respect to EEG synchronization. This agreement indicates that the cutaneous fibres concerned with the skin pressure reflex belong to GII fibres.

Recent investigations indicate that proprioception[10–12] as well as pressure and touch impulses[13] have a double pathway in the spinal cord, the uncrossed dorsal and crossed ventral funiculus, and the impulses conducted in the ventral funiculus are activated monosynaptically only from the contralateral afferent nerves. The topographic organization of the dorsal funiculus and its properties are sufficiently elaborated. Pressure sensation controlled by this phylogenetically younger pathway was found to be discriminative and epicritic. On the other hand, pressure sensation served by the phylogenetically older ventral funiculus, the topographic organization of which was described by WALKER[14], seems to be protopathic.

The results of the present experiment indicate that the afferent pathway of the skin pressure reflex passes upward not through the dorsal funiculus but in the phylogenetically older ventral funiculus, which is, in the rabbit, much larger than the dorsal funiculus.

This may be explained by the fact that the rabbit seems to be a considerably primitive animal. This agrees with the observation of BROUWER[15] that the proportional dimension of the ventral funiculus as compared with the dorsal funiculus of various classes of vertebrates, is larger in lower classes than in highly evolved classes.

The present investigation by means of MARCHI's stain has shown that the highest terminations of the degenerated fibres, namely the secondary long ascending fibres in the ventral funiculus, were found in the superior colliculus. This indicates that in rabbits, the so-called ventral spinothalamic tract does not reach the thalamus anatomically[16]. The collaterals running into the reticular formation are obviously identical with the spino-reticular fibres described by BRODAL[16].

Conclusion. The impulses evoked by pressure to the skin are conducted in primary afferent cutaneous fibres (GII). Then the impulses are conducted by neurons ascending in the phylogenetically older ventral funiculus of the contralateral side of the spinal cord. In the course of the pathway to the superior colliculus, the ascending fibres give off a considerable amount of collaterals to the spinal cord, medullary, and midbrain reticular formation. Some of them enter into the superior peduncle. It is concluded that such a pathway belongs anatomically to the spino-tectal and the spino-reticular tract[17].

Zusammenfassung. Am Kaninchen wurde der Einfluss einer chronischen einseitigen Durchschneidung des medialen Vorderstranges bei Th12 auf die reflektorische Hemmung von Kältezittern durch Hautdruck unterhalb der Durchschneidung untersucht. Das Kältezittern wurde nur dann gehemmt, wenn der Druck auf der Seite der Läsion appliziert wurde. Demnach kreuzt die afferente Bahn dieses Reflexes im Rückenmark und verläuft im contralateralen Vorderstrang im sogenannten Tractus spino-thalamicus medialis. Die Verfolgung der degenerierten Axone der durchschnittenen Bahn nach rostral ergab, dass zahlreiche Neurone zur Formatio Reticularis der Medulla ziehen. Degenerierte Fasern konnten rostralwärts bis zum Tectum nachgewiesen werden.

M. KOSAKA[18], K. TAKAGI and Y. KOYAMA

Department of Physiology, Nagoya University School of Medicine Nagoya, and National Cancer Centre, Tokyo (Japan), 6th March 1967.

[10] F. MAGNI and O. OSCARSSON, Acta physiol. scand. *54*, 53 (1962).
[11] B. HOLMQVIST and O. OSCARSSON, Acta physiol. scand. *58*, 57 (1963).
[12] O. OSCARSSON, Prog. Brain Res. *12*, 164 (1964).
[13] J. FULTON, *A Textbook of Physiology*, 17th edn (W. B. Saunders Company, Philadelphia and London 1955).
[14] A. E. WALKER, Archs Neurol. Psychiat., Chicago *42*, 284 (1940).
[15] B. BROUWER, *Anatomical, Phylogenetical, and Clinical Studies on the Central Nervous System* (The Johns Hopkins University Lectures on the Herter Foundation, The Williams and Wilkins Company, Baltimore 1927).
[16] A. BRODAL, *The Reticular Formation of the Brain Stem* (The William Ramsay Henderson Trust Lecture, Oliver and Boyd, Edinburgh 1957).
[17] The authors wish to thank Director Prof. M. KURU, National Cancer Centre in Tokyo, and Director Prof. R. THAUER, and Dr. E. SIMON, Kerckhoff-Institute, Bad Nauheim, for their kind advices.
[18] Present address: W. G. Kerckhoff-Institute of Max-Planck-Gesellschaft, 635 Bad Nauheim (Germany).

