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THE NEW MICROSCOPES.

A Discussion by

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It is, to speak conservatively, of extreme interest to review the recent progress made by the scientist in his endeavor to penetrate the unseen world of the minute and disease-causing organisms, in particular a world of viruses—suspected, yet lying just beyond the scope of human vision and the power of the microscope to reveal; for the laboratory research worker, the doctor, the technician long have been familiar with the effects of these unseen enemies they have been called upon to treat and to cope with in man, animal, and plant, and while their knowledge of the infinitesimal has been growing steadily, they were, until very recently, unable to make the slight step "beyond" which would enable them to "see." But today, Science is exploring—looking for the first time upon totally new worlds through the eyes of totally new types of microscopes, microscopes new in principle of construction and in principle of illumination.

THE ELECTRON MICROSCOPE.

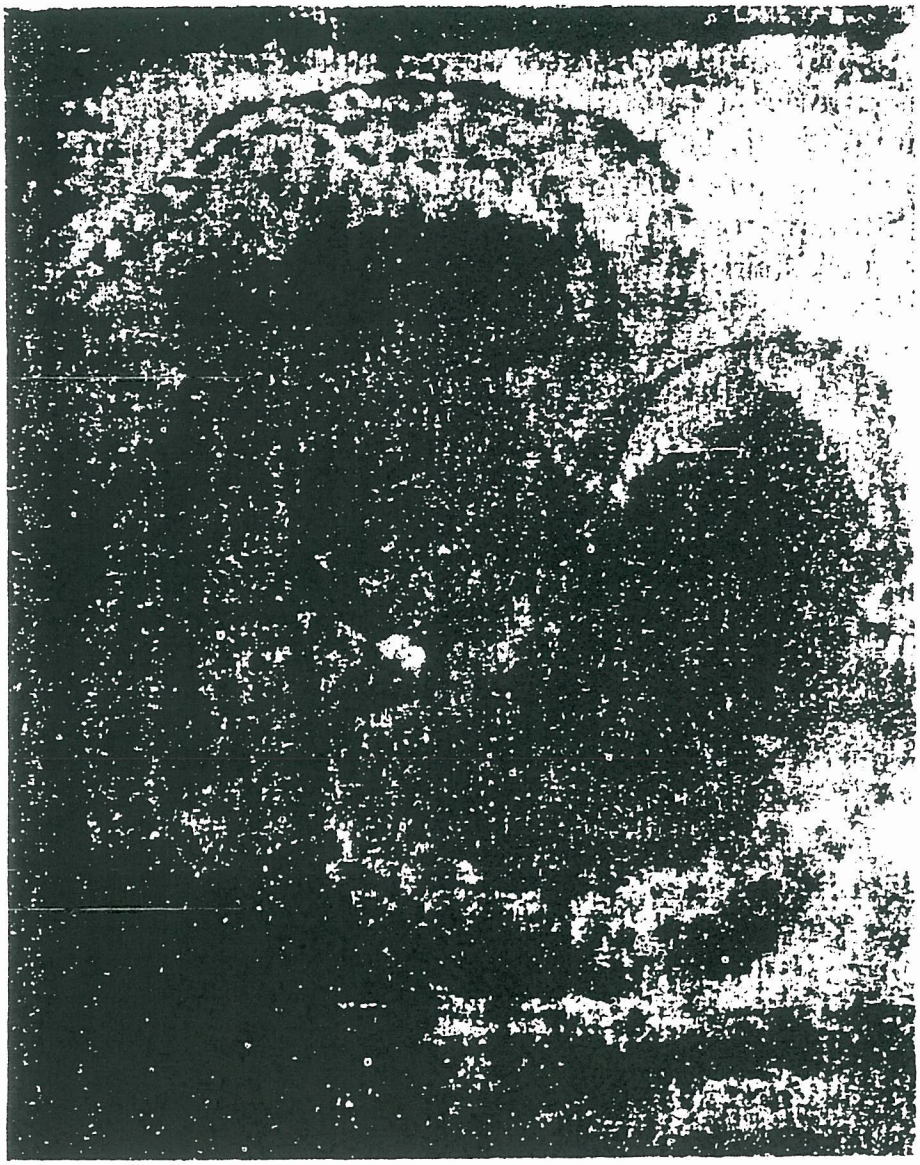
One of these new instruments, the Electron Microscope, has received considerable attention and is now being used extensively in both industrial and medical research. Based on the principles of geometric electron optics, this microscope utilizes electrons as a source of illumination instead of the light source of the ordinary light microscope.

Electrons, practically speaking, are the smallest, lightest particles of matter and electricity. Like light, they behave like corpuscles guided by waves. Unlike light, however, they travel in a straight line in a vacuum while, subject to the action of electric and magnetic fields, their behavior coincides with the laws and principles set down by Sir William Hamilton who, more than a century ago, demonstrated the existence of a close analogy between the path of a light ray through refracting media and that of a particle through conservative fields of force.

