneration, Juvenile, Bilateral * **(Later Stage)**, right eye of a brunette youth 13 years old. W. O. I. No. 1,542.

Family History. — Negative. *Past History.* — Two years before this examination, had consulted an ophthalmologist because vision had been failing for six months. Vision uncorrected at that time = 6/60, each eye. Both antra have been opened; tonsils and adenoids removed. *Present Illness.* — Has not been able to attend school on account of poor sight.

Physical Examination. — Medical, negative. Sinuses, neurological, negative. *Laboratory Reports.* — Blood, normal. Wassermann, negative. Urine, negative.

Eye Examination. — Externally, both eyes normal. Vision, each eye, with correction, = 6/60 +. Visual Fields: peripheral, normal; relative central scotoma. Blind spots, slightly enlarged for colours. Colour sense, markedly impaired. Light sense: at beginning, somewhat reduced; in dark, sensitivity increases at approximately normal rate; after 15 minutes of dark adaptation, the sensitivity is 1/10 normal. Slit lamp, and intraocular tension, normal. *Ophthalmoscopic Examination.* — Right eye. Media, clear. Disk, normal; incomplete choroidal ring. Retinal vessels, normal with the exception of tortuosity of arteries (probably congenital). Periphery, normal. The macular region presents a degenerated, amorphous appearance. The area is occupied by granules and clumps of pigment and a few minute, white, atrophic spots. Over this whole region, the light-reflexes vary in colour from beaten silver to beaten gold; but it is impossible to depict the beauty of these evanescent reflections. In brilliant illumination, small vascular twigs appear as fine red threads.

The fundus of the left eye presents a similar appearance.

Plate 89 illustrates the earlier stage of a similar condition. These fundus lesions resemble two cases that were described by Batten[43] in 1897.

NOTE: Nearly five years later, sight, visual fields, disk, and vessels are unchanged. In the macular region, the pigment shows tendency to accumulate in groups, and to render the intervening atrophic spots more visible. The beaten gold reflexes are more pronounced.

* Courtesy of Dr. Lee Cohen.

[43] Batten, R. D. "Two brothers with symmetrical disease of the macula, commencing at the age of 14." Trans. Ophth. Soc. U. K. XVII. p. 48. 1897.

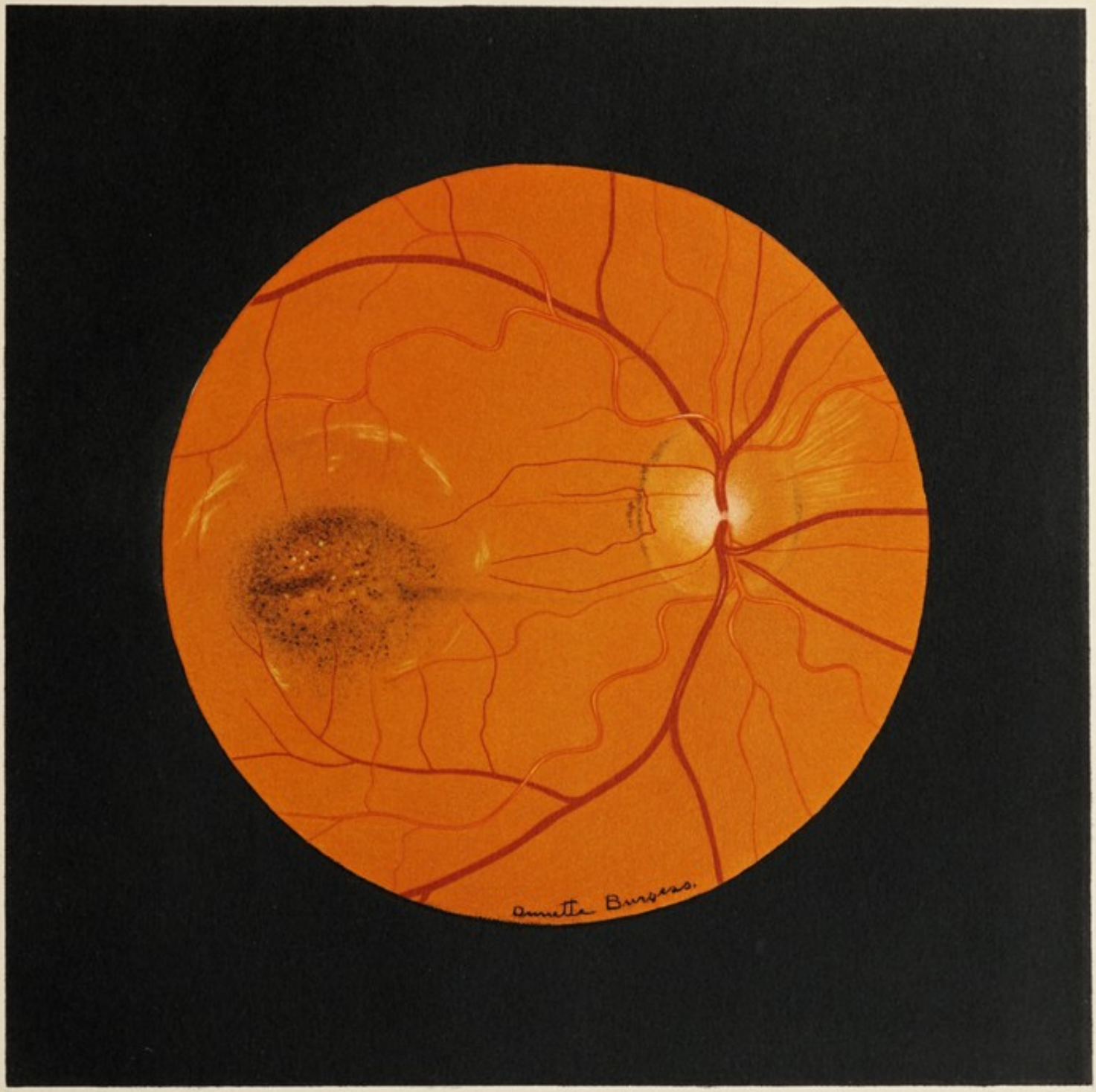

Annette Burgess.

PLATE 91

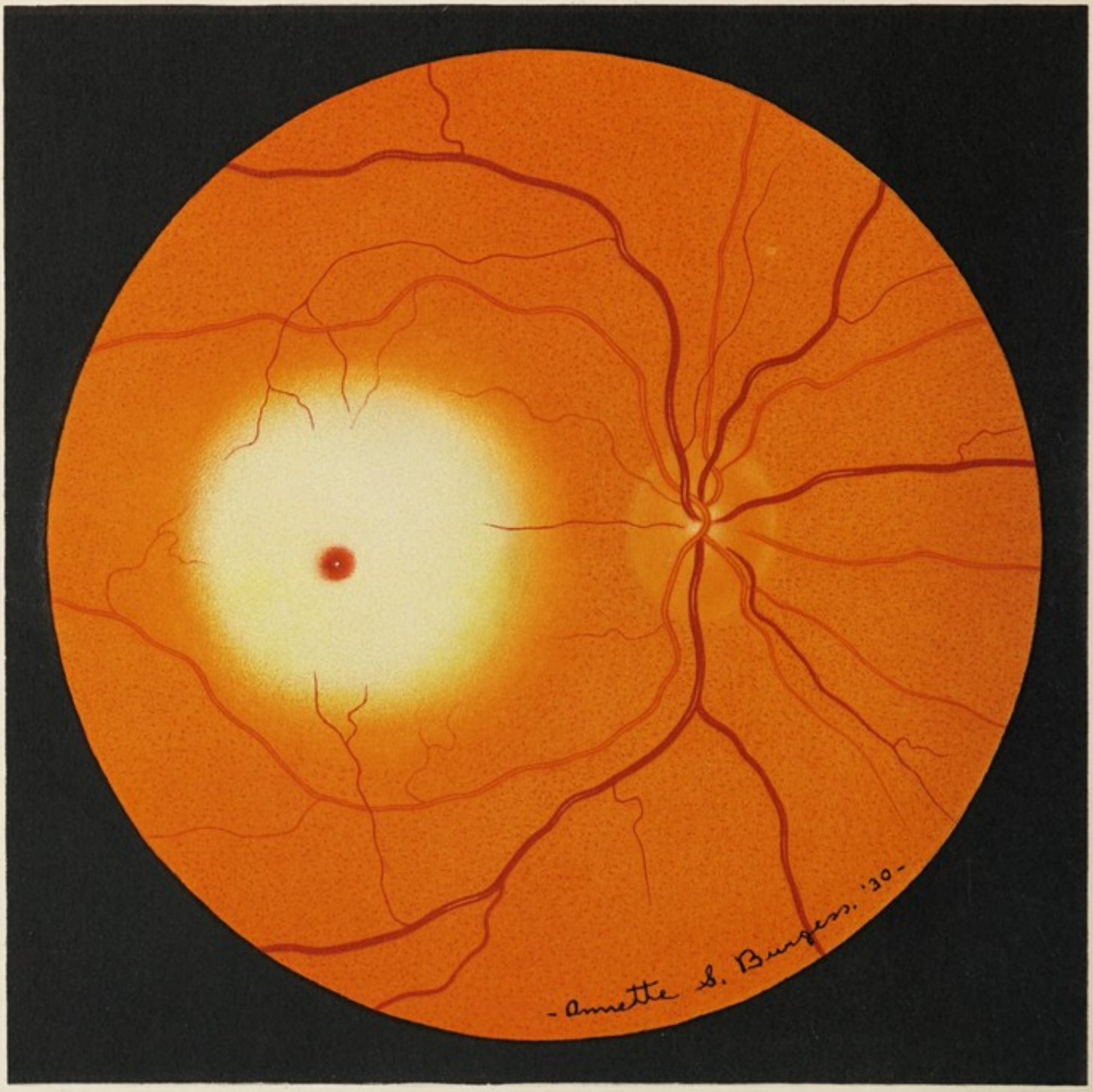


PLATE 91

Macular Changes in Amaurotic, Familial Idiocy, Infantile (Tay-Sachs' Disease), Bilateral, right eye of a girl 11 months old. Unit No. 65,933.

