ture develops tubules in greater number and of greater length than a sister culture incubated immediately. Their development is not suppressed by substances that enhance cell activity unless they induce, at the same time, the immediate coagulation of the medium. Embryonic tissue juice prevents their formation by producing immediate coagulation.

So far, the tubules have no definite walls. These begin to be formed very shortly after coagulation has taken place in the medium. The walls do not arise as a direct transformation of the fibrin clot. Instead, they are formed by the activity of living cells, or cell products, the so-called thrombocytes, that have been deposited along the course of the tubule. Where there are gaps between the cells confined in the tubule, these minute bodies may be seen to spin out fine hair-like filaments at the interphase between the lumen of the tubule and the surrounding coagulum. It is believed that the fibrin of the plasma clot serves as a supporting structure upon which the thrombocytes lay down their fiber-like strands. Out in the surrounding medium, these small corpuscles produce similar strands, but here at random. The majority of them tend to agglutinate. Very often, the agglutinated masses become joined together by numerous threads.

After a few days, the red cells within the capillary-like formations become progressively phagocytized by the macrophages. Eventually, these in turn escape into the surrounding medium, sometimes through definite breaks in the walls, but more often by way of their proximal ends. When the tube has become empty, as may occur after 4 or 5 days, any number of macrophages may remain spread out over its outer surface. In this position, they bear striking resemblance to the much discussed cells of Rouget. At times, they are so numerous that their undulating membranes seem to fuse with one another, giving the impression of an unbroken syncytium. If the cultures were fixed and stained at this moment, their nuclei might easily be mistaken for nuclei present in the wall. This apparently accounts for the statement of Hueper and Russell[2] that the wall itself becomes nucleated. This has not been confirmed. When, as may eventually happen, these Rouget-like cells wander away, they leave a fibrous wall that is quite devoid of any cellular structure whatsoever.

Occasionally, the wall is incompletely formed, the fibrillar strands being laid down over a single portion of the original pathway. At other times, a single cord of fibrous material may extend along one side of it, or even this may be absent. Invariably, however, its lumen remains open and filled with the clear fluid that has diffused in from the medium.

To summarize: Isolated blood cells, in a plasma substratum, are capable of constructing highly organized channels that are analogous to the blood capillaries of the organism.

RAYMOND C. PARKER

THE ROCKEFELLER INSTITUTE
FOR MEDICAL RESEARCH
NEW YORK CITY

LAMINAR DESTRUCTION OF THE NERVE CELLS OF THE CEREBRAL CORTEX

ONE of the structural characteristics of the cerebral cortex is that it is composed of a number of layers of nerve cells. Generally a fundamental subdivision in six layers is accepted nowadays.

Very little is known as yet about the functions of these various layers. It is known that in the gigantopyramidal area of the cortex (field 4 of Brodmann) the giant pyramidal cells of the fifth layer give rise to most of the nerve fibers descending into the spinal cord as the fibers of the pyramidal tracts. It is assumed on the basis of histological evidence that the three or four outer layers are predominantly receptive in function and that the two inmost layers more particularly subserve efferent functions. Perhaps a few additional, although indeed less probable assumptions could be made, but that would be all. Our factual knowledge of the functions of these various layers is as yet very restricted. This is largely due to the stupendously complex structure of this tissue, but also to the fact that until now no method has been available which permitted an experimental attack upon the various layers of the cortex, and by that a direct approach to their respective functions.

In this preliminary paper I want to describe briefly a simple method which makes possible destruction, at will, of consecutive layers of the nerve cells of the cerebral cortex, *i.e.*, of either its first two superficial layers, or of the first four, or of all the six layers. This is possible by applying heat locally to the exposed cortex for a very short period. It was found that heating to 90°–100° C. for five seconds results in death of all the nerve cells in the heated area throughout the whole thickness of the cortex, and that, by heating it to about 70° C. for from one to two seconds, it is possible to kill the nerve cells of only the two superficial layers.

The apparatus used in these experiments is very simple. The copper tip of an ordinary electric soldering-iron is sawed off so that a rectangular surface of appropriate size (5 × 7 millimeters) is obtained. This surface can be heated to any temperature suitable for our purposes, by taking off the proper voltage from a potentiometer-rheostat (of f.i. 600 ohms, 1 Amp.) plugged into a power outlet. For special purposes copper tips of various size and shape are used, which can be screwed into the stem of the soldering-iron. A series of settings of the rheostat was established for a few suitable temperatures (60, 70, 80, 90, 100° C.) for each type of copper tip used. The temperatures of the tips were determined in the usual

way with thermocouples and a ballistic galvanometer. These experiments were performed on monkeys (*Macacus rhesus*) under sterile conditions; the animals were killed after one or two weeks and the changes in the cerebral cortex studied by the Nissl method.[1]

The lesions are found to be strictly localized to the heated area. It shows as an encapsulated area, sharply marked off from the surrounding normal cortex by a wall of proliferated connective tissue and blood-vessels. The nerve cells within this area have all disappeared; those immediately outside this wall of connective tissue show a normal Nissl picture. Of great interest is the fact that the neuroglia inside the damaged area is not killed, but is found to have reacted to the heating by proliferation. Even a temperature of 130° C. applied for ten seconds does not kill the cortical neuroglia.

