Because the spinal cord is encased in a bony framework, it is particularly susceptible to injury from the edema which consistently accompanies the virus-induced nerve cell damage. Any decrease in serum albumin caused either by accelerated protein catabolism or disturbed protein synthesis and occurring as one of the systemic manifestations of the disease would lower the plasma osmotic pressure and accentuate the spinal cord edema. Conversely, if the serum albumin (and osmotic pressure) were raised by the administration of plasma, the process might be reversed.

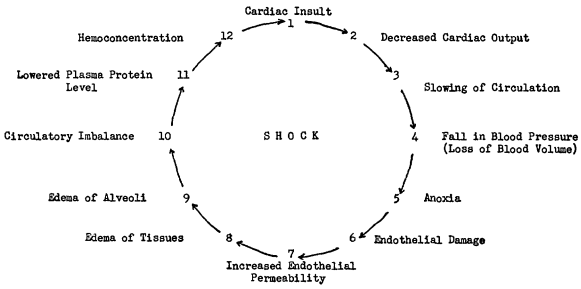

FIG. 1. It is probable that the shock state may be produced by a type of chain reaction initiated at any one of the above 12 points. Hemorrhagic shock emanates from point 4 as an actual loss of blood volume. Infectious shock would start at point 6 with endothelial damage.

In uncomplicated hypoproteinemia, the osmotic pressure of plasma proteins must be reduced to approximately 20 mm of mercury or below before edema is clinically evident. However, when factors tending to precipitate shock are operative, much more moderate decreases in plasma protein may become important in the pathogenesis of generalized or local edema. For instance, it has been shown by Eaton (*2*) that after an acute hemorrhage is induced in dogs, a degree of pulmonary edema rapidly develops which seems to be the result of a shock syndrome, in which there is a decrease in cardiac output, slowing of the circulation, drop in blood pressure, anoxia, endothelial damage, increased permeability of endothelium, transudation of fluid through the impaired endothelial structure, lowering of serum protein levels, and subsequent pulmonary edema (Fig. 1). In these experiments only a slight lowering of the already depressed serum albumin level existent in the shock state was necessary in one group of hemorrhaged dogs to accelerate significantly the accumulation of free fluid in the pulmonary tissue as compared with a control group of hemorrhaged dogs in which no added alteration of serum albumin was made. In poliomyelitis, on the other hand, it is postulated that the virus-induced infection itself may initiate a similar, although at first local, shock syndrome (infectious shock) at point 6 in the diagram, and cause damage to capillary endothelium, vascular congestion, and anoxia, and consequently lead to the transudation of fluid across the impaired endothelium and into the cord. Here again, slight lowering of the plasma osmotic pressure, caused by increased protein catabolism and disturbed protein synthesis as a systemic manifestation of the disease, could lead to a prompt increase in both the degree and the rate at which the local edema of the cord develops.

According to reports in the literature, plasma in moderate amounts has been given in the past to patients with poliomyelitis, with the idea of introducing the immune bodies of the globulin fraction. In one brief study reported by Barnum and Bower in 1944 (*1*), large amounts of plasma were intravenously administered with apparently good results, but again with the apparent intent to administer γ-globulin. The present paper suggests that the therapeutic value of plasma in poliomyelitis may more correctly be attributed to the albumin fraction and to its effect in reducing cord edema. Our preliminary results with a group of 76 Los Angeles patients, soon to be reported, are in accord with this hypothesis and indicate that generous amounts (600 to 900 ml daily) are required.

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A Photoelectric Microdensitometer

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The photoelectric microdensitometer was designed for the semiquantitative determination of colorimetric histo- and cytochemical tests. Visual judgment of color intensity is not sufficiently reliable to permit comparison of the degree of color in experimental and control preparations. This instrument completely eliminates the subjective element of judging color intensities. It is possible to duplicate the values of different sets of tests (e.g. the Feulgen reaction) on comparable material within ±2%.

The microddensitometer is based on ideas from a number of sources, particularly Dempsey *et al.* (*2*), and Stowell (*3*). Although this densitometer assembly is not new in principle, its adaptability and reliability make it a valuable laboratory aid.

As shown in Fig. 1, the assembly consists of a monocular microscope, a Leitz Makam with a ground glass back, and a model 512 Photovolt Electronic Photometer with a Type C search unit. The phototube search unit is mounted in a traversing mechanism which can be used to move the search unit over the ground glass screen. This assembly in turn is mounted on an arm that can be moved up and down a vertical post. The arm is counterbalanced by a spring-activated steel tape fixed to the top of the vertical post and is provided with a collar which will lock the assembly at any height by a simple set screw. Details of the arm and traversing mechanism are shown in Fig. 2.

Illumination of the Kohler type, as described by Copeland (*1*), is provided by any good microscope lamp and

[1] U. S. Public Health Service, National Cancer Institute Research Fellow.