Family History. — Parents, Jewish (Russian). Patient, the last of five pregnancies. First child had Tay-Sachs' disease. Miscarriages terminated second and fourth pregnancies. Third child, normal. *Past History.* — Delivered by forceps at full term. Nothing abnormal noticed during neonatal period; no diseases; no infections; vision seemed normal at six weeks of age; first tooth at seven months; gained well on hand feeding. *Present Illness.* — Child has never been able to sit erect or hold up head; has never spoken; hyperresponsive to auditory stimulation.

Physical Examination. — Medical: well nourished; weak; somewhat hypotonic; playful; slow in perceiving stationary objects. Reflexes, hyperactive. *Laboratory Reports.* — Blood. — Chemistry, normal. R. B. C., 4,600,000; W. B. C., 9,500. Hgb., 37%. Differential count, normal. Wassermann, negative. Urine, normal except for 20 — 30 W. B. C. per low power field. Cerebrospinal fluid: pressure, normal; clear; 3 cells per cu. mm.; Pandy test, negative.

Eye Examination. — Externally, both eyes, normal. Ocular movements, normal. *Ophthalmoscopic Examination.* — Right eye. Media, clear. Disk, retinal vessels, and peripheral fundus, normal. In the macular region, there is a milk-white area a trifle greater in width than two disk-diameters. This zone has fairly well-defined margins. In its centre, there is a blood-red, clear-cut spot with a bright foveal reflex. The opaque, whitish appearance of this area is due to the swelling and degeneration of the ganglion cells of the retina. In the fovea, the choroid is especially vascular, the retina very thin, and the ganglion cells practically absent. Therefore — as characteristic of this disease — the choroid appears brilliantly red in contrast to the surrounding opaque retina. The appearance of the macular region resembles the condition seen in embolism of the central retinal artery.

There is a similar condition in the left eye.

Disturbed lipoid metabolism has been suggested as the cause of this disease.

NOTE: Since this illustration was made, the patient has died; but another baby has been born and it is afflicted with a similar condition. Altogether, three children in this family have suffered from this disease.

PLATE 92

Angioid Streaks of Choroid, right eye of a man 26 years old. Unit No. 33,116.

Family History. — Negative. *Past History.* — When 8, adenoids removed. At 9, swelling about shoulders, elbows, hips, gradually increasing in size. *Present Illness.* — Five months prior to admission, sore throat. Two weeks later, albumin and blood in urine; loss of weight. No complaint of eyes.

Physical Examination. — Medical: calcification of muscles about hips, shoulders, elbows; of skin of axillae and cubital fossae; of many blood vessels; tachycardia; firm, smooth mass in epigastrium. Blood pressure, 118/50. Chronic tonsillitis. *Laboratory Reports.* — Blood. — N. P. N., 74 mgm.%; NaCl., 590 mgm.%; calcium, 9.7 mgm.%; phosphorus, 10.4 mgm.%; CO_2 combining power, 27.7 vol.%. R. B. C., 4,104,000; W. B. C., 10,500; Hgb., 68%. Wassermann, negative. Urine: large amounts of albumin; a few R. B. C.; casts. Phthalein excretion, 0 in 2 hours. X-ray: marked calcification of vessels; bone deposits around joints. B. M. R., − 1. *Course.* — Continuous vomiting, progressive anemia, uremia, and death.

Clinical Diagnosis. — Calcinosis generalisata; hypo-parathyroidism?; chronic nephritis.

Eye Examination. — Externally, both eyes, normal. R. E. V., with correction, = 6/6 +. *Ophthalmoscopic Examination.* — Media, clear. Disk, normal red colour; optic cup, insignificant; around nasal and upper margin of disk, a narrow zone of stippled pigment. A yellowish red ring of choroidal atrophy embraces this zone. On temporal side of disk, the scleral ring and the choroidal atrophy form a plaque one-half disk-diameter in size, varying in colour from a pale red to a dirty grey. An attenuated choroidal vessel runs vertically through this zone. Above, it is continuous in one of the striae. Below, it is connected with a radiating choroidal vessel. A few pigment granules are scattered irregularly over this area. The retina appears normal; and its vessels lie anterior to the scars and pigment deposits. Radiating from the disk, there are six pale yellowish red striae. In four of these streaks, there is a partially atrophic choroidal vessel running down the centre; and the margins of all of the streaks are dotted with pigment granules. In addition, there are many pigment granules scattered over the central area, but they do not form dense groups. The lesions seem to be quiescent.

Left eye presents a similar appearance.

NOTE: Five months after this illustration was made, patient died in uremia. Autopsy No. 824: massive localized calcification including skin, media of arteries, muscles, etc.; immense amyloid deposits in kidneys and other organs, including parathyroids. Repeated examinations of serial sections of the eye: in choroid, fine disseminated scars and foci of round cell infiltration (low grade chronic choroiditis). No amyloid deposits found in vessels. Retina, entirely normal.

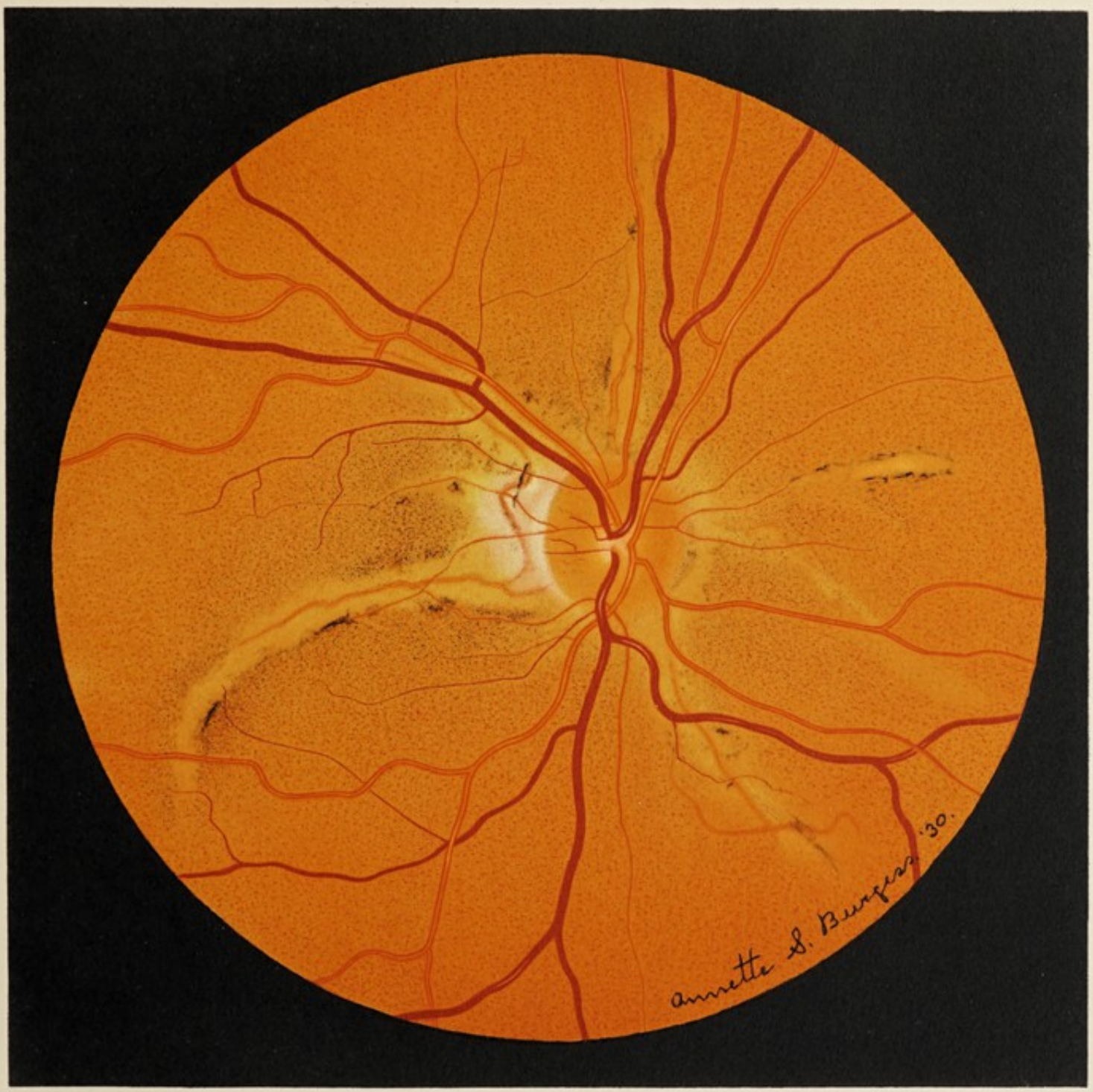

annette S. Burgess '30.