Experimental Lymphography by Means of a Subarachnoidal Injection of Lipiodol Ultrafluid (Guerbet)

From both the theoretical and the practical point of view, the lymphographic demonstration of lymph vessels participating in the fluid metabolism of the brain and the eye, is of major importance.

Techniques. 8 dogs of both sexes were punctured intracisternally under hexobarbital anaesthesia. 5–8 ml of the cerebrospinal fluid were removed and the same volume of lipiodol was injected slowly intracisternally. 48 h after the injection, X-ray pictures were taken and the animals killed by an overdose of the anaesthetic. Frozen sections stained with oil red were used for histological examinations.

Results. In animals kept in a horizontal posture for several hours after the injection, the contrast material appeared in the form of droplets in the subarachnoidal spaces at the basis cranii and the spinal cord. If, however, the animals were located in a plane tilted 45° cranially, part of the contrast material surrounded sheathlike both Nn. optici, and surrounded, in the form of a sheath, the eyeball, with the exception of the cornea. Also the lymph vessels at the base of the nasal cavity, as well as the angular and retroauricular lymph nodes, could be well seen (Figures 1 and 2).

Histological investigation revealed lipiodol droplets in the subarachnoidal space around the optic nerve, as well as in the leptomeningeal sheaths of the optic nerve, especially around the blood vessels. Lipiodol droplets were found in the retina, too, within the layer between the pigment epithelium and the photoreceptors. Droplets were present episclerally and between the sheets of the sclera, too. In the swollen bulbar conjuctiva, part of the lipiodol was found in lymph vessels lined by endothelial cells (Figures 3–6).

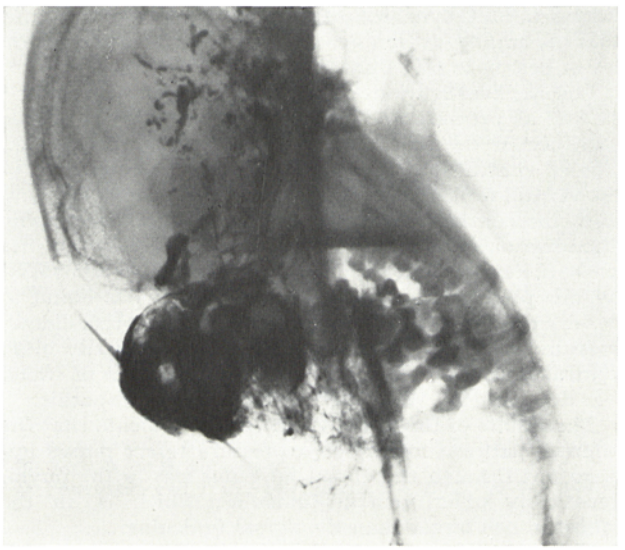

Fig. 1. and 2. Lipiodol surrounds both Nn. optici and the eyeballs.

