Cutter (E) ol

Reprint from Medico-Legal Journal, June, 1886.

DIAGNOSIS OF CONSUMPTION

—BY—

Means of the Microscope,

WITH REFERENCE TO

LIFE INSURANCE.

By EPHRAIM CUTTER, M. D., of New York.

W. A. Kellogg, New York.

DIAGNOSIS OF CONSUMPTION BY MEANS OF THE MICROSCOPE, WITH REFERENCE TO LIFE INSURANCE.*

By Ephraim Cutter, M.D., New York.

Consumption has long been regarded as a deceptive disease in which the usual signs furnished by auscultation and percussion may prove fallacious. So it has happened that some cases have proved to be consumptive that were regarded as not consumptive, and vice versa. Such confusion must add to the risks in life insurance. If it can be shown that there are any means of diagnosticating consumption in these doubtful cases when the usual physical signs do not clearly establish a diagnosis, it will certainly be advantageous to Life Insurance Companies by lessening their risks from incorrect diagnoses.

*Read before the New York Medico-Legal Society, April 21st, 1886.

The object of this paper is to make known that there are means of diagnosticating consumption any time within one year *before* the physical signs of lung necrosis and breaking down appear—that is in what may be called the pretubercular state.

To show that this is no untried or unstudied idea, I beg to refer to a volume in my hands written in 1877, entitled "A New Physical Sign of the Pretubercular State of Consumption," illustrated with 63 microphotographs including some taken with objectives as high as the 1-75 inch.

As this essay is unpublished, I shall draw freely from it in the present case feeling that I have a right to present facts that have stood the test of ten or more years time in my own experience as not unworthy of consideration by life insurance examiners. To make my presentation stronger I would state that my work is antedated by a publication in 1868, entitled "Microscopic Examinations of Blood," &c., by Dr. J. H. Salisbury. At the same time he had ready for the press a work on the causes and treatment of consumption with XXX plates of illustrations. This work I am happy to say is expected to be issued by W. A. Kellogg of this city as soon as the drawings can be reproduced by the Homer Lee Bank Note Company for printing. This contains a complete description of the subject matter of the present effort. The points made are in brief as follows :

1. Consumption of the lungs is characterized by a definite morphology of the blood, which, taken in account with the other physical and rational signs is characteristic of the disease.

2. This morphology differs from that of healthy blood, of syphilitic, of rheumatic blood, &c., &c., though it is possible for these morphologies to be present together, two or more in combination.

3. For any time within a year previous to the necrosis or breaking down of the lungs, this morphology of consumptive blood is found, so that—

4. In a doubtful case where a medical examiner for life insurance—for example—finds it to be on the borderland of health and disease, the morphology of consumptive blood comes in to settle at once the diagnosis and clearly define the line of action.

5. This is regarded as of value in life insurance as no company wants to insure the lives of consumptives nor on the other hand to refuse a risk, other things being equal, for a non-consumptive.

6. The importance of these statements as making out an advance in medical knowledge may well justify the presentation in a simple plain manner so that those who choose to avail themselves of them may do so in the most practical common sense way, and I crave your indulgence as I try to set forth the use of the new physical sign of microscopic inspection in the diagnosis of consumption.

MORPHOLOGY OF HEALTHY BLOOD.

That of a healthy nursing infant with a healthy mother is the type. "To obtain the blood a clean puncture or cut is made in any part of the body desired, the surface being previously cleaned." The capillary blood is the one studied not arterial nor venous. "The blood at once is transferred to a slide, then quickly covered with thin glass and placed under the microscope with 1-5 inch objective and one inch eye-piece." At the present day a good enough microscope can be procured for this purpose for fifty dollars, ($50.00) but the definition should be clear and achromatic. "By a little experience the blood may be under observation in one second from the time it leaves the stream."

FEATURES OF HEALTHY BLOOD.