PLATE 93

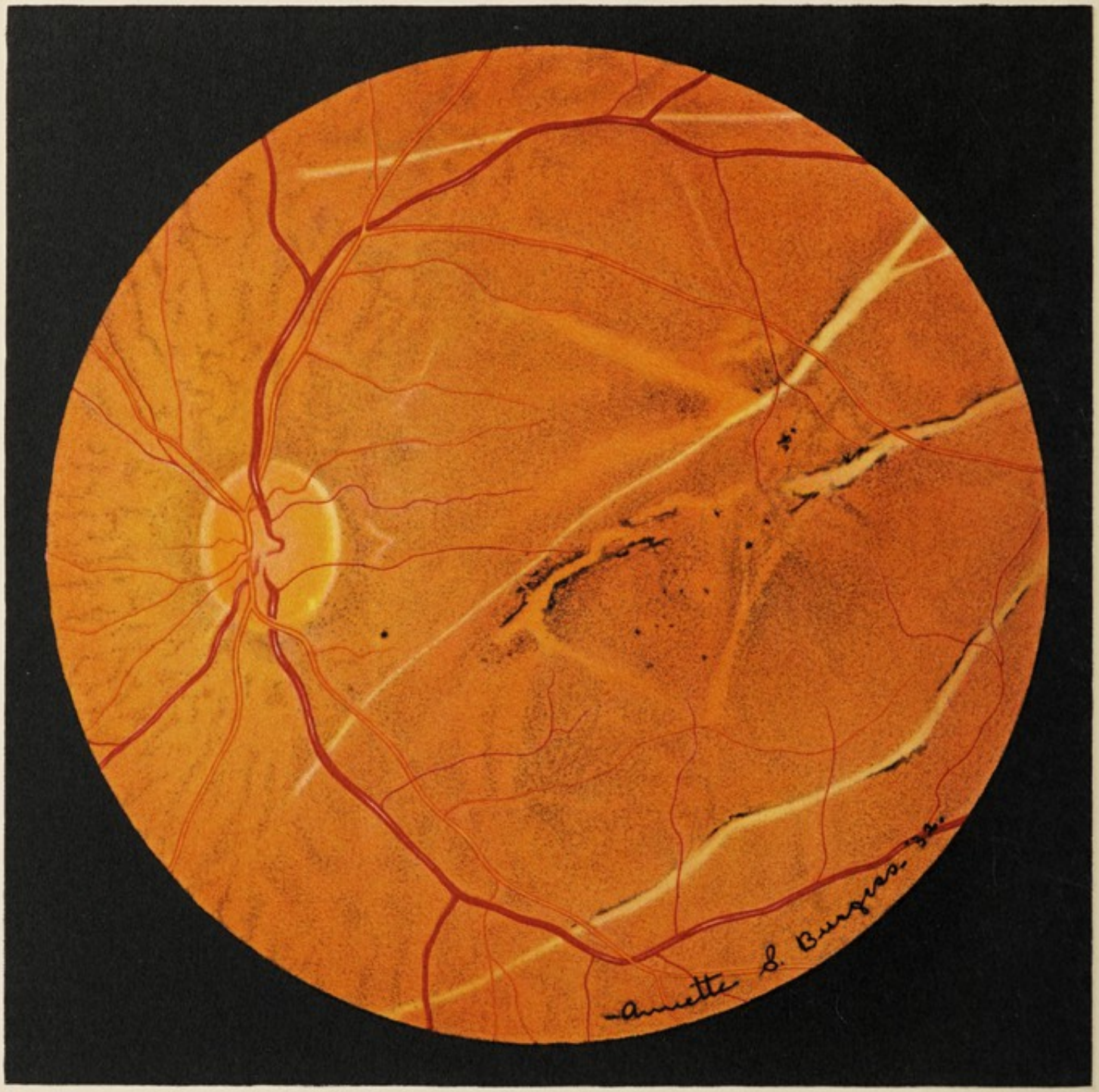


PLATE 93

Choroiditis, Striate, left eye of a man 24 years old. W. O. I. No. 5,432.

Family History. — Negative. *Past History.* — When 20 years of age, objects seen with the left eye were distorted. Three years later, intestinal disturbances; pus in right antrum. *Present Illness.* — Complained of flashes of light in right eye, and of flashes of light, black spots, and impaired vision, in left eye.

Physical Examination. — Medical, negative. Blood pressure, 130/86. Gastro-intestinal tract, negative. Enlarged and edematous adenoids. Teeth, negative. *Laboratory Reports.* — Blood, including Wassermann, negative. Urine, negative. Phthalein excretion, 65% in 2 hours. X-ray: chest, old fibroid tuberculosis of apices. B. M. R., − 7. Spinal fluid, negative. Tuberculin, positive to 1/1000 mgm.

Eye Examination. — Externally, both eyes normal. L. E. V. with correction = 6/15. Visual Field: concentric contraction; numerous scotomata. Colour sense, impaired. Slit lamp: opacities in deeper layers of corneal epithelium; depigmentation of pupillary margin. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Media: slight opacity of cornea and of posterior cortex of lens; many vitreous opacities. Disk, normal, with well-marked scleral ring; optic cup, insignificant. Retinal vessels, normal, and anterior to exudates, scars, and pigment. On the disk, the inferior temporal artery slightly compresses two veins; but this phenomenon does not appear elsewhere in the fundus. Around the macular region, there is a yellowish red, irregularly-triangular, choroidal scar. From its apex, a stripe of a similar, but lighter, colour extends upward and out. Above the macula, there is another very pale yellowish red, V-shaped disturbance of the choroid; but this lesion is more recent, the atrophy less advanced, and the pigment not so noticeable. To the temporal side of the disk, there is a small triangular scar. The very narrow streak in the upper part of the fundus, the long, irregular line running obliquely above the macula, and the diagonal band in the lower temporal periphery show varying stages of choroiditis. The borders of some of the striae are pigmented. In the central area, the pigment is accumulated into small clumps, or else it is diffusely deposited in a stippled form. In some places, where the exudation has not been absorbed, the over-lying retinal vessels are slightly elevated. Around the disk, and in the other unaffected portions of the background, the tessellated appearance is typical of the normal brunette fundus. The appearance of this fundus is somewhat similar to that of Plate 92.

The right eye is normal except for many, minute vitreous opacities.

NOTE: After twenty months of tuberculin therapy, sensitivity to tuberculin reduced from 1/1000 mgm. to 1/10 mgm.; eye lesions, quiescent; vision, slightly improved.

Retinitis, Exudative, Massive (Coats' Disease), left eye of a boy 12 years old. W. O. I. No. 7,906.

Family History. — Negative. *Past History.* — Measles, chicken-pox, scarlet fever. Right eye amblyopic (congenital). At nine years of age, tonsils and adenoids removed. About the same time, head injury without after effects. Three months prior to admission, L. E. V. with S. + 6.0 D. = 6/6. Fundus was normal. *Present Illness.* — Six weeks before this examination, sight of left eye suddenly became blurred; and it has steadily grown worse.

Physical Examination. — Medical, negative. Blood pressure, 110/72. Pitting of finger nails; no cause found. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Hgb., 90%. Clotting time, 3 min. Wassermann, negative. Urine, negative. Phthalein excretion, 85% in 2 hours. X-ray, negative. B. M. R., + 16. Tuberculin, negative to 1/10 mgm.

Eye Examination. — Externally, right eye turns in; left eye, normal. L. E. V. with correction = 1/60 −. Visual Field: cannot be taken accurately; normal size for light. Blind spot cannot be measured. Color sense, recognition of red and blue. Light adaptation curve: normal in shape; but sensitivity, 1/100 of normal. Slit lamp: slight increase in visibility of aqueous ray; vitreous fibres hang in vertical, zigzag folds, stippled with pigment granules. Intraocular tension, normal. *Ophthalmoscopic Examination.* — Media, clear. Disk cannot be located except by the converging vessels; its site is best seen with + 8.0 D. Only portions of the very tortuous vessels can be seen. Arteries, attenuated. Veins, somewhat ribbon-shaped; only anterior loops visible; posterior arches hidden by exudations. Vessel light-streaks, insignificant. Macular region marked by round and fusiform dilatations of small vessels — mostly veins. On these enlargements, the light-streaks are very pronounced. Near the fovea in the anterior part of the retina, there is a very small, round, dense exudation with reddish centre. This exudation is surrounded by a faint, greyish ring. Macular region best seen with a + 10.0 D. The greater part of the fundus appears blurred, waxy, and gelatinous, with a hazy, reddish background. In the periphery, particularly below and also to the nasal side, the exudations are especially dense and waxy-looking. In the extreme periphery, the vessels have broad, white, edematous borders. This phenomenon is illustrated in the case of one of the superior nasal branches. Best seen with + 6.0 D. to + 8.0 D. The right eyeground is normal. This plate is made slightly smaller than the original painting in order to show as much of the fundus as possible.