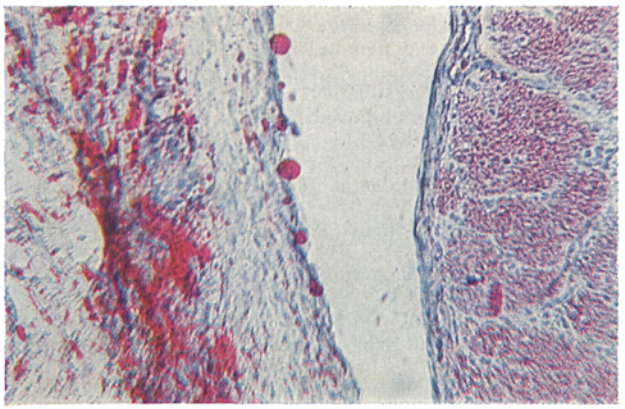

Fig. 3. Lipiodol droplets between the optic nerve and its meningea sheath. × 40.

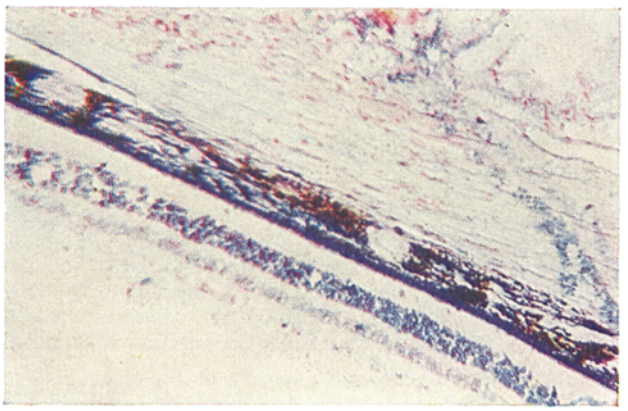

Fig. 5. Lipiodol in the episclera and sclera. × 40.

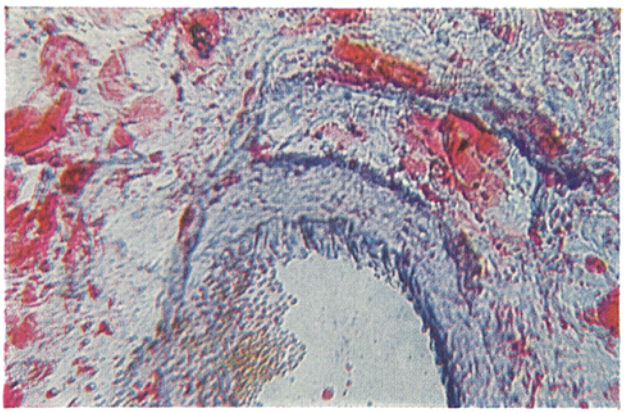

Fig. 4. Lipiodol surrounding central vessel of the retina. × 80.

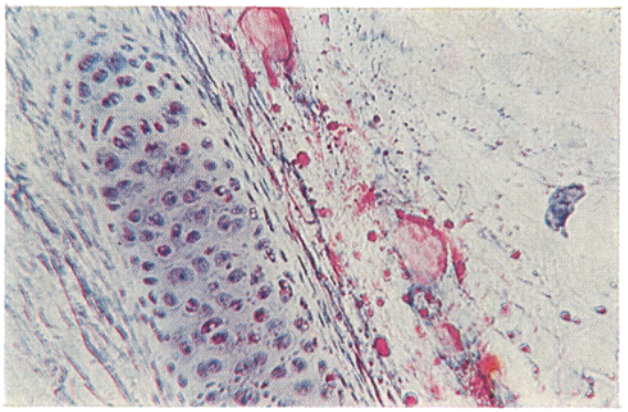

Fig. 6. Lipiodol in endothelium lined lymph-vessels in the plica semilunaris. × 40.

Discussion. 'Paralymphatic' pathways devoid of an endothelial lining and lymph vessels that play a vital role in the fluid circulation of intracranial structures, can readily be visualized by means of an intracisternal injection of lipiodol ultrafluid.

According to DAVSON[1] 'there is no free passage of fluid from the peri-optic subarachnoid space into the retinal tissue, the latter space being apparently sealed off at the lamina cribrosa'.