We know that these negatively-charged particles, the electrons, revolving about in their various orbits in the atom, serve to maintain the balance of the atom while the nucleus exerts the "positive" force which holds it together; and we also know that when this balance is upset, due to gain or loss of electrons, we think of the atom as "charged," since it is this circumstance which causes the tiny particle to attract or

is it not reasonable to suppose that effort to do better still may conceivably be rewarded?"

To such an inquiry there can be but one logical answer—an agreement which, while perhaps not concurred in by all, must, for those stimulated to more intense interest and effort by the possibilities of uncovering new facts, pose further questions; for, if the improvement of one part results in the improved performance of the whole, is it not



Chlorophyl Cell (algae) (The Universal Microscope). 17,000× on 35 mm. film.

also reasonable to suppose that additional changes of additional parts, yes, even changes with respect to principle and method might likewise bear fruit?

THE UNIVERSAL MICROSCOPE. ← Start here

It is not only a reasonable supposition, but already, in one instance, a very successful and highly commendable achievement on the part of Dr. Royal Raymond Rife of San Diego, California, who, for many

years, has built and worked with light microscopes which far surpass the theoretical limitations of the ordinary variety of instrument, all the Rife scopes possessing superior ability to attain high magnification with accompanying high resolution. The largest and most powerful of these, the Universal Microscope, developed in 1933, consists of 5,682 parts and is so-called because of its adaptability in all fields of microscopical work, being fully equipped with separate substage condenser units for transmitted and monochromatic beam, dark-field, polarized, and slit-ultra illumination, including also a special device for crystallography. The entire optical system of lenses and prisms as well as the illuminating units are made of block-crystal quartz, quartz being especially transparent to ultra-violet radiations.

The illuminating unit used for examining the filterable forms of disease organisms contains fourteen lenses and prisms, three of which are in the high-intensity incandescent lamp, four in the Risley prism, and seven in the achromatic condenser which, incidentally, has a numerical aperture of 1.40. Between the source of light and the specimen are subtended two circular, wedge-shaped, block-crystal quartz prisms for the purpose of polarizing the light passing through the specimen, polarization being the practical application of the theory that light waves vibrate in all planes perpendicular to the direction in which they are propagated. Therefore, when light comes into contact with a polarizing prism, it is divided or split into two beams, one of which is refracted to such an extent that it is reflected to the side of the prism without, of course, passing through the prism while the second ray, bent considerably less, is thus enabled to pass through the prism to illuminate the specimen. When the quartz prisms on the Universal Microscope, which may be rotated with vernier control through 360 degrees, are rotated in opposite directions, they serve to bend the transmitted beams of light at variable angles of incidence while, at the same time, a spectrum is projected up into the axis of the microscope, or rather a small portion of a spectrum since only a part of a band of color is visible at any one time. However, it is possible to proceed in this way from one end of the spectrum to the other, going all the way from the infra-red to the ultra-violet. Now, when that portion of the spectrum is reached in which both the organism and the color band vibrate in exact accord, one with the other, a definite characteristic spectrum is emitted by the organism. In the case of the filter-passing form of the Bacillus Typhosus, for instance, a blue spectrum is emitted and the plane of polarization deviated plus 4.8 degrees. The predominating chemical constituents of the organism are next ascertained after which the quartz prisms are adjusted or set, by means of vernier control, to minus 4.8 degrees (again in the case of the filter-passing form of the Bacillus Typhosus) so that the opposite angle of refraction may be obtained. A monochromatic beam of light, corresponding exactly

to the frequency of the organism (for Dr. Rife has found that each disease organism responds to and has a definite and distinct wavelength, a fact confirmed by British medical research workers), is then sent up through the specimen and the direct transmitted light, thus enabling the observer to view the organism stained in its true chemical color and revealing its own individual structure in a field which is brilliant with light.