NOTE: Since the painting of this plate (13 months ago), there have been great changes in the fundus. The disk is more clearly seen, and it is less elevated. The vessels are more visible, and the aneurysmal dilatations in the macular region have disappeared. Arteries and veins retain their normal relation in size; but they are extremely tortuous. In the periphery, the vessels — particularly the veins — are bordered by white lines. Figure 1 illustrates the present appearance of the optic disk. Figure 2 shows the appearance of the inferior nasal vein and the numerous solid-looking white plaques in the nasal periphery. The colour and details of the peripheral fundus have become more normal, and the elevation is reduced 4 dioptres.

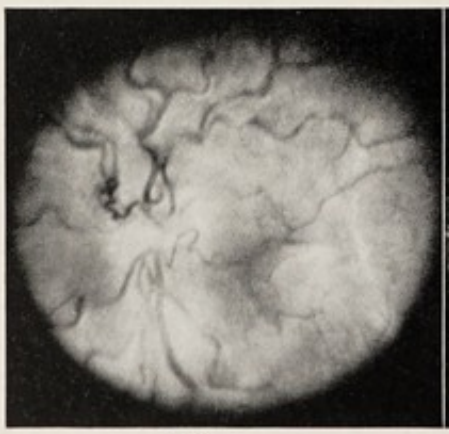


Fig. 1
OPTIC DISK

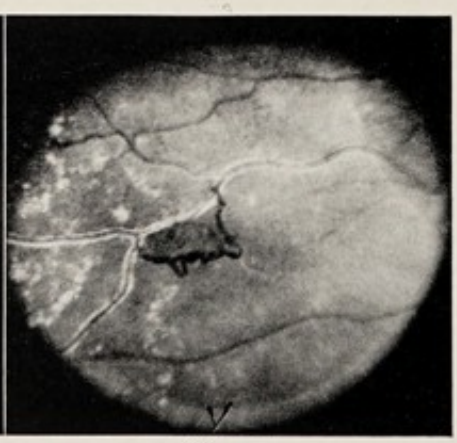


Fig. 2
INFERIOR NASAL VEIN, EXUDATES

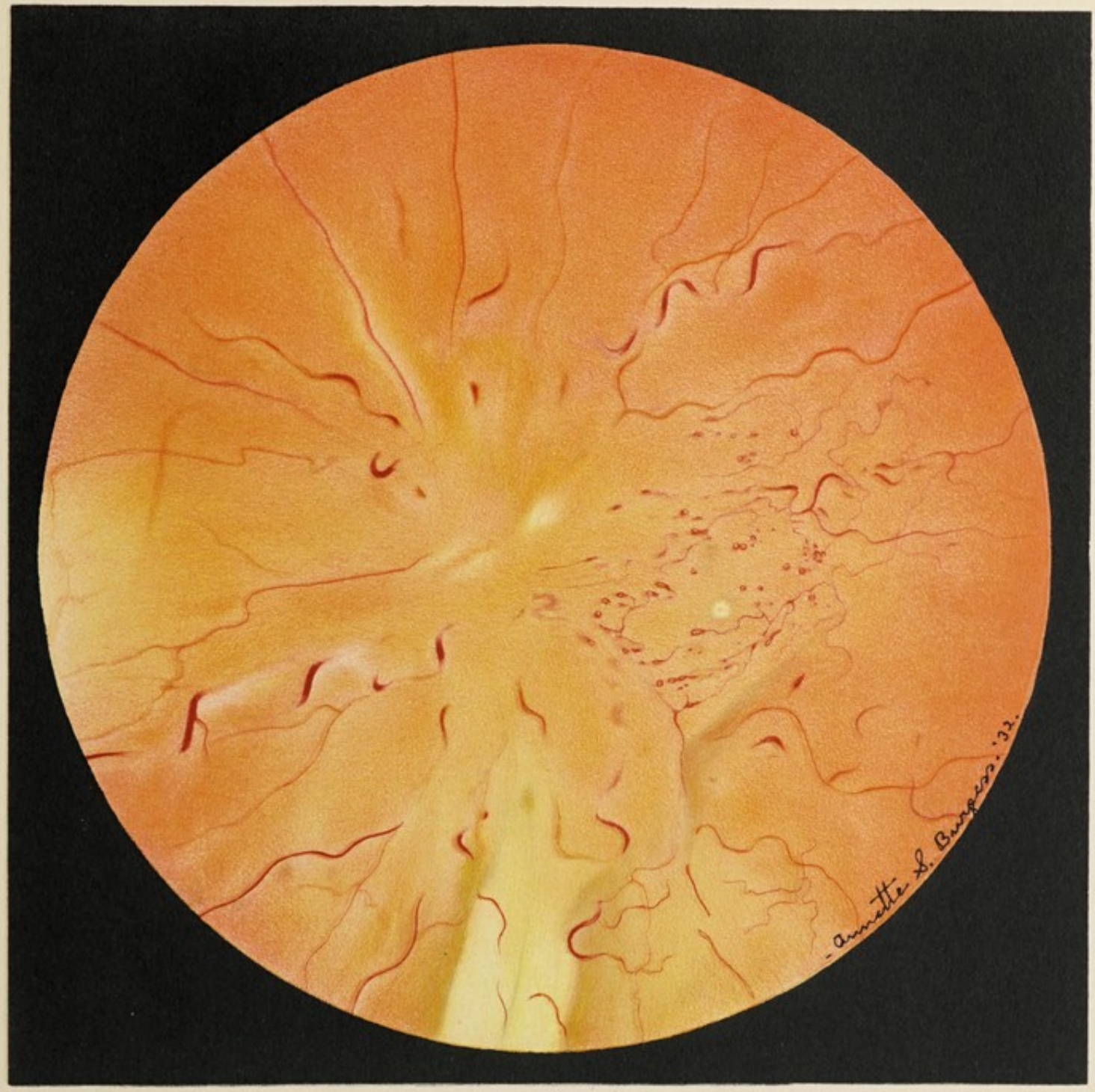
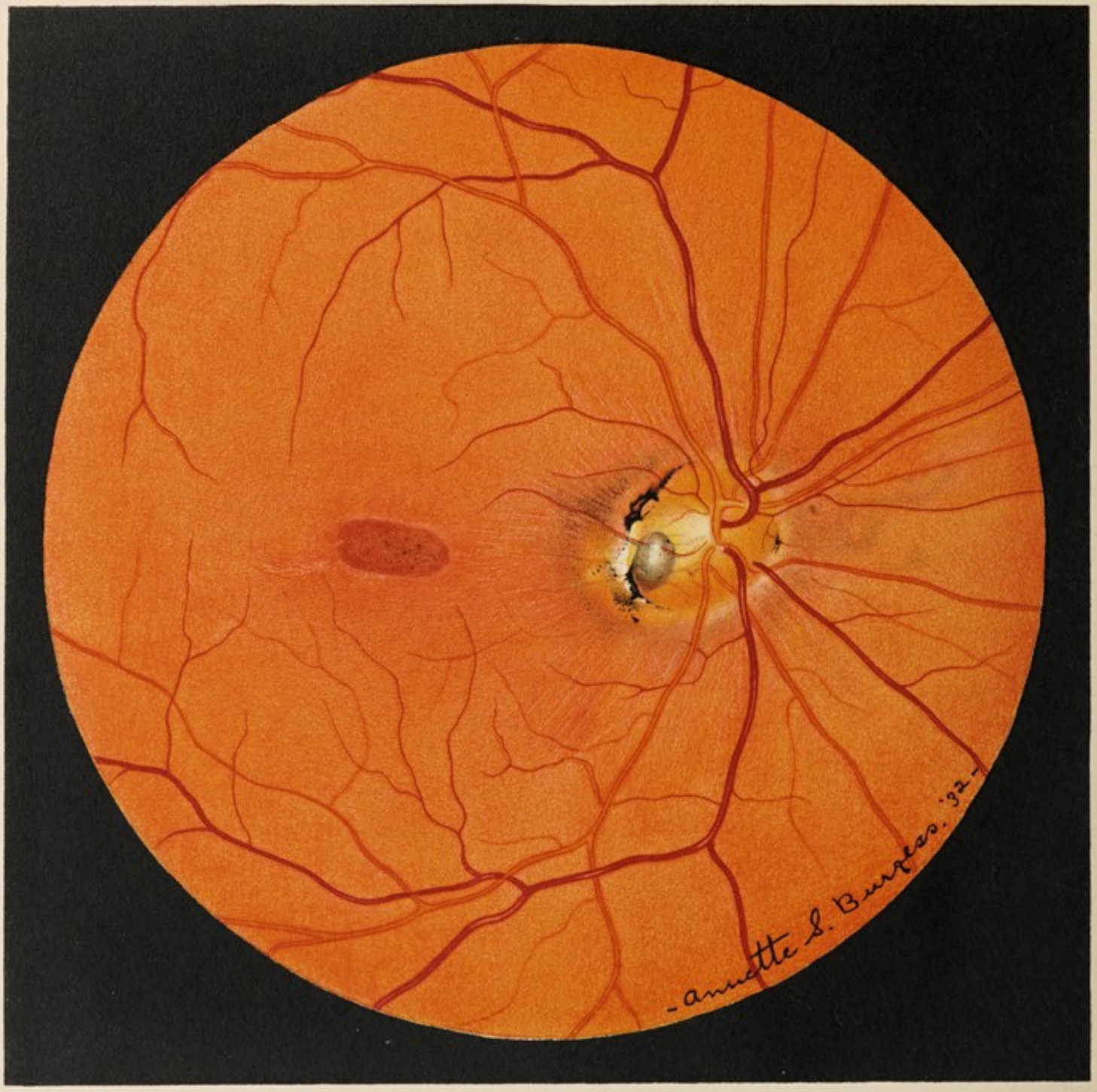

Annette L. Burgess. '32.