1. Colored corpuscles. 2. Colorless corpuscles.
3. Serum. 4. Fibrine filaments.
5. Foreign bodies accidentally present.

1. COLORED CORPUSCLES,

in healthy blood, appear biconcave with edges well rounded out, clear, distinct and well defined ; their color is a deep, lustrous, ruby red appreciable fully only by actual observation ; their size varies in the same individual, average 1-3400 of an inch; uniformly *distributed through the field, sometimes in rouleaux;* number in the field varies with method of manipulation. If the drop of blood is large for the cover, they will be crowded and

numerous ; if small they will be fewer ; they are sometimes nucleated.

PASSIVE PHYSICAL MOVEMENTS OF RED BLOOD CORPUSCLES.

These are caused by clotting—by the capillarity of the space between the slide and cover—by evaporation and drying. They will move in masses swayed to and fro like a collection of old bottle corks floating on a stream of water. In themselves they are very passive and differ in this respect very much from white blood corpuscles. They are not usually regarded as having amoeboid movements, but to the writer they have; as occasionally he has seen them move with the independence of the white blood corpuscles. The arrangement of the red blood corpuscles, in rouleaux or evenly distributed about the field, their ruby strong color, number, size and clear cut outlines are the features which characterize health.

2. COLORLESS CORPUSCLES IN HEALTHY BLOOD.

Features: color, number, size, shape, amoeboid movements, and sticky qualities.

1. *Color*—Their color is white, and they are rightly named. This is shown with beauty in the photographic illustrations. An objective that does not bring out their true color is not a good one for blood study.

2. *Number*—This varies in health relative to the red, but one to 300 red is about the proportion. In consumption they are more numerous.

3. *Size*—Varies less in health than in disease. Rarely are they smaller than the red ; usually they are larger. Perhaps they may be rated at 1-2200 inch on an average. In consumption they are large and vary more.

4. *Shape*—Is usually globular but varies constantly; sometimes they are triangular, oblong, obovoid. They are surrounded with a deeply cut and irregular margin forming objects of weird, bizarre and awry characters difficult to describe or imagine. Indeed the grotesque changes of outline go beyond the imagination. Sometimes they will push out long lines of substance like an arm or handle to a pan. Sometimes they will project themselves like a leech, and change their place. Indeed these changes are so wonderful as to demand a separate paragraph.

5. Amoeboid movements, (amoeba–change.)—The colorless corpuscles move among the red like policemen in a crowd of people. They break through the fibrine filaments ; they push the red corpuscles out of the way as with authority ; they go over or under the red corpuscles and pursue their straight forward movements like a determined officer. But they can do more than any such functionary, for they can *divide themselves up into parts—separate to considerable distances—travel on and* "apparently" *reunite their separate segments and move on again whenever they will* to be ready to go. No law seems to govern their movements except independent volition if such a term can be applied to such minute bodies. While these movements are being made,

with an exceptionally good objective, the granular contents of the corpuscles may be seen whirling and pushing along in currents and vortices of visual violence and force.

6. On the other hand, white blood corpuscles present a phase directly opposed to that just described, when not undergoing movements they *stick* fast to the slide as if they meant to *move only* when ready to do so. While the colored are rushed helplessly along in swift torrents the colorless corpuscles will be seen underneath still and quietly resting and resisting the charges and onsets of the scudding movements over them. They split the stream like a rock in the rapids of a river; they will also stick in the vacuoles of drying blood. Certainly this sticking power compared with the amoeboid movement are two remarkable features to occur in the same body.

3. *Serum.* When coagulation has become thoroughly established in the specimen of blood the red corpuscles contract together leaving inter-spaces which in health should be clear and clean, except the serum, white corpuscles, and the filaments of fibrine, which in health are faint and seen with difficulty.

Although to inspection, the serum is clear and diaphanous, it is really one of the most complex fluids of the body. The chemical elements embrace all those found in solution in the system and are invisible, save fibrine, which may be regarded as an insoluble form of albumen. It is on the clearness and cleanness of the serum that the diagnosis of healthy blood *mainly* turns.