The objectives used on the Universal Microscope are a 1.12 dry lens, a 1.16 water immersion, a 1.18 oil immersion, and a 1.25 oil immersion. The rays of light refracted by the specimen enter the objective and are then carried up the tube in parallel rays through twenty-one light bends to the ocular, a tolerance of less than one wavelength of visible light only being permitted in the core beam, or chief ray, of illumination. Now, instead of the light rays starting up the tube in a parallel fashion, tending to converge as they rise higher and finally crossing each other, arriving at the ocular separated by considerable distance as would be the case with an ordinary microscope, in the Universal tube the rays also start their rise parallel to each other but, just as they are about to cross, a specially-designed quartz prism is inserted which serves to pull them out parallel again, another prism being inserted each time the rays are about ready to cross. These prisms, inserted in the tube, which are adjusted and held in alignment by micrometer screws of one hundred threads to the inch in special tracks made of magnelium (magnelium having the closest coefficient of expansion of any metal to quartz), are separated by a distance of only thirty millimeters. Thus, the greatest distance that the image in the Universal is projected through any one media, either quartz or air, is thirty millimeters instead of the 160, 180, or 190 millimeters as in the empty or air-filled tube of an ordinary microscope, the total distance which the light rays travel zig-zag fashion through the Universal tube being 449 millimeters, although the physical length of the tube itself is 229 millimeters. It will be recalled, that if one pierces a black strip of paper or cardboard with the point of a needle and then brings the card up close to the eye so that the hole is in the optic axis, a small brilliantly-lighted object will appear larger and clearer, revealing more fine detail, than if it were viewed from the same distance without the assistance of the card. This is explained by the fact that the beam of light passing through the card is very narrow, the rays entering the eye, therefore, being practically parallel, whereas without the card the beam of light is much wider and the diffusion circles much larger. It is this principle of parallel rays in the Universal Microscope and the resultant shortening of projection distance between any two blocks or prisms plus the fact that objectives can thus be substituted for oculars, these "oculars" being three matched pairs of ten-millimeter, seven-millimeter, and four-millimeter objectives in short mounts, which make possible not only the unusually high magnification

and resolution but which serve to eliminate all distortion as well as all chromatic and spherical aberration.

Quartz slides with especially thin quartz cover glasses are used when a tissue section or culture slant is examined, the tissue section itself also being very thin. An additional observational tube and ocular which yield a magnification of 1,800 diameters are provided so that that portion of the specimen which it is desired should be examined may be located and so that the observer can adjust himself more readily when viewing a section at a high magnification.

The Universal stage is a double rotating stage graduated through 360 degrees in quarter minute arc divisions, the upper segment carrying the mechanical stage having a movement of 40 degrees, the body assembly which can be moved horizontally over the condenser also having an angular tilt of 40 degrees plus or minus. Heavily-constructed joints and screw adjustments maintain rigidity of the microscope which weighs two hundred pounds and stands twenty-four inches high, the bases of the scope being nickel cast-steel plates, accurately surfaced, and equipped with three leveling screws and two spirit levels set at angles of 90 degrees. The coarse adjustment, a block thread screw with forty threads to the inch, slides in a one and one-half dovetail which gibs directly onto the pillar post. The weight of the quadruple nosepiece and the objective system is taken care of by the intermediate adjustment at the top of the body tube. The stage, in conjunction with a hydraulic lift, acts as a lever in operating the fine adjustment. A six-gauge screw having a hundred threads to the inch is worked through a gland into a hollow, glycerine-filled post, the glycerine being displaced and replaced at will as the screw is turned clockwise or anti-clockwise, allowing a five-to-one ratio on the lead screw. This, accordingly, assures complete absence of drag and inertia. The fine adjustment being seven hundred times more sensitive than that of ordinary microscopes, the length of time required to focus the Universal ranges up to one hour and a half which, while on first consideration, may seem a disadvantage, is after all but a slight inconvenience when compared with the many years of research and the hundreds of thousands of dollars spent and being spent in an effort to isolate and to look upon disease-causing organisms in their true form.

Working together back in 1931 and using one of the smaller Rife Microscopes having a magnification and resolution of 17,000 diameters, Dr. Rife and Dr. Arthur Isaac Kendall of the Department of Bacteriology of Northwestern University Medical School were able to observe and demonstrate the presence of the filter-passing forms of Bacillus Typhosus. An agar slant culture of the Rawlings strain of Bacillus Typhosus was first prepared by Dr. Kendall and inoculated into six cubic centimeters of "Kendall" K Medium, a medium rich in protein but poor in peptone and consisting of one hundred mg. of