PLATE 95



Congenital Pit in Optic Disk, with Recent, Central Choroidoretinitis,* right eye of a blond woman 31 years old. W. O. I. No. 8,037.

Family History. — Negative. *Past History.* — Health, good, except pyelitis during pregnancy thirteen years ago, and cystitis three years ago. *Present Illness.* — Seven months prior to examination, blurring of vision right eye. Eyes never examined until two months ago, when she was told that there was "a tumour of optic nerve of right eye."

Physical Examination. — Medical, negative. Blood pressure, 118/78. Gastro-intestinal, nose, throat, teeth, neurological, genito-urinary, negative. *Laboratory Reports.* — Blood. — Chemistry and cytology, normal. Wassermann, negative. Urine, negative. Phthalein excretion, 70% in 2 hours. B. M. R., + 6. Tuberculin, positive to 1/10 mgm.

Eye Examination. — Left eye, normal in all respects. Right eye, externally normal. R. E. V. = 4/60. Visual Field: peripheral, slightly contracted; central scotoma. Colour sense, impaired. Light sense, slit lamp, intraocular tension, normal. *Ophthalmoscopic Examination.* — Media, clear. Disk, irregularly oval; margins, fairly well-defined; optic cup, slight; scleral ring, marked. On temporal side, pigment ring with large, partial, scleral crescent, similar to a myopic conus. Faint, radiating lines of edema partially surround the disk.

At the lower temporal margin of the disk, there is a small whitish area surrounded by grey, apparently 6 × 9 mm. in size. With the ordinary monocular ophthalmoscope, this area seems to be elevated. But the slit ophthalmoscope (especially with the binocular attachment) shows that the apparent nodular projection is really a small pit 2 to 3 dioptres deep. The greyish white colour at the bottom of this small depression in contrast to its slightly darker grey borders, causes the optical illusion of projection. Brightness is a secondary criterion of depth. Therefore, when the accommodation is relaxed, and the extrinsic muscle sense is in abeyance, an object that is white seems nearer to the observer than one that is grey. One small vascular twig dips down into the pit on its nasal side, and then climbs up over its temporal rim. Great magnification shows that two minute twigs encircle the lower margin of the pit. The vitreous with its limiting membrane is evidently pushed down into the bottom of this depression; for no membrane or glial tissue can be seen stretching across from one margin to another. The pit, which extends back to the lamina cribrosa, belongs to the class of circumscribed pit-formations recently described by Judasz-Schäffer.[44]

Macular region, a deeper red than rest of fundus; faintly granular; slight edema on temporal side. The macula seems depressed, and the lamina interna of the retina forms a thin homogeneous, over-hanging edge. General effect is that of "hole in the macula." The retinal vessels and the periphery are normal.

NOTE: Fourteen months after this illustration was made, the defect on the disk shows no change; but the vision is slightly better, the scotoma smaller, and the macular lesion less active. Evidently the pit on the disk is congenital, and the inflammation recent and incidental.

* Courtesy of Dr. Angus L. MacLean.

[44] Judasz-Schäffer, A. "Umschriebene Grubenbildung des Sehrnervenkopfes." Zeitsch. f. Augenhk. p. 314. Oct. 1933.

Hemangioma of the Retina (Lindau's Disease),* [45] left eye of a man 40 years old. W. O. I. No. 2,813.

Family History. — Father and aunt died from so-called " cystic tumour of the brain." Patient's eight children, brother, two sisters, free from retinal abnormalities. *Past History. — Oct. 1919.* Suffered from illness simulating cerebro-spinal meningitis. *Dec. 1922.* After bilateral cerebellar exploration, a " low-lying and superficially placed cyst " was removed. Uneventful recovery. Difference of opinion about choked disk in left eye; enormous veins running downward were observed; but angioma was not detected until more than five years after the operation. *Present Illness. — April 1928.* Complained of poor vision.

Eye Examination. — Externally, right eye, normal. Left eye, pupil irregular. L. E. V. w. S. + 7.5 D. = 1/60. Visual Field: confined to small inferior temporal quadrant. *Ophthalmoscopic Examination.* — Right eye, no retinal angioma. Left eye, posterior synechiae below; slight lens opacity. Disk, small; uniformly reddish; margins, blurred; accumulation of pigment on temporal side. Two very large vessels run downward and out from the disk. From its start, the artery is markedly beaded for the space of one disk-diameter. It narrows very much for a similar distance, then resumes its beading for the length of two disk-diameters. Where second beading ends, artery slightly indents its vein. Midway between this crossing and the tumour, there are two more beads. Vein, enormously enlarged and tortuous. Artery gives off one large, and two small branches; vein, two large branches, and a few tiny twigs. Two arteries enter the tumour, and two veins emerge. Superior retinal vessels, fairly normal; but upper nasal artery and vein, a trifle small.

Light-streaks, very marked on arterial beads and on anterior arches of veins. No pulsation. The tumour is in the extreme, lower, temporal periphery. It has a general pinkish colour, stippled with pigment granules; and it is traversed by two small blood vessels. The mass is elevated 2 to 3 dioptres. Its upper margin is hemispheric in shape; clear-cut in outline; white and fibrous looking; with a dense pigment ring. Lower border of mass, not visible. To upper, temporal side of disk, a large, irregular, wavy, whitish patch in the retina — apparently fibrous. On its nasal margin, there is an extensive patch of pigment, and a very small one on its lower border. From the main body of fibrous tissue, there are two processes. The larger one curves downward and outward, far below the macula; but only the beginning of the second is shown. To nasal side of disk, another large, white, irregular, fibrous patch, which also shows areas of pigmentation. A heart-shaped opening in the lower portion of this plaque allows the normal retina to be seen. Retinal vessels run anterior to both patches. Below, there are extensive masses of pigment, similar to ink blots. Where the beaded artery crosses its vein, there is a small, pear-shaped, whitish mass with pigment on its nasal margin. This area is traversed by two venous twigs. To temporal side of disk, a few minute cholesterol crystals.

General fundus of tessellated type. Beading of artery, great enlargement of vessels, similarity in their colour, and presence of a tumour, are characteristics of this disease. The resemblance in the colour of arteries and veins, is due to free intercapillary communication of vessels in the angioma. These tumours are of a familial and congenital nature, very vascular, with a rich reticulum containing fat-laden cells. Gliosis and fibrosis are secondary.

This plate has been made ⅔ the size of the original painting.

* Courtesy of Dr. Cushing.

[45] Cushing, Harvey, and Bailey, Percival. "Hemangiomas of Cerebellum and Retina. Lindau's Disease." Arch. Oph. Vol. LVII. No. 5. Sept.–Oct. 1928.