It is very likely possible to discover some diseased elements in an otherwise apparently healthy person's blood. In such a case the significance would be void ; no one physical sign of disease taken alone stands out against, controls or "orients" so to speak, all the other signs when healthy. The writer has seen a case of crepitant rales in the lungs of an otherwise healthy person, but that single sign did not decide that consumption was present. The comparison with the rational excludes the diagnosis. People exist in a slightly impaired state of health, and have evidences of disease in the blood while systemically, it is latent as in rheumatism and syphilis. The subject is so new as to have many points yet to settle; however, no subject is so old as to have no unsettled points. Still with these limitations, it may be said that in the great majority of cases the serum of the healthy blood is clear of dirt like debris, dots, spots and masses, or if present the quantity is limited.

4. *Fibrine Filaments.* As has been observed, these naturally exist in the blood, but they are very faint and delicate, and elude observations unless specially conducted with great care and under favorable auspices. The reverse of this is true in some diseases. They form a striking and impressive feature in the field and need but little pains to be seen.

5. *Foreign Substances* accidentally present in the blood of health. These come from the skin, the slide, cover and instrument of puncture as dirt or "matter out of place." This dirt may be to a great extent eliminated

by careful washing. Dirt furnishes material enough for a volume. It includes all dust and debris arising from the friction of various bodies and surfaces that come in contact in the wear and tear of life. Air teems with them. Dirt, includes smoke, clouds of dust, sweepings, organized substances, as fibers of cotton and wool, linen and silk from clothing, feathers from animals and beds, straw, wood and fibres, leather, salts of excretions and secretions, starch grains of all kinds, pollen grains, hairs of plants, spores, cryptogamic plants, algae, fungi, mosses, lichens, ferns, vegetations of fermentation, putrefaction and decay, fragments of inorganic bodies in impalpable powder, earths, insects, dead epithelia, &c., &c. It is a long work to understand the various substances that enter into dirt. It is a micrographic field that is exhaustless, always present, most penetrating and when overlooked, most fruitful of error. As the importance of having a clean slide and cover is an injunction that will bear repetition, so also the eye pieces and objectives must be clean. It is a good plan to study *before hand* the field of the microscope without any objects in order to know how clean they really are.

Sometimes the eye piece will be dotted with spots that cannot be wiped away; simply rotating the eye piece will reveal these blemishes by showing them in motion, which could not be when the slide is still. *Fat* is another thing which may be found in healthy blood and mistaken for diseased conditions. Epithelia from the skin and the lining of blood vessels, bubbles of air in

globar and other shapes, are found in healthy blood. To recapitulate: in healthy blood there should be good color, clean and plump outlines, very faint fibrin filaments, clear interspaces, and accidentally, fat, epithelia, dirt, and epidermal vegetations.

MORPHOLOGIES OF DISEASED BLOOD.

In the work above quoted as published in 1868, allusion was made to the diseased appearances in consumption, anæmia, rheumatism, carbuncle, variola, vaccinia, remittent fever, typhoid fever, and in other places syphilis, malaria, and erysipelas. These quotations show the broad scope of the researches, and that they are not mere hap-hazard observations. We have not time to allude to more than the

MORPHOLOGY OF CONSUMPTIVE BLOOD.

1. Red corpuscles, generally massed and sticky.
2. Colorless corpuscles, enlarged.
3. Serum presents
4. Fibrine filaments, large, dense, strong and
5. Foreign substances; *a* abnormal, vinegar yeast; *b* accidental.

These elements in consumptive blood taken in connection with the rational signs constitute the diagnostic evidence of tuberculous disease and what is here termed a new sign of the

PRETUBERCULAR STATE.