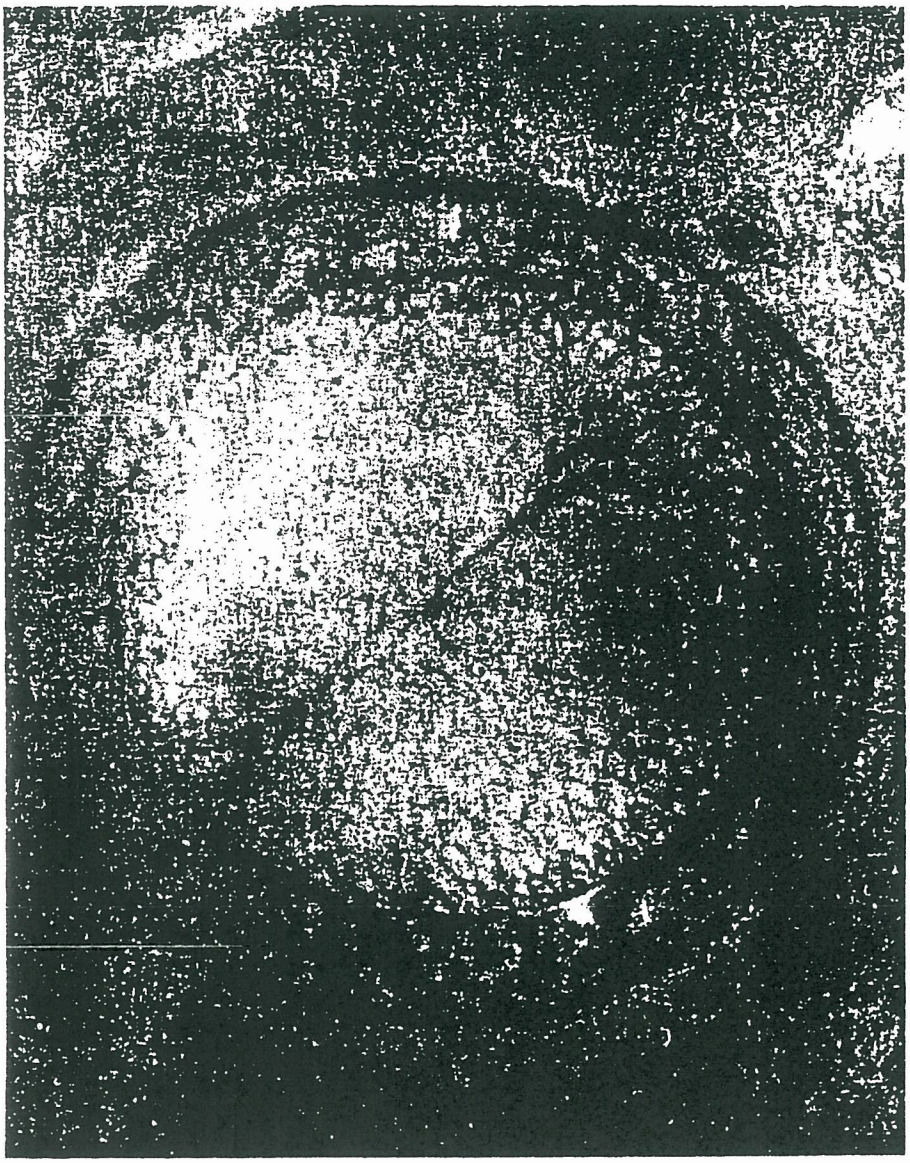
dried hog intestine and 6 cc. of tyrode solution (containing neither glucose nor glycerine) which mixture is shaken well so as to moisten the dried intestine powder and then sterilized in the autoclave, fifteen pounds for fifteen minutes, alterations of the medium being frequently necessary depending upon the requirements for different organisms. Now, after a period of eighteen hours in this K Medium, the culture was passed through a Berkefeld "N" filter, a drop of the filtrate being added to another six cubic centimeters of K Medium and incubated at 37 degrees centigrade. Forty-eight hours later this same process was repeated, the "N" filter again being used, after which it was noted that the culture no longer responded to peptone medium, growing now only in the protein medium. When again, within twenty-four hours, the culture was passed through a filter—the finest Berkefeld "W" filter, a drop of the filtrate was once more added to six cubic centimeters of K Medium and incubated at 37 degrees centigrade, a period of three days elapsing before the culture was transferred to K Medium and yet another three days before a new culture was prepared. Then, viewed under an ordinary microscope, these cultures were observed to be turbid and to reveal no bacilli whatsoever. When viewed by means of dark-field illumination and oil immersion lens, however, the presence of small, actively-motile granules was established, although nothing at all of their individual structure could be ascertained. Another period of four days was allowed to elapse before these cultures were transferred to K Medium and incubated at 37 degrees centigrade for twenty-four hours when they were then examined under the Rife Microscope where, as was mentioned earlier, the filterable typhoid bacilli, emitting a blue spectrum, caused the plane of polarization to be deviated plus 4.8 degrees. Then when the opposite angle of refraction was obtained by means of adjusting the polarizing prisms to minus 4.8 degrees and the cultures illuminated by a monochromatic beam coördinated in frequency with the chemical constituents of the typhoid bacillus, small, oval, actively-motile, bright turquoise-blue bodies were observed at a magnification of 5,000 diameters, in high contrast to the colorless and motionless debris of the medium. These observations were repeated eight times, the complete absence of these bodies in uninoculated control K Media also being noted.