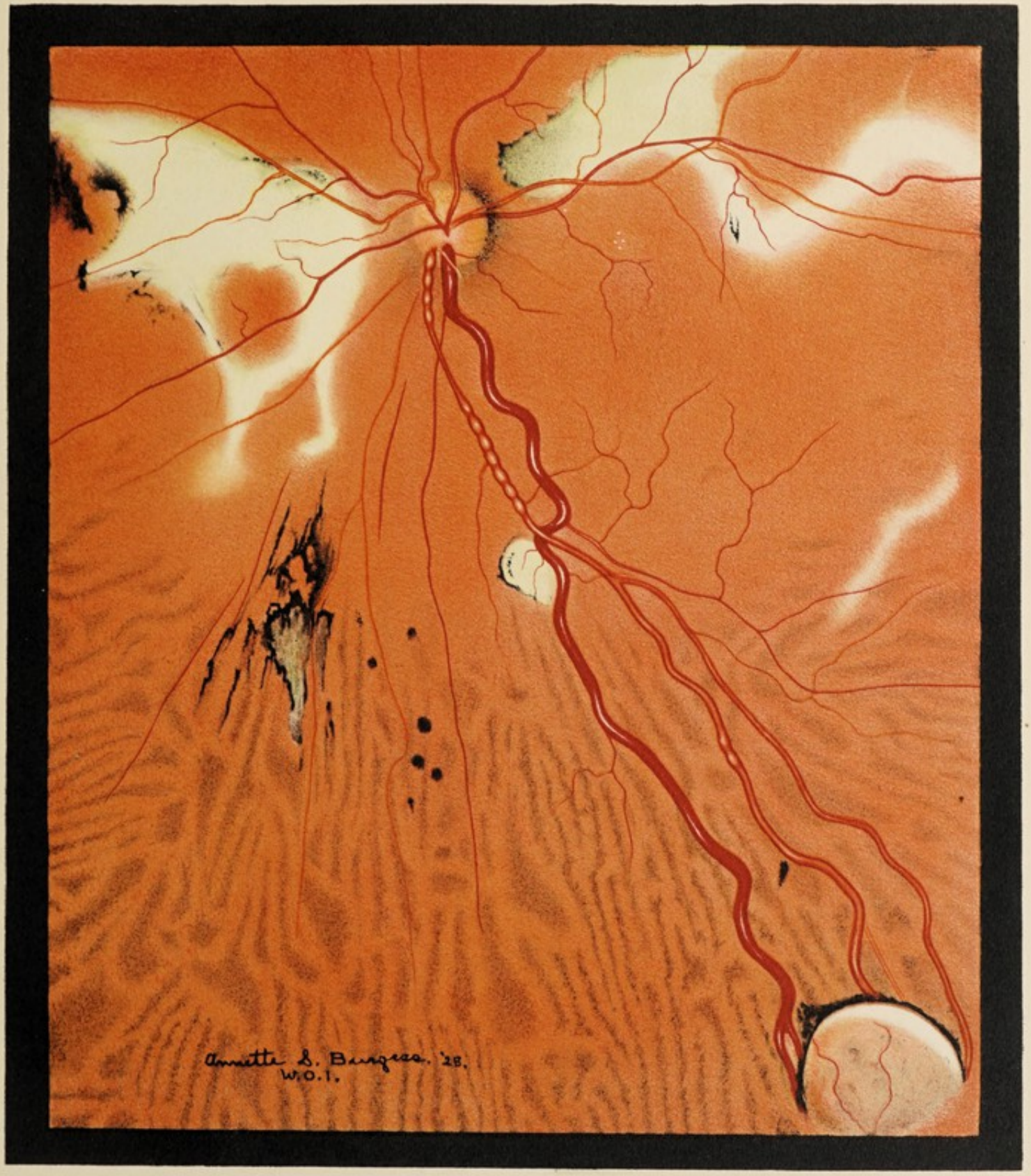

Annette S. Burgess. '28.
W.O.1.

PLATE 97

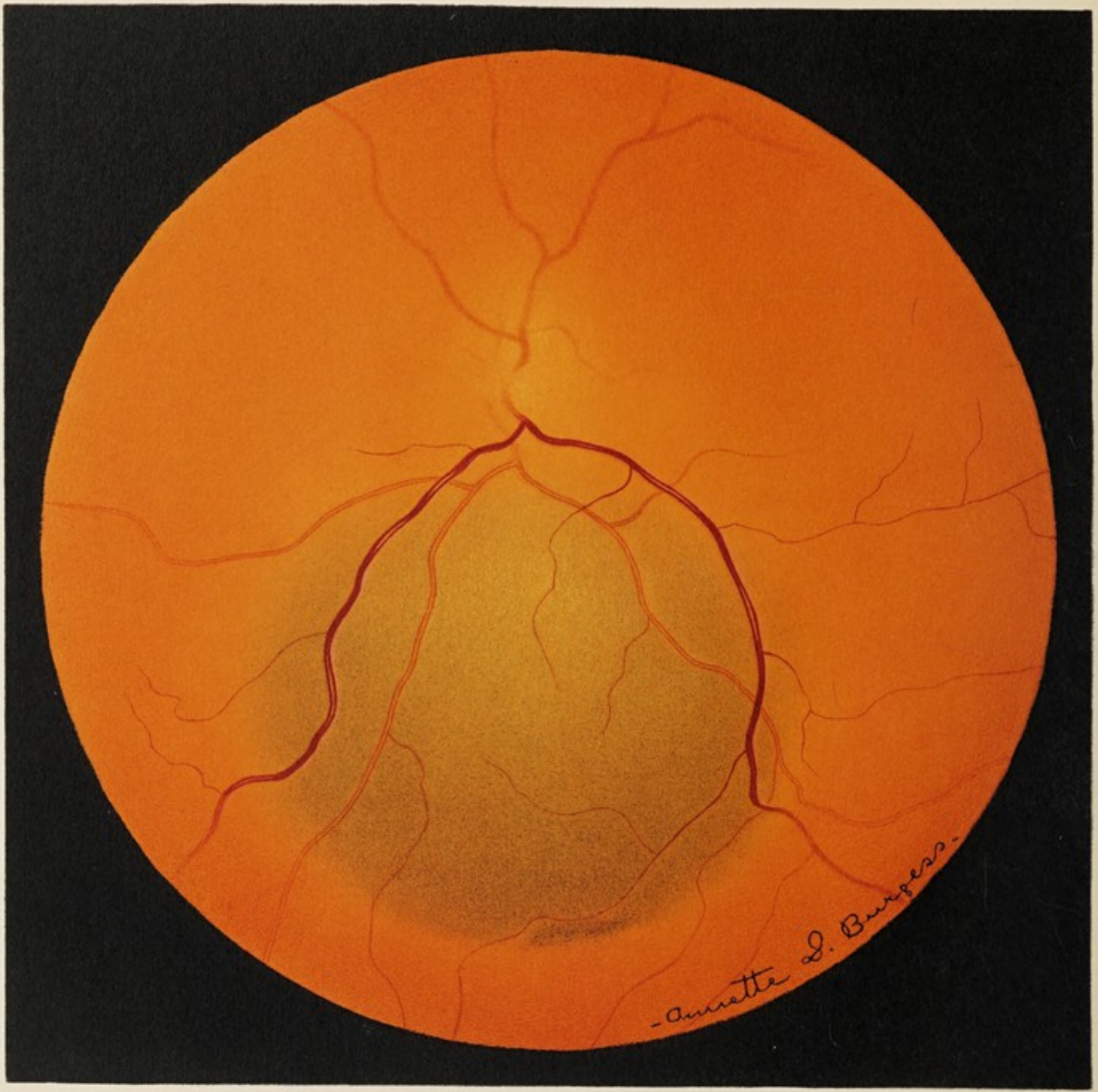


PLATE 97

Leukosarcoma of Choroid,* left eye of a woman 34 years old. W. O. I. No. 643.

Family History. — Negative. *Past History.* — Two years before admission, was struck on left side of head in an automobile accident. Sixteen months later, objects seen with left eye appeared blurred, amber-coloured, and reduced in size. Thorough survey made, and tuberculin treatment received. *Present Illness.* — Left eye, vision has been growing steadily worse. No pain. No discomfort.

Physical Examination. — Medical, negative, according to report brought by patient; sinuses and teeth, infected; laboratory tests, negative; tuberculin, positive.

Eye Examination. — Right eye, normal in all respects. Left eye, externally normal. L. E. V. = 1/60. Visual Field: slightly contracted peripherally; large scotoma in upper portion. Blind spot, continuous with scotoma. Slit lamp, normal. Intraocular tension, normal. Transillumination, faulty. *Ophthalmoscopic Examination.* — Media, vitreous opacities. Whole fundus hazy. Disk, a uniformly light red; margins, blurred. Retinal vessels, normal. Immediately below the disk, there is a mass which is about 3⅓ disk-diameters in its vertical aspect, a trifle wider horizontally, and elevated 4 to 5 dioptres. It is light brown in colour, and stippled with black. The lower temporal border is a somewhat darker colour, owing to the accumulation of pigment. This mass has a solid appearance. There is no fluid visible between it and the overlying retina. No separate system of blood vessels can be seen on the surface, or within the mass. Between the lower border of the tumour and the extreme periphery, there is a zone of practically normal fundus a little more than one disk-diameter in width. The diagnosis of sarcoma of the choroid was verified by enucleation, and by microscopic examination.

In this illustration, only the tumour is in focus. Compare this plate with Plates 45, 46, 48, 49, and 98.

Pathological Report. — Anterior segment of globe, normal; a lens-shaped mass arises from lower margin of optic disk; tumour very vascular and composed of completely-arranged, spindle-shaped cells; pigment scanty; at one point, cells have penetrated almost to nerve-fibre layer of retina. Histological diagnosis: circumpapillary leukosarcoma of choroid.

NOTE: Six and a half years after enucleation, patient was reported to be in good condition.

* Courtesy of Dr. Conrad Berens.

PLATE 98

Melanosarcoma (Malignant Melanoma) of Choroid, with Detachment of Retina, right eye of a woman 32 years old. W. O. I. No. 37.