This method of laminar thermo-coagulation of the cerebral cortex, as it might be called, results, therefore, within a wide range of temperatures, in a sharply localized, selective destruction of the nervous elements. By selecting a suitable temperature and a suitable period of application of the heat it is possible to destroy, at one's discretion, the nervous elements, the nerve cells and their processes, in consecutive layers of the cortex.

Details can not be given in this preliminary paper; suffice it to point out that this method permits a new attack upon many important problems in the fields of physiology, anatomy and experimental pathology of the cerebral cortex.

J. G. DUSSER DE BARENNE
YALE UNIVERSITY

LITHIUM IN SEA WATER

COMPARATIVELY little is known concerning the distribution of the rarer alkali metals in nature in spite of the intrinsic interest of the subject. Beyond the fact that the order of occurrence is probably Na, K, Li, Rb, Cs, Va, no quantitative data are available to enable us to assign numerical ratios to this series. Even in the case of sea water, which has been extensively studied by so many investigators since the beginnings of chemistry, quantitative determinations of the alkalies, lithium, rubidium and caesium are practically non-existent, and virginium has only recently been discovered. Analyses by Schmidt,[1] frequently quoted in works on oceanography and geochemistry, give values as high as 0.04 per cent. of rubidium in sea salt, but examination of Schmidt's original paper shows that his results are based upon indirect analysis with a very high probable error. Grandeau,[2] who found rubidium in beet root, failed to detect the element in sea water and also mentions Bunsen's failure to find it.

So far as the authors know there is no published account of even the detection of caesium in sea water. In some works on oceanography its identification is attributed to Sonstadt, but in every such case the writer has overlooked Sonstadt's[3] admission that the spectrum lines he thought were due to caesium were actually given by strontium.

As far as is known, the authors report in this paper the first quantitative determination of lithium in sea water. In this procedure a liter sample is used. The calcium and magnesium are removed by precipitation with sodium carbonate. This precipitate is dissolved and reprecipitated in order to avoid the possibility of loss of some of the lithium with the carbonates.

The filtrates from the two precipitations are combined and evaporated, the magnesium carbonate which continues to precipitate as the solution evaporates being removed by filtration from time to time. When the volume is about 100 ml the solution is filtered and acidified with hydrochloric acid. The evaporation is then continued in the acid solution.

When sodium chloride begins to separate the solution is cooled, and an equal volume of ethyl alcohol is added, which precipitates much of the sodium chloride. This is filtered off, washed with a little 50 per cent. alcohol and evaporation of the filtrate continued. The sodium chloride is reserved for subsequent treatment.

When sodium chloride again begins to crystallize from the solution, the above procedure is repeated, and this is continued until the volume is about 10 ml. The precipitation may also be accomplished with hydrogen chloride gas.

At this point all the sodium chloride which has been removed is dissolved in water and reprecipitated by the same process of alternate evaporation and addition of alcohol until the volume of solution remaining is about 5 ml. This is added to the 10 ml of filtrate from the first procedure. Reprecipitation of the sodium chloride is necessary to avoid loss of some of the lithium with the sodium chloride.

An equal volume of alcohol is added to the combined filtrates and the solution is saturated with dry hydrogen chloride. The greater part of the remaining sodium chloride and sulfate and some potassium is removed by this operation, and the solution is evaporated to dryness.

It is now necessary to remove the remainder of the magnesium. The residue from evaporation is dissolved in 20 ml of 50 per cent alcohol, 2 ml of normal sodium carbonate solution is added, and the solution is boiled. The precipitate is filtered off, dissolved and reprecipitated to avoid any possible loss of lithium. The combined filtrates from the two pre-

[1] I am greatly indebted to Dr. Harry M. Zimmerman, of the department of pathology, for the preparation and help in interpretation of this histological material.

[1] Schmidt, *Bull. Acad. St. Petersburg*, 24: 231, 1878.
[2] Grandeau, *Comp. Rend.*, 53: 1100, 1861.
[3] Sonstadt, *Chem. News*, 22: 25, 1870; *ibid.*, 22: 44, 1870.