To further confirm their findings, Doctors Rife and Kendall next examined eighteen-hour old cultures which had been inoculated into K Medium and incubated at 37 degrees centigrade, since it is just at this stage of growth in this medium and at this temperature that the cultures become filterable. And, just as had been anticipated, ordinary dark-field examination revealed unchanged, long, actively-motile bacilli; bacilli having granules within their substance; and free-swimming, actively-motile granules; while under the Rife Microscope were demonstrated the same long, unchanged, almost colorless bacilli; bacilli, prac-

tically colorless, inside and at one end of which was a turquoise-blue granule resembling the filterable forms of the typhoid bacillus; and free-swimming, small, oval, actively-motile, turquoise-blue granules. By transplanting the cultures of the filter-passing organisms or virus into a broth, they were seen to change over again into their original rod-like forms.

At the same time these findings of Doctors Rife and Kendall were confirmed by Dr. Edward C. Rosenow of the Mayo Foundation, the magnification with accompanying resolution of 8,000 diameters of the Rife Microscope, operated by Dr. Rife, was checked against a dark-field oil immersion scope operated by Dr. Kendall and an ordinary 2 mm. oil immersion objective, × 10 ocular, Zeiss scope operated by Dr. Rosenow at a magnification of 900 diameters. Examinations of gram and safranin stained films of cultures of Bacillus Typhosus, gram and safranin stained films of cultures of the streptococcus from poliomyelitis, and stained films of blood and of the sediment of the spinal fluid from a case of acute poliomyelitis were made with the result that bacilli, streptococci, erythrocytes, polymorphonuclear leukocytes, and lymphocytes measuring nine times the diameter of the same specimens observed under the Zeiss scope at a magnification and resolution of 900 diameters, were revealed with unusual clarity. Seen under the dark-field microscope were moving bodies presumed to be the filterable turquoise-blue bodies of the typhoid bacillus which, as Dr. Rosenow has declared in his report ("Observations on Filter-Passing Forms of Eberthella Typhi—Bacillus Typhosus—and of the Streptococcus from Poliomyelitis," Proceedings of the Staff Meetings of the Mayo Clinic, July 13, 1932), were so "unmistakably demonstrated" with the Rife Microscope, while under the Zeiss scope stained and hanging drop preparations of clouded filtrate cultures were found to be uniformly negative. With the Rife Microscope also were demonstrated brownish-gray cocci and diplococci in hanging drop preparations of the filtrates of streptococcus from poliomyelitis. These cocci and diplococci, similar in size and shape to those seen in the cultures although of more uniform intensity, and characteristic of the medium in which they had been cultivated, were surrounded by a clear halo about twice the width of that at the margins of the debris and of the Bacillus Typhosus. Stained films of filtrates and filtrate sediments examined under the Zeiss microscope, and hanging drop, dark-field preparations revealed no organisms, however. Brownish-gray cocci and diplococci of the exact same size and density as those observed in the filtrates of the streptococcus cultures were also revealed in hanging drop preparations of the virus of poliomyelitis under the Rife Microscope, while no organisms at all could be seen in either the stained films of filtrates and filtrate sediments examined with the Zeiss scope nor in hanging drop preparations examined by means of the dark-field. Again using the Rife Microscope

at a magnification of 8,000 diameters, numerous nonmotile cocci and diplococci of a bright-to-pale pink in color were seen in hanging drop preparations of filtrates of Herpes encephalitic virus. Although these were observed to be comparatively smaller than the cocci and diplococci of the streptococcus and poliomyelitic viruses, they were shown to be of fairly even density, size, and form and surrounded by a halo. Again,



Tetanus Spores (The Universal Microscope). 25,000×
on 35 mm. film, enlarged 227,000×.

both the dark-field and Zeiss scopes failed to reveal any organisms, and none of the three microscopes disclosed the presence of such diplococci in hanging drop preparations of the filtrate of a normal rabbit brain. Dr. Rosenow has since revealed these organisms with the ordinary microscope at a magnification of 1,000 diameters by means of his special staining method and with the Electron Microscope at a magnification of 12,000 diameters. Dr. Rosenow has expressed the opinion that the

inability to see these and other similarly revealed organisms is due, not necessarily to the minuteness of the organisms, but rather to the fact that they are of a non-staining, hyaline structure. Results with the Rife Microscopes, he thinks, are due to the "ingenious methods employed rather than to excessively high magnification." He has declared also, in the report mentioned previously, that "Examination under the Rife Microscope of specimens containing objects visible with the ordinary microscope, leaves no doubt of the accurate visualization of objects or particulate matter by direct observation at the extremely high magnification obtained with this instrument."