Family History. — Negative. *Past History.* — General health has always been good. *Present Illness.* — For one year prior to admission, there have been white spots before right eye. Five weeks ago, a cloud appeared in upper field of vision; it has steadily increased.

Physical Examination and Laboratory Reports. — Negative.

Eye Examination. Left eye, normal in all respects. Externally, right eye, normal. R. E. V. = 6/60. Visual Field: concentric constriction; large superior temporal defect. Blind spot cannot be measured. Colour sense, recognition of primary colours. Light sense, candle motion at 20 feet. Slit lamp, normal. Intraocular tension, normal. Transillumination, very faulty. *Ophthalmoscopic Examination.* — Media, clear. Whole fundus, somewhat hazy. Disk, uniformly light red in colour; margins, blurred; optic cup, scarcely visible. Retinal vessels, fairly normal. At the lower border of the disk, there is a waxy-looking, greenish grey, faintly-stippled area. This zone is elevated from 4 to 5 dioptres. Below this mass, there is a semi-translucent, hemispheric area, elevated 12 to 15 dioptres; brownish red in colour, and stippled with pigment. In places, the pigment granules are arranged in small clumps. Between the solid-looking mass above, and the more translucent area below, there is a black line which runs across the lower segment of the eye in shape like a rainbow. This dark band is caused by the sudden elevation of the retina, by the disturbed retinal pigment, and by the reflection of the light away from the eye of the observer. The lower border of this area is beyond the limit of ophthalmoscopic examination. In the upper nasal quadrant, there are a few thin, superficial masses of pigment.

The diagnosis of malignant melanoma of choroid was made, and the eye enucleated.

Pathological Report. — Anterior segment of globe, normal. Large serous detachment of retina below. Underlying this, choroid thickened for a distance of 1 cm. from disk. Part of tumour nearest disk, densely pigmented; other portions, lacking in pigment. Tumour has broken through retinal pigment epithelium at its most anterior portion. Cells of tumour are mostly spindle-shaped, with great variation in form and size. Mitoses, few; extensive degeneration, and some proliferation of over-lying pigment epithelium.

NOTE: Eighteen months after enucleation, metastasis occurred in pelvis, and patient died from a general sarcomatosis. There was no return of the growth in the orbit.

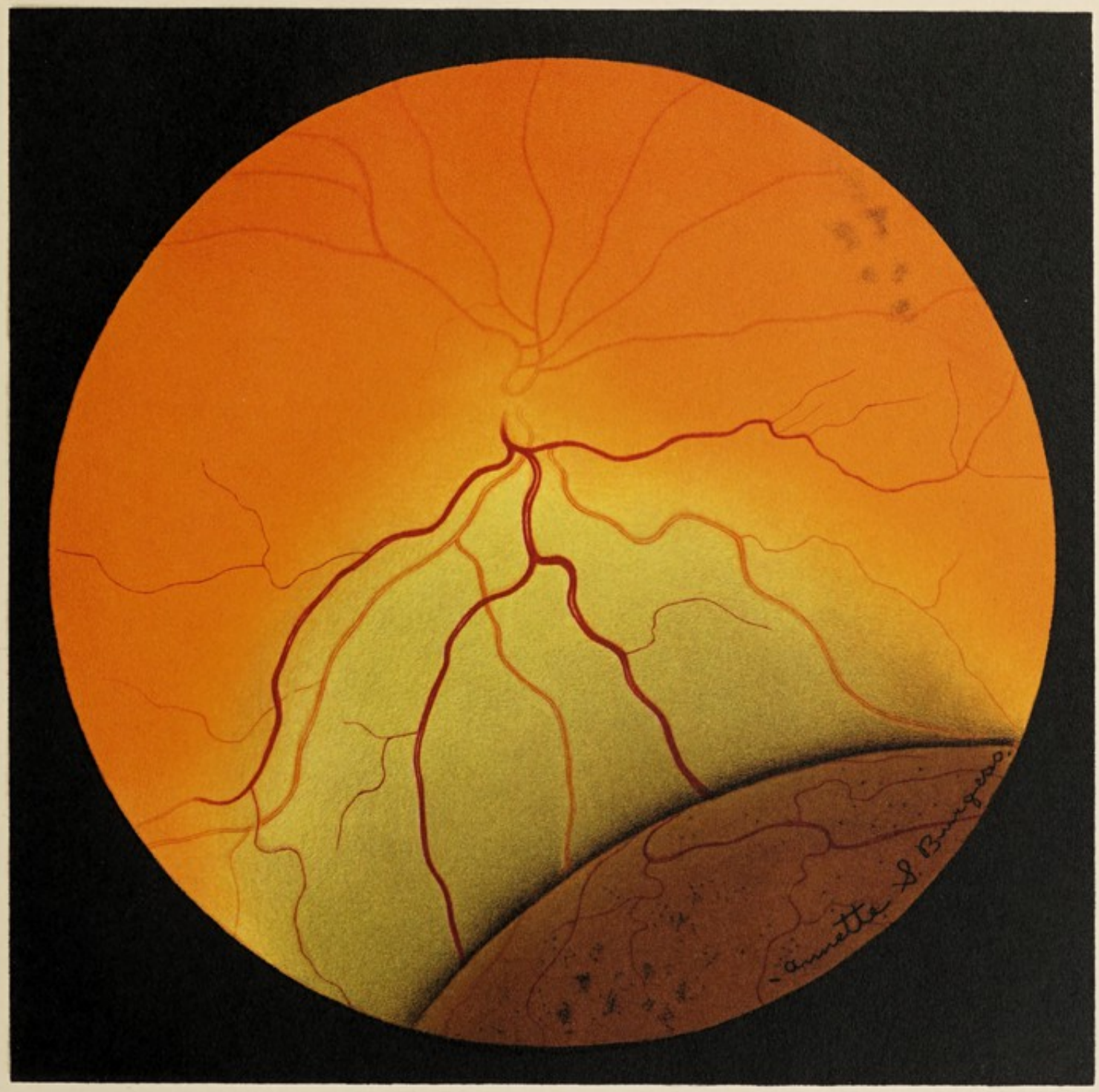


PLATE 99

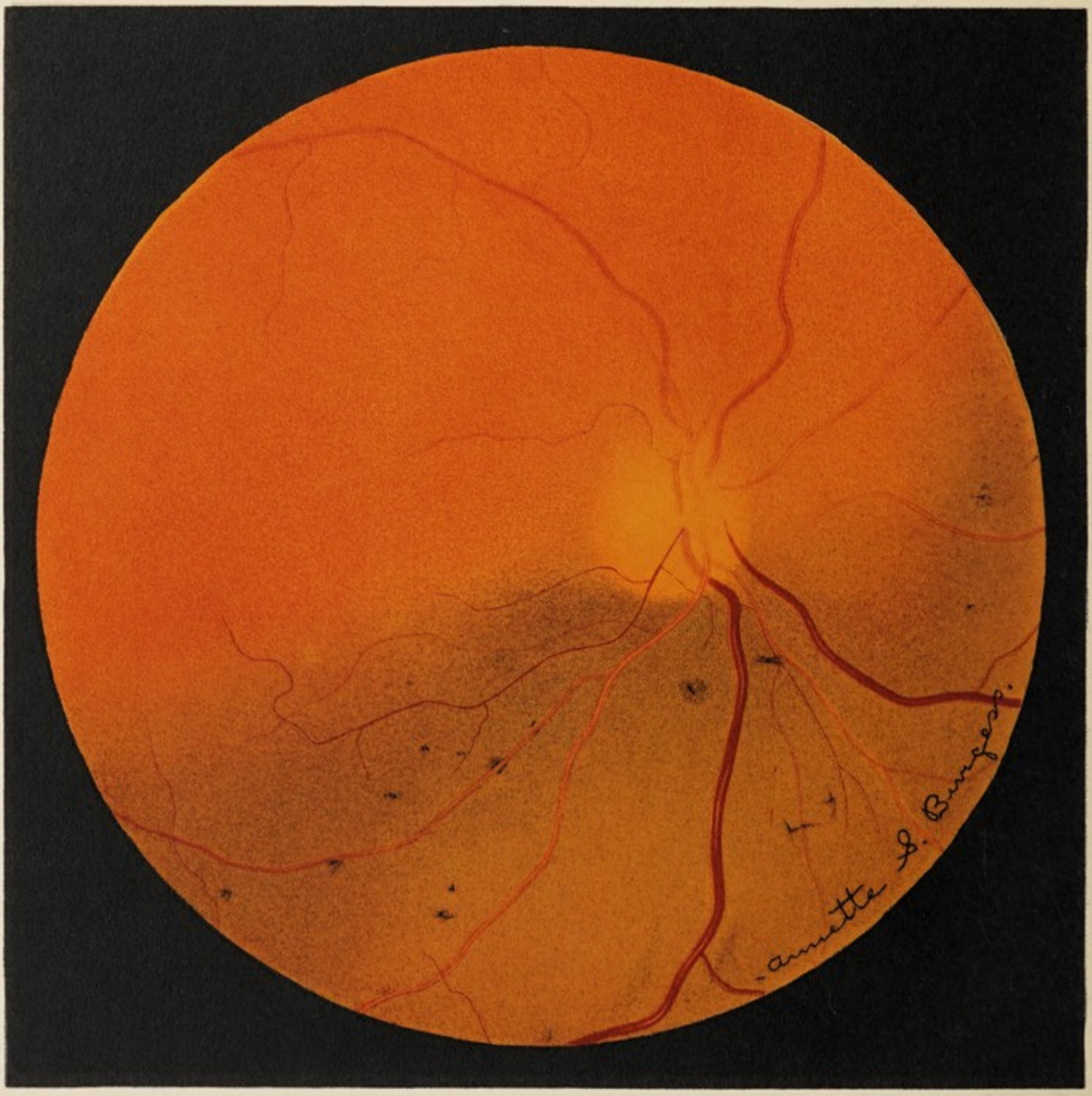


PLATE 99

Carcinoma of Choroid, Metastatic, Bilateral, right eye of a woman 40 years old. W. O. I. No. 3,249. (This plate was painted in Oct. 1928, before use of radium. Plate 100 shows the same eye six months later).