1. Red corpuscles are diminished in number, not uniformly distributed in the field of the microscope, are

strongly clotted and massed together, edges not well defined, not well rounded out, flattened—not clean cut, sticky, pasty, flabby; they form themselves into regularly rounded masses rather than rouleaux. The rouleaux may be seen partially formed; color is a pale, yellowish red or sickly look, as the countenance of an ordinary consumptive looks to the naked eye as compared with a robust healthy person. Number of red corpuscles less than in health, and sometimes nucleated.

It should be remembered that the red blood corpuscles are very sensitive to exercises that fatigue the body or mind. A single night of overwork has been known to diminish their number and brilliancy in health.

2. White corpuscles, color a dirty white; sometimes the red are so bleached and the white so dark that they cannot be distinguished by their color. Size varies more than in health; sometimes aggregate themselves in masses and appear like foreign bodies, number decidedly more than in health. Shape varies as in health. Amoeboid movements are the same as in health; they are so distended by the changes (growths,) going on inside, that they often burst and discharge their contents to form spore masses. The white corpuscles deserve a separate and careful study in all complaints as affording a pasture ground for the feeding of chronic diseases, as in syphilis for example. Rational signs remove the chances of error.

3. Serum constantly shows morbid elements—consumptive. Its spaces look as if filled with dirty debris

in marked contrast with the clearness and cleanness of the same space in healthy blood. These objects in the serum are regarded as vinegar yeast developed in the blood.

4. *Fibrine Filaments.*—Are always present in consumptive blood—are numerous, large, coarse, distinct, long and fill the field with a beautiful net work which presents different angles in different directions. Their strength in clotting is one of the causes of the masses and huddles of the red corpuscles alluded to. This is also found in rheumatic blood, but the rational signs would exclude rheumatism, though it is not impossible to have both together.

5. *Foreign Abnormal Substances.*—*a* spores single of vinegar yeast; *b* spores of vinegar massed in collects. In bad cases they are very abundant and large enough to fill the field; the forms vary as might be expected under the physical conditions found in living blood: viz., swift motions—friction with themselves and the blood elements in the narrow and crooked walls of the blood vessels. Accordingly they are found flattened, rolled, twisted, torn into irregular divisions, broken up into small masses, divided, linear, and filamentous. It is somewhat important not to confound them with white corpuscles whose airy, fantastic and impressive changes can imitate almost anything.

The abnormal appearances described are not found always together in the same specimen, and to the neophyte they may not appear at first sight. Time, pa-

tience and study will make the matter clearer. Those who follow out this line of research are respectfully requested to follow:

1. The method of collection, which is to take the blood direct from the blood stream.

2. The best kind of microscope and illumination.

3. Be sure to take a decidedly tuberculous case, and then, with some experience, these cases can be distinguished.

ILLUSTRATIVE CASES.

POSITIVE.

Case 1. A man aged about 24 years of age took a severe cold; his cough was troublesome; expectoration not copious; lost flesh, strength and voice; was pale, anæmic, thin and not robust. His father died of consumption; had a sister in the last stages of consumption, who died subsequently; there were no physical signs of lesion in the lungs. Inspection with the laryngoscope revealed a reddened and thickened condition of the vocal cords and larynx. Inspection of the blood by the microscope revealed fibrine filaments very abundant and strongly marked; spores and collections of spores very numerous and large; white corpuscles too numerous for health and much enlarged; red corpuscles thin, flabby, outlines not clearly cut, pale, sticky and aggregated in irregular masses.

Case 2. A mother of a family of four children began to run down rapidly. She was 33 years of age. She coughed badly and was partially aphonic; no copious

expectoration ; she lost flesh and strength ; was hardly able to keep about in the performance of her ordinary household duties. She had night-sweats, throat was sore, deglutition painful. There were, at the examination, no physical signs of lesion in the lungs. The blood inspection revealed fibrin filaments abundant and marked. Spores and spore collects in great abundance. Red corpuscles, sticky, adhesive, massed and huddled together. White corpuscles too numerous and too much enlarged. Also to the naked eye the color of the blood was a light red. Taking all the circumstances, the general and rational signs pointed to some rapidly increasing systemic trouble of a very serious nature. At a later date the same physical signs were found and added to them was a diminished resonance over the left upper third front chest, with ruder respiration.