Exceedingly high powers of magnification with accompanying high powers of resolution may be realized with all of the Rife Microscopes one of which, having magnification and resolution up to 18,000 diameters, is now being used at the British School of Tropical Medicine in England. In a recent demonstration of another of the smaller Rife scopes (May 16th, 1942) before a group of doctors including Dr. J. H. Renner of Santa Barbara, California; Dr. Roger A. Schmidt of San Francisco, California; Dr. Lois Bronson Slade of Alameda, California; Dr. Lucile B. Larkin of Bellingham, Washington; Dr. E. F. Larkin of Bellingham, Washington; and Dr. W. J. Gier of San Diego, California, a Zeiss ruled grading was examined, first under an ordinary commercial microscope equipped with a 1.8 high dry lens and × 10 ocular, and then under the Rife Microscope. Whereas fifty lines were revealed with the commercial instrument and considerable aberration, both chromatic and spherical noted, only five lines were seen with the Rife scope, these five lines being so highly magnified that they occupied the entire field, without any aberration whatsoever being apparent. Dr. Renner, in a discussion of his observations, stated that "The entire field to its very edges and across the center had a uniform clearness that was *not* true in the conventional instrument." Following the examination of the grading, an ordinary unstained blood film was observed under the same two microscopes. In this instance, one hundred cells were seen to spread throughout the field of the commercial instrument while but ten cells filled the field of the Rife scope.

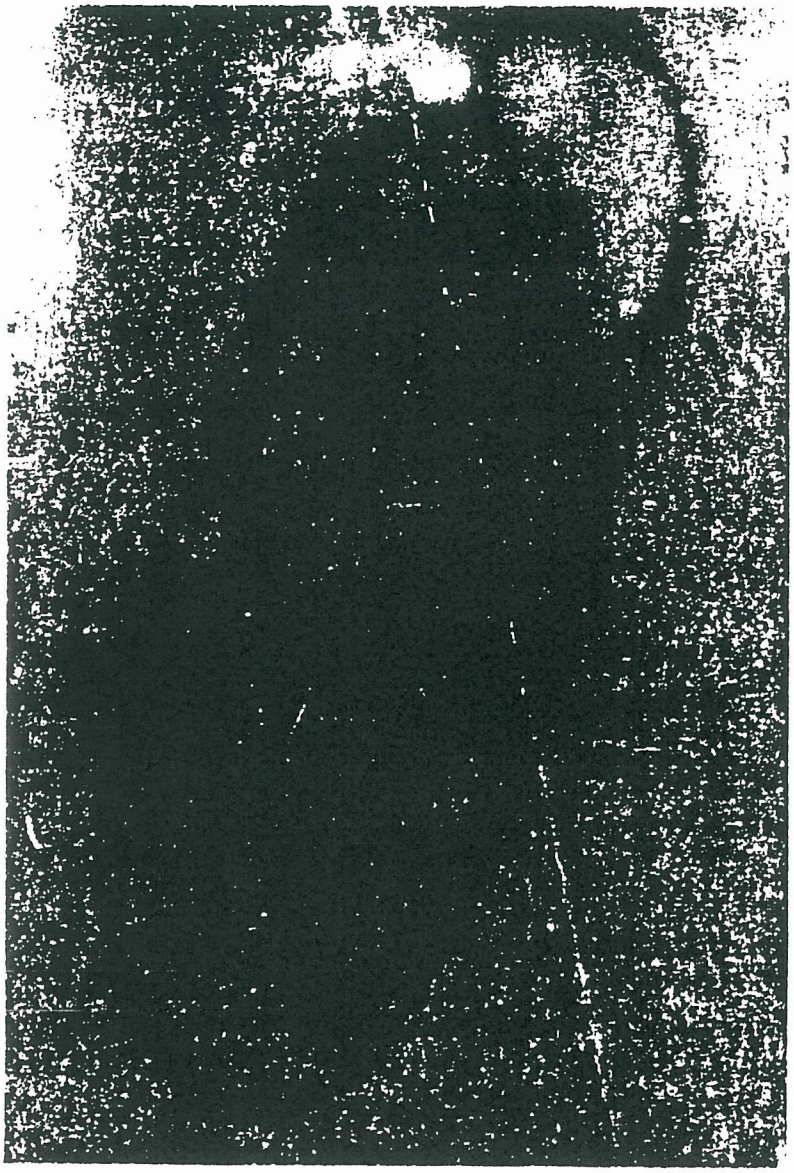
The Universal Microscope, of course, is the most powerful Rife scope, possessing a resolution of 31,000 diameters and magnification of 60,000 diameters. With this it is possible to view the interior of the "pin point" cells, those cells situated between the normal tissue cells and just visible under the ordinary microscope, and to observe the smaller cells which compose the interior of these pin point cells. When one of these smaller cells is magnified, still smaller cells are seen within its structure. And when one of the still smaller cells, in its turn, is magnified, it, too, is seen to be composed of smaller cells. Each of the sixteen times this process of magnification and resolution can be repeated, it is demonstrated that there are smaller cells within the

smaller cells, a fact which amply testifies as to the magnification and resolving power obtainable with the Universal Microscope.