Family History. — Negative. *Past History.* — Five months prior to examination, left breast and axillary glands were removed for adenocarcinoma. *Present Illness.* — Three months later, sudden loss of vision, left eye; no complaint about right eye.

Physical Examination. — Oct. 11, 1928. Medical, negative. *Laboratory Reports.* — Blood, normal. X-ray: no tumour in other parts of body; bones abnormally opaque (snowy looking).

Eye Examination. — Externally, eyes normal. R. E. V. with correction = 6/6 − 2. L. E. V. = 3/60. Visual Field: right eye, peripheral, normal; absolute scotoma above point of fixation; left eye, concentrically contracted; absolute central scotoma. Slit lamp, negative. Intraocular tension, normal. Transillumination, poor. *Ophthalmoscopic Examination.* — Right eye. Media, clear. Disk, elevated 1 dioptre; margins and optic cup, blurred. Below disk, there is a stippled brownish mass with small clumps of pigment on its anterior surface. This area is solid-looking, and elevated 8 dioptres. Retinal vessels — hazy in other portions of fundus — are a trifle enlarged and well-defined over tumour. To nasal side of disk, retina is not elevated, but stippled with pigment. Left eye, condition much more extensive.

Jan. 10, 1929. During past two months, difficulty in swallowing from involvement of ninth nerve, and of second and third branches of trifacial. During past three months, radium has been extensively used. Extract from notes of Dr. C. F. Burnam: "In radiation of eyes, employed a single portal of entry on each side. A heavy lead cylinder with a 2 inch aperture was placed against the skin of the temple and the radium placed in the cylinder 3 inches away from the skin. The beam was so directed as to spare the cornea and perhaps the lens. Between Oct. 15 and Nov. 6, 1928, each eye received a total of 16.8 grams of radiation. Between Jan. 10 and 16, 1929, an additional 12 grm. hrs. was given with exactly the same arrangement. In addition, the sphenomaxillary fossa in front of the left ear and the medulla and base of the brain were given about 2/3 the dosage given the eyes. Palpable glands disappeared from the left upper neck and a glossopharyngeal paralysis cleared up. There have been no bad effects from the radiation so far as we can see. I am especially interested in the tolerance of the normal eye structure to this radiation."

PLATE 100

Carcinoma of Choroid, Metastatic, Bilateral (after use of radium), right eye of a woman 40 years old. W. O. I. No. 3,249. (Plate 99 illustrates the same eye six months earlier). *Interval History.* — Since first examination, *Oct. 11, 1928*, patient has had intensive radiation. *Ophthalmoscopic Examination. — April 6, 1929.* Media, clear. Disk, clear-cut; margins, fairly distinct; optic cup, visible; no elevation. Area around disk, stippled with pigment. Retinal vessels, clearly-defined above the disk and over the tumour. The tumour mass is a chalky, yellowish red colour, and it is elevated less than 3 dioptres. There are deposits of disintegrated and accumulated pigment granules in the retina over the tumour. These pigment spots occupy various positions relative to the retinal vessels.

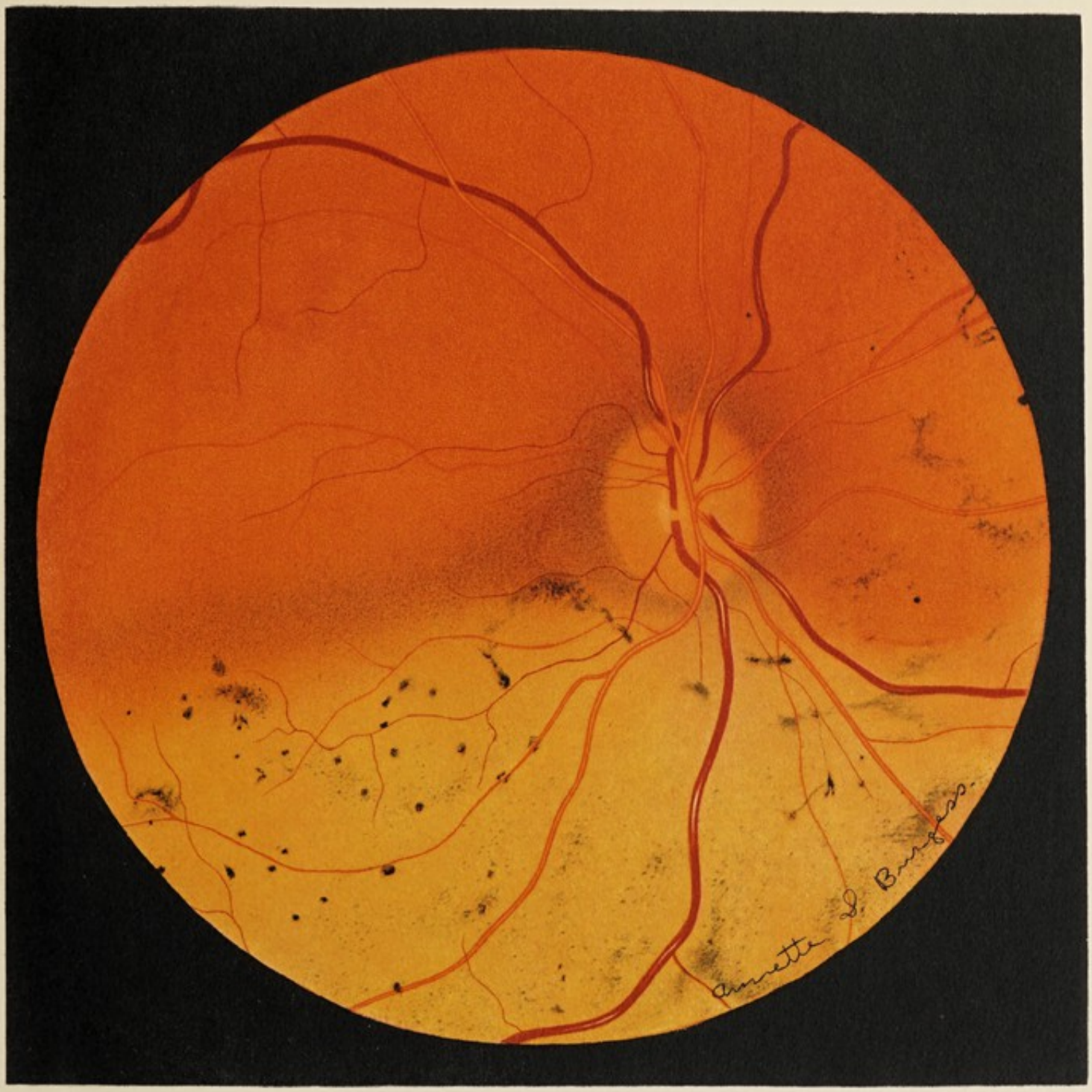
During the past six months, there has been a great change in the cellular architecture of the tumour. It is smaller, flatter, and of a lighter colour. The changes in the left eye are even more marked.

Sept. 1929. Dr. Burnam stated that the right eye has been radiated for 5.6 grm. hrs., and the left eye for 7.7 grm. hrs. The same arrangement and portals as formerly described were employed.

Oct. 17, 1929. Patient's general condition, good; eyes comfortable. *April 3, 1930* (17 months after Plate 99 was made). Patient states that apart from accumulation of fluid in abdomen, general health has been good; eyes have given no trouble. R. E. V. with correction = 6/5; L. E. V. = 6/60. Visual Fields: right eye, practically normal; left eye, improved; but there is still contraction above, and a central scotoma.

Extracts from Dr. Burnam's notes: "*July 1930*, right eye received 2 grm. hrs. of radiation, left eye 3 grm. hrs. *Oct. 16, 1930.* Patient confined to house for some time. Radium given over abdomen in an effort to prevent recurrent accumulation of fluid. In spite of radium, abdomen fills about once a week and abdominal masses, which formerly responded so satisfactorily to radiation, now cease to respond at all." Patient died two days later, on Oct. 18.

Up to the end, the right eye remained normal in function, and the left eye retained its slight improvement.


Annette L. Barker

R/O/R