be applied directly. Nevertheless, we are of the opinion that the current practice of trepining before thermocautery is a neurological tradition rather than an ideal procedure. In a species with poorly marked cortical surfaces, it can not be of much aid to have the surface in view at the moment of operation. The maps of lesions presented by current investigators do not indicate that the prevailing techniques consistently produce the desired destruction. In consequence of this lack of control of cerebral lesions, the researcher produces lesions in many animals and selects for study the animals which happen to possess the sort of destruction which he wishes to study, disregarding the remainder.

This general procedure must be followed today, regardless of how the lesions are produced. If a hot instrument is applied extracranially, the production of lesions is an extremely easy process. The rat is anesthetized, the skull exposed, the cautery applied (in our instance, for fifty seconds), the wound sewed and covered with collodion. Aside from preliminary anesthetization, the entire operation can be performed in three minutes. The skull is left intact. Far from being a cruder method, this method seems to us to provide as good or even better control of the lesion than does the more complicated technique.

The technique has been entirely successful in meeting our needs. We wished to destroy all or most of the striate area. By examining the relation between the striate area and the skull markings, we determined where the cautery should be applied. Experimentation upon rats other than the main experimental group showed what duration of exposure to the heat would most often produce the desired destruction. Examination of sections, to be reported in detail later, show that the desired effect with respect to location, depth and shape of lesion was produced more often than reports of other investigators would lead one to expect from the employment of the traditional methods.

Our lesions were in general round in shape, two millimeters in diameter and were limited to the cortex. It seems likely, however, that one could devise cautery points which would produce lesions of almost any desired shape, and that these lesions could be produced at any point adjacent to the skull. The depth of the lesion may be controlled by varying the duration of the application of the heat, or by varying the intensity of the heat. It is even possible that almost complete decortication might be produced by applying a relatively small cautery point to many areas or by making a metal cap to fit the skull and then applying it when heated.

In addition to simplicity, the technique has the advantage of completely avoiding exposure of the cranial contents to the danger of infection.

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SPECIAL ARTICLES

A FILTERABLE VIRUS RECOVERED FROM WHITE MICE

DURING recent work with the viruses of equine encephalomyelitis and hog cholera an infective agent was obtained from white mice which was pathologically and serologically distinct from both viruses. Its origin was not definitely known, but it seemed likely that the natural host of the agent was the mouse, in spite of the fact that in our mouse colony no disease had been previously recognized. In an experiment designed to trace the origin of the infectious agent, 60 five-week-old, healthy-looking mice from our colony were each given an intracerebral injection of a small amount of sterile bouillon. Fifty-one of these mice showed no evidence of illness during the three weeks that they were under observation. Four died in from 3 to 13 days following the inoculation, and three were killed on from the sixth to the eighth day when they showed symptoms similar to those observed in the mice inoculated with the unknown agent. On the sixth day two additional mice that showed photophobia but no other symptoms were killed. From one of these mice no material was obtained for inoculation, but bacteriologically sterile suspensions of the brain of each of the other eight when injected into guinea-pigs caused symptoms which could not be differentiated from those produced by the original material. This experiment, together with others, suggests that the infectious agent is carried by apparently healthy mice in our colony and that symptoms may be brought out by the intracerebral injection of foreign protein.

Among the mice from our colony only about 60 per cent. develop symptoms after intracerebral injection of infectious material and only 40 per cent. die. The incubation period is from 5 to 10 days. The clinical symptoms are somnolence, photophobia, tremors of the legs, followed by tonic spasms of the muscles of the hind quarters, shown when the mouse is lifted by its tail. Paralysis has not been observed. One of 30 mice inoculated with infectious material by the intraperitoneal route developed symptoms, while

intravenous and intracutaneous inoculations into the footpads have been negative. The agent has been demonstrated in the brain as well as in the viscera of mice that have succumbed to the infection. Macroscopically the only changes noted are a nutmeg liver and slight enlargement of the spleen. A preliminary microscopic examination shows a certain degree of infiltration of the meninges, ependyma, choroid plexus and perivascular lymph spaces with round cells. In addition there is necrosis of some of the nerve cells in the cerebral cortex, cerebellum, brain stem and spinal cord. In the last the anterior horn cells are predominantly involved. In the cerebellum it is the Purkinje cells that are affected. There may be some proliferation of the ependyma and of the glia cells of the gray matter.