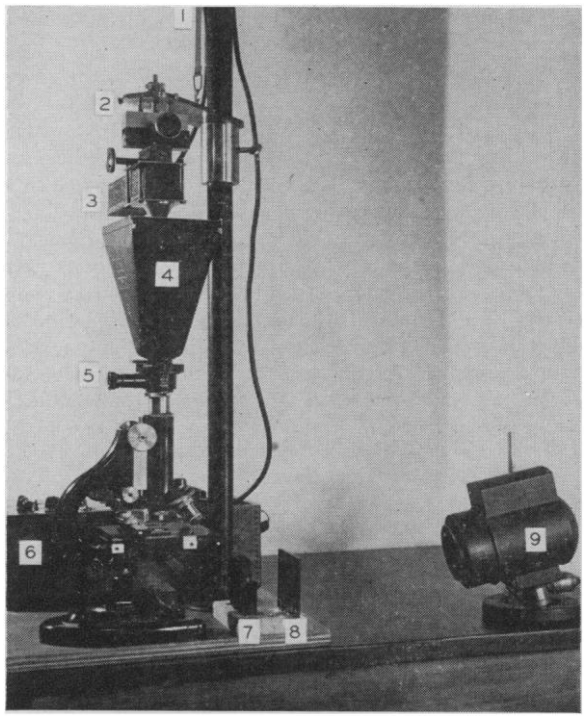

FIG. 1. Photoelectric Microdensitometer. 1. Spring-activated counterbalance. 2. Arm and traversing mechanism. 3. Search unit. 4. Leitz Makam. 5. Side ocular. 6. Photovolt Electronic Photometer. 7. Polaroid variable density screen. 8. Color filter. 9. Lamp housing.

may be adjusted in intensity by a polaroid variable density screen.[2] A 90° prism[2] cemented with Clarite on the flat surface of the microscope mirror converts the light reflecting system, in effect, into a first-surface mirror. This eliminates the secondary light images formed by an ordinary or back-silvered mirror.

The Leitz Makam is used because it can be mounted directly on the microscope, thereby reducing the bulk of the equipment. Furthermore, this camera is equipped with a side ocular for critically centering and focusing the material to be studied. Almost any other type of microscope camera with a ground glass back can be used.

The traversing mechanism for the phototube was made from two rack and pinion units mounted at right angles to one another (see Fig. 2). The search unit was clamped between two brass plates held together by four long screws. The lower plate was provided with an opening slightly larger than the window of the search head, allowing the use of interchangeable aperture cones which adapt the instrument for reading areas of different sizes. These aperture cones used in conjunction with low, medium, and oil immersion objectives make possible densitometric readings of large tissue areas, individual cells, and even small areas within a cell such as the nucleus.

In practice, a filter complementary to the color of the material studied was used. The light intensity was adjusted by means of the polaroid screen until the light passing through a clear area of the slide read approximately 100 on the densitometer. Then the densitometer was adjusted so that it read exactly 100. The section to be studied was then placed in the field, accurately focused, and read by recording the meter readings of specific areas of the section as the search unit (with suitable aperture cone) was placed over parts of the section as seen on the ground glass. Since the initial adjustments constitute the blank readings corresponding to 100% transmission, the subsequent determinations were read as percent transmission. Where controls give the approximate zero point of color intensity, it is possible to adjust the control reading either to 100% or 0% transmission, and then read the experimental results corrected for the controls.

[2] Available from Army surplus material.

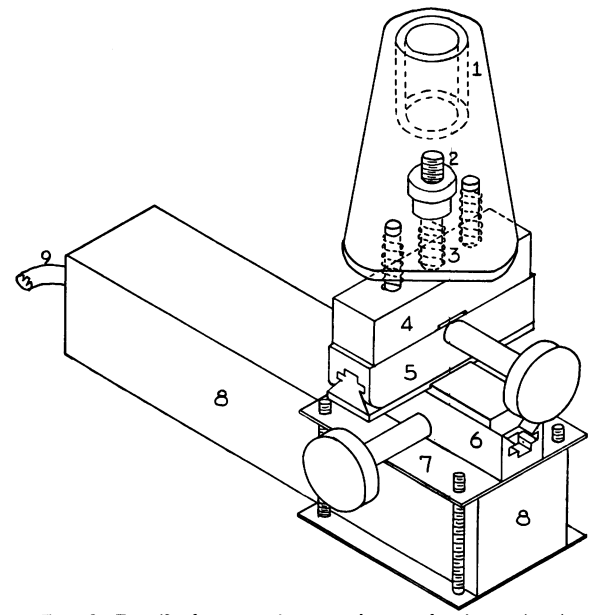

FIG. 2. Detail of arm and traversing mechanism. 1. Arm with collar. 2. Screw mechanism for raising and lowering search unit. 3. Springs. 4. Brass block. 5. Transverse rack and pinion. 6. Longitudinal rack and pinion. 7. Clamp for search unit. 8. Search unit. 9. Cord to electronic photometer.

Readings do not correspond to specific absorption as determined by spectrophotometry where transmission of individual wavelengths can be determined. They can, however, be used as an accurate estimate of the intensity of a reaction provided that experimentals and controls are prepared under exactly comparable conditions. The readings may be used to construct charts and graphs which facilitate the interpretation of results.

The photoelectric microdensitometer can be adapted for use in microchemical determinations. Depression slides may be used as microcuvettes to prepare a set of standards of known concentration for calibration of the instrument. Curves of these values may be plotted and used to determine unknown concentrations as found in densitometer readings of tissue sections, if the difference between the thickness of microcuvettes and of tissue sections is known.

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