NEGATIVE.

Case 3. April 15, 1876.—Mr. C. A. W., meat dealer, age about 50 years, complained of a constant, severe and harassing cough; there were considerable expectoration, some emaciation and loss of strength with a slight alteration in his phonation. The laryngoscope revealed a redness and injection of the mucous membrane of the larynx. There was no paralysis of the vocal cords, but well marked patches of ulceration were found in the pyriform fossæ. The chest was not developed as much as it ought to have been, but it exhibited no physical signs of tubercle in the lungs, though his family regarded

his case as consumptive. Inspection with the microscope showed in the blood no so-called filaments; no spores; no collections of spores and no enlarged white corpuscles. However, the red corpuscles were less numerous and less highly colored than normal, but not massed. The case was pronounced non-tuberculous. History has proved the judgment correct.

Case 4. Mrs. M., in May 1875, was found in bed and suffering from severe pain in the left chest, middle and lower thirds; from severe cough; from night sweats; from emaciation and an excessively irritated nervous system.

She was a chronic invalid, turned over to the writer by her physician as a case that would soon die of tuberculous consumption; her father died thus.

Suspiciously there were no marked signs of physical abnormal changes going on in the lungs, still the case had a very bad look. On exploring the blood microscopically, the red corpuscles were pale, thin and flattened. The white corpuscles were not enlarged, neither were they too numerous. There were no spores; no fibrine filaments; no debris. The hematic interspaces were clear and clean. From this examination immediately no tubercle was diagnosticated, whatever else might be the matter. A month's treatment restored the blood to full color. The general symptoms improved markedly. The case proved one of general debility, resulting mainly from old uterine retroversion combined with two excessively severe labors, in which there was

complete rupture of the perineum. As this patient was naturally frail and weak, it is fair to conclude that she might eventually have realized the end feared by Dr. ——. The writer believes such cases are extremely liable to develope tubercule ; just as parasitic diseases affect plants that are not vigorous and sickly.

Case 5. Miss R., aged 17 years, was a pale, wan, thin girl. Her mother is a feeble person, laboring under a large uterine fibroid. After the conception and before the birth of Miss R., her mother underwent a very trying experience with the sickness and death of two children from scarlet fever. The feeble constitution of Miss R. is attributed to this fact. She had a cough which was dry. Her appetite was good, but her physique was bad ; and she moved about like a person of declining years, entirely unlike girls of her age. She suffered from anteversion of the womb, which probably prevented healthy locomotion. Aside from narrowness, her chest showed no sign of disease. The colored corpuscles showed a decided paleness and diminution of number, but the interspaces between them were devoid of abnormalities and were beautifully transparent. The history of more than two years has justified the decision of non-tuberculosis.

Case 6. Mrs. Dr. ——, aged about 55 years, mother of one child, in July, 1876, was seized with a cough of severity, sore throat and pain in chest; followed by loss of flesh and strength; stooping posture, with general malaise with coarse crepitant rales, more or less scattered throughout both lungs. There was no dullness on per-

cussion anywhere about the chest. Her husband, a practitioner of the largest experience and the highest success, feared that with the bronchitis there might be tuberculosis, as some members of her family had died of it, and particularly as he had buried his former wife and a daughter from the same disease.

The microscopical examination of the blood showed no evidence of tuberculous disease. The hematic interspaces were entirely clean and clear of spots, masses, or debris. The anxious physician was confidently assured of the fact that no tuberculosis difficulty was present; decided by the absence of the physical sign hereinbefore described. The woman is now restored to health and confirms the negative diagnosis of tubercle.

NOTE. The reading of this paper was followed by a demonstration with a Marcy's sciopticon of 25 or more plates taken from microphotographs of the morphologies of healthy and consumptive blood; the microphotographs had been taken by the reader and Dr. G. B. Harriman of Boston.