Guinea-pigs have proved to be very susceptible as they develop symptoms following intracerebral, subcutaneous and intranasal inoculation. The mortality has varied with different strains used but has been practically 100 per cent. after intracerebral inoculation and from 80 to 90 per cent. following subcutaneous injection. The course of the disease is more chronic than in mice, there being a remittent type of fever with emaciation, somnolence, salivation and markedly labored breathing. Death occurred in from 10 days to 3 weeks after inoculation. One of eight guinea-pigs in contact with an infected animal developed the disease. At autopsy pneumonia of the virus type is often encountered. In addition to the changes noted in the mouse brains, acidophilic intranuclear inclusions have been found in the round cells present in the meninges and choroid plexi. The infectious agent has been demonstrated in the brain, blood and suspensions of the diseased lungs. Three guinea-pigs have recovered from the disease and have resisted further injections. In a limited number of experiments attempts to infect rabbits have been negative.

Material known to be infectious has shown no organized forms when examined by the usual bacteriological procedures and no growth has occurred on a variety of media. The disease has been produced by material passed through Berkefeld "N" and "W" filters that have held back *B. prodigiosus,* and also by material that has been in 50 per cent. glycerol for at least one month. From these facts we conclude that the agent is a filterable virus.

The disease caused by this virus is definitely different from infectious ectromelia.[1] The virus of spontaneous encephalitis of mice described by Theiler[2] produces a different clinical picture and is confined to the central nervous system, whereas the virus we have been working with is distributed generally. The origin of the virus recovered by Armstrong[3] from a monkey inoculated with virus from a human case of encephalitis during the St. Louis epidemic has not been definitely established. It produces a clinical picture in mice which is strikingly like that described above, and the lesions in the central nervous system have much in common with those observed in our animals.

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[1] J. Marchal, *Jour. Path. and Bact.,* 33: 713, 1930.
[2] M. Theiler, SCIENCE, 80: 122, 1934.

THE RELATION OF STREAM DOUBLE REFRACTION TO TOBACCO MOSAIC VIRUS

IN a previous publication[1] we reported that juice expressed from tomato tissues infected with tobacco mosaic virus contains a high concentration of M.C.S.D.R. (material causing stream double refraction), whereas juice from healthy tissues contains a relatively slight concentration of material causing this phenomenon.

The high concentration of M.C.S.D.R. in mosaic plants is probably subject to one of the following three explanations. (1) The M.C.S.D.R. in mosaic plants may be the same material as that in healthy plants, but is in much higher concentration in mosaic plants. (2) The stream double refraction exhibited by juice from mosaic plants may be caused by a high concentration of virus particles, together with a very low concentration of the material which causes stream double refraction in healthy plants. (3) Most of the M.C.S.D.R. in mosaic plants may be composed of a product of the virus or of the diseased host not present in healthy plants.

Previous work[2] has shown that Vinson's purification technique removes all the detectable M.C.S.D.R. from juice of healthy plants but leaves a high concentration of M.C.S.D.R. and virus in infective juice. When different methods of juice extraction were used it was found[1] that the method which yielded the highest concentration of M.C.S.D.R. from mosaic plants yielded the lowest concentration from healthy plants and the method yielding the highest concentration from healthy plants yielded the lowest from mosaic plants. When juice from healthy plants has been stored at room temperature for from 12 to 24 hours it no longer exhibits stream double refraction, whereas juice from mosaic plants contains a concentration of M.C.S.D.R. even slightly higher than freshly extracted

[3] C. Armstrong, with pathology by R. D. Lillie, *Publ. Health Rep.,* 49: 1019, 1934.
[1] W. N. Takahashi and T. E. Rawlins, "Application of Stream Double Refraction in Identification of Streak Diseases of Tomato." *Phytopath.* In press.
[2] W. N. Takahashi and T. E. Rawlins, SCIENCE, 77: 284, 1933.