More than 20,000 laboratory cultures of carcinoma, were grown and studied over a period of seven years by Dr. Rife and his assistants in what, at the time, appeared to be a fruitless effort to isolate the filter-passing form, or virus, which Dr. Rife believed to be present in this condition. Then, in 1932, the reactions in growth of bacterial cultures to light from the rare gasses was observed, indicating a new approach to the problem. Accordingly, blocks of tissue one-half centimeter square, taken from an unulcerated breast carcinoma, were placed in triple-sterilized K Medium and these cultures incubated at 37 degrees centigrade. When no results were forthcoming, the culture tubes were placed in a circular glass loop filled with argon gas to a pressure of fourteen millimeters, and a current of 5,000 volts applied for twenty-four hours, after which the tubes were placed in a two-inch water vacuum and incubated at 37 degrees centigrade for twenty-four hours. Using a specially designed 1.12 dry lens, equal in amplitude of magnification to the 2 mm. apochromatic oil immersion lens, the cultures were then examined under the Universal Microscope, at a magnification of 10,000 diameters, where very-much animated, purplish-red, filterable forms, measuring less than one-twentieth of a micron in dimension, were observed. Carried through fourteen transplants from K Medium to K Medium, this B. X. virus remained constant; inoculated into four hundred and twenty-six Albino rats, tumors "with all the true pathology of neoplastic tissue" were developed. Experiments conducted in the Rife Laboratories have established the fact that these characteristic diplococci are found in the blood monocytes in 92 per cent. of all cases of neoplastic diseases. It has also been demonstrated that the virus of cancer, like the viruses of other diseases, can be easily changed from one form to another by means of altering the media upon which it is grown. With the first change in media, the B. X. virus becomes considerably enlarged although its purplish-red color remains unchanged. Observation of the organism with an ordinary microscope is made possible by a second alteration of the media. A third change is undergone upon asparagus base media where the B. X. virus is transformed from its filterable state into cryptomyces pleomorphia fungi, these fungi being identical morphologically both macroscopically and microscopically to that of the orchid and of the mushroom. And yet a fourth change may be said to take place when this cryptomyces pleomorphia, permitted to stand as a stock culture for the period of metastasis, becomes the well-known mahogany-colored Bacillus Coli.

It is Dr. Rife's belief that all microörganisms fall into one of not more than ten individual groups (Dr. Rosenow has stated that some of the viruses belong to the group of the streptococcus) and that any alteration of artificial media or slight metabolic variation in tissues will

induce an organism of one group to change over into any other organism included in that same group, it being possible, incidentally, to carry such changes in media or tissues to the point where the organisms fail to respond to standard laboratory methods of diagnosis. These changes can be made to take place in as short a period of time as forty-eight



Typhoid Bacillus (The Universal Microscope). 23,000×
on 35 mm. film, enlarged 300,000×.

hours. For instance, by altering the media—four parts per million per volume—the pure culture of mahogany-colored Bacillus Coli becomes the turquoise-blue Bacillus Typhosus. Viruses or primordial cells of organisms which would ordinarily require an eight-week incubation period to attain their filterable state, have been shown to produce disease within three days' time, proving Dr. Rife's contention that the incubation period of a microörganism is really only a cycle of reversion. He states:

"In reality, it is not the bacteria themselves that produce the disease, but we believe it is the chemical constituents of these micro-organisms enacting upon the unbalanced cell metabolism of the human body that in actuality produce the disease. We also believe if the metabolism of the human body is perfectly balanced or poised, it is susceptible to no disease."

In other words, the human body itself is chemical in nature, being comprised of many chemical elements which provide the media upon which the wealth of bacteria normally present in the human system feed. These bacteria are able to reproduce. They, too, are composed of chemicals. Therefore, if the media upon which they feed, in this instance the chemicals or some portion of the chemicals of the human body, becomes changed from the normal, it stands to reason that these same bacteria, or at least certain numbers of them, will also undergo a change chemically since they are now feeding upon a media which is not normal to them, perhaps being supplied with too much or too little of what they need to maintain a normal existence. They change, passing usually through several stages of growth, emerging finally as some entirely new entity—as different morphologically as are the caterpillar and the butterfly (to use an illustration given us). The majority of the viruses have been definitely revealed as living organisms, foreign organisms it is true, but which once were normal inhabitants of the human body—living entities of a chemical nature or composition.

Under the Universal Microscope disease organisms such as those of tuberculosis, cancer, sarcoma, streptococcus, typhoid, staphylococcus, leprosy, hoof and mouth disease, and others may be observed to succumb when exposed to certain lethal frequencies, coördinated with the particular frequencies peculiar to each individual organism, and directed upon them by rays covering a wide range of waves. By means of a camera attachment and a motion picture camera not built into the instrument, many "still" micrographs as well as hundreds of feet of motion picture film bear witness to the complete life cycles of numerous organisms. It should be emphasized, perhaps, that invariably the same organisms refract the same colors when stained by means of the monochromatic beam of illumination on the Universal Microscope, regardless of the media upon which they are grown. The virus of the Bacillus Typhosus is always a turquoise-blue, the Bacillus Coli always mahogany-colored, the Mycobacterium li prae always a ruby shade, the filter-passing form or virus of tuberculosis always an emerald green, the virus of cancer always a purplish-red, and so on. Thus, with the aid of this microscope, it is possible to reveal the typhoid organism, for instance, in the blood of a suspected typhoid patient four and five days before a Widal is positive. When it is desired to observe the flagella of the typhoid organism, Hg salts are used as the media to see at a magnification of 10,000 diameters.

In the light of the amazing results obtainable with this Universal Microscope and its smaller brother-scopes, there can be no doubt of the ability of these instruments to actually reveal any and all micro-organisms according to their individual structure and chemical constituents.

With the aid of its new eyes—the new microscopes, all of which are continually being improved—Science has at last penetrated beyond the boundary of accepted theory and into the world of the viruses with the result that we can look forward to discovering new treatments and methods of combating the deadly organisms—for Science does not rest.

To Dr. Karl K. Darrow, Dr. John A. Kolmer, Dr. William P. Lang, Dr. L. Marton, Dr. J. H. Renner, Dr. Royal R. Rife, Dr. Edward C. Rosenow, Dr. Arthur W. Yale, and Dr. V. K. Zworykin, we wish to express our appreciation for the help and information so kindly given us and to express our gratitude, also, for the interest shown in this effort of bringing to the attention of more of the medical profession the possibilities offered by the new microscopes.

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FILTERABLE BODIES SEEN WITH THE RIFE MICROSCOPE

SCIENCE Magazine - Vol. 74, December 11, 1931.

Using the new "super-microscope" invented by Dr. Royal Raymond Rife, of San Diego, Dr. Arthur Isaac Kendall, of Northwestern University Medical School, has seen for the first time the exceedingly minute moving bodies that apparently carry the life of bacteria when these are induced to "dissolve" into a form that will pass through the pores of the finest porcelain filter and still remain alive and able to resume their microscopically visible bodies upon suitable treatment. The work was done at the Pasadena Hospital, and will be reported in the official publication of the California Medical Association, California and Western Medicine.

The material used by Dr. Kendall was a culture of the typhoid bacillus, ordinarily a fairly large germ, easily visible under the higher-powered lenses of a compound microscope. By feeding it on his recently-evolved "K medium," which apparently has the power of causing all visible bacteria to pass over into an invisible, filterable phase, Dr. Kendall induced the bacilli in his cultures to go through this change. Under the highest power of the ordinary microscope, he could see nothing moving in the fluid, except a swarm of rather active little granules that could be seen only as tiny motile points.

Examined with the Rife microscope, however, these points became plainly visible as small, oval, actively moving bodies, turquoise-blue in color. These appeared in all the cultures, and could be transferred from one culture to another through the fine pored filters, so Dr. Kendall considers them to be the actual filterable forms of the typhoid bacillus.

He put them to another, more definitely crucial test. Reasoning that since they were all that were to be found in "K medium" cultures of more than eighteen hours' growth, he might find them in an intermediate state in younger cultures, he tried examining samples from cultures exactly eighteen hours old. In these he found both full-sized bacilli still unchanged, and his small, turquoise-blue bodies, and in addition there were peculiarly altered bacilli within whose substance the turquoise-blue bodies could be seen. These he holds to be bacilli caught in the act of changing from the filterable to the non filterable phase.

This visual demonstration of the hitherto invisible, living and moving particles of the filterable phase of a bacillus is hailed editorially by California and Western Medicine. Of Dr. Rife's microscope the editorial says: "Whereas our present microscopes magnify from one to two thousand diameters, in this new microscope we have an instrument for which a magnification as high as seventeen thousand diameters is claimed. This is certainly a long stride from the initial efforts of Van Leuwenhoek, whose simple instrument may be said to have laid the foundation for the science of bacteriology which later came into being; and by means of which science much of the world's progress in man's conquest of the infective and other diseases has been made possible."

In the forthcoming article only meager details of the ne microscope itself are given. It is made known, however, that all th optical parts are of quartz instead of the usual glass, tha attachments make possible spectroscopic examinations and motio pictures of the material under the lens, and that magnifications up t seven thousand diameters are possible. The work on Dr. Kendall' filterable typhoid germs was done at a magnification of five thousan diameters.

The light used with Dr. Rife's microscope is polarized, that is, it is passed through crystals that stop rays except those vibrating i one particular plane. By means of a double reflecting prism built int the instrument, it is possible to turn this plane of vibration in an desired direction, controlling the illumination of the minute object in the field very exactly. Further details regarding the mechanica construction and the optics of the sensational new instrument ar promised at an early date.