Our studies disprove this view and support the idea[2] that conjunctival and orbital lymph vessels, taking part in the fluid circulation of the eyeball proper, are in direct communication with the intracranial fluid circulation. The possibility of artifacts in the above studies can completely be excluded.

Zusammenfassung. «Paralymphatische» Bahnen sowie Lymphgefässe, welche im Flüssigkeitskreislauf der intrakranialen Strukturen eine wichtige Rolle spielen, können im Tierversuch durch intrazisternal injiziertes Lipiodol ultrafluid dargestellt werden. Nach DAVSON[1] scheint die Lamina cribrosa das freie Eindringen einer Flüssigkeit aus dem perioptischen Subarachnoidealraum in das Retinalgewebe zu verhindern. Auf Grund der beschriebenen Befunde, welche die Möglichkeit von Kunstprodukten mit Sicherheit ausschliessen, vertreten die Autoren den Standpunkt, dass die Lymphgefässe der Bindehaut und der Orbita mit dem intrakranialen Flüssigkeitskreislauf in direktem Zusammenhang stehen.

M. FÖLDI, T. SZENES, A. KAHÁN, G. THURY and Ö. T. ZOLTÁN

Departments of Internal Medicine No. II., Radiology and Ophtalmology, University Medical School, Szeged (Hungary), 14th March 1967.

[1] H. DAVSON, *Physiology of the ocular and cerebrospinal fluids* (J. and A. Churchill Ltd., London 1956).

[2] M. FÖLDI, F. KUKÁN, G. SZEGHY, A. GELLÉRT, M. KOZMA, M. POBERAI, Ö. T. ZOLTÁN and L. VARGA, Acta anat. *53*, 333 (1963).

The Content of Non-Esterified Fatty Acids and Glycerol in the Blood of the Hedgehog During the Hibernation Period[1]

The periodic spontaneous arousals of hedgehogs during the winter[2] give a good opportunity to investigate the influence of the body temperature upon the content of non-esterified fatty acids (NEFA) and glycerol in the blood of the hedgehog (*Erinaceus europaeus* L.).

Throughout the winter the hedgehogs must live on food reserves – fat deposits – which they have built up in their bodies. At least in hibernating (hypothermic) animals, the RQs are those of lipids.

For demonstration of the changes related to the hibernation cycle (to the periodicity of hibernation) in midwinter (late January) the 6 following groups were created on the basis of continuously monitored body temperature recordings via thermocouples implanted s.c. in the interscapular region[2].

Group 1. Animals at about the middle of their hypothermia period from 4–5 days in deep hypothermia. Body temperature (TB) less than 1 °C higher than prevailing ambient temperature (TA) in a cold animal room (TA constantly at 4.2 ± 0.5 °C).

Group 2. Spontaneously arousing animals with a body temperature of 6 °C (thermocouples implanted s.c. in the interscapular region).

Group 3. Spontaneously arousing animals. TB has reached 15 °C when analyzed.

Group 4. 'Fully aroused animals': as a result of the spontaneous arousal process the recorded TB had reached its 'normal' level.

Group 5. Animals entering hypothermia with TB of 20 °C.

[1] Dedicated to Prof. H. MISLIN on the occasion of his 60th birthday.

[2] R. KRISTOFFERSSON and A. SOIVIO, Suomal. Tiedeakat. Toim. A IV, *80*, 1 (1964).

The content of non-esterified fatty acids and glycerol in the blood of hedgehogs. Means ± SE (and number of animals) are presented.

	NEFA meq/l	Glycerol μM/ml
Animals awake in late summer (7.IX)	0.396 ± 0.039 (5)	–
Animals awake in late autumn (27.-29.X) just before the onset of hibernation	0.492 ± 0.034 (6)	0.306 ± 0.031 (8)
Hypothermic animals in the beginning of hibernation (1.XI-16.XI)	0.555 ± 0.040 (6)	0.208 ± 0.019 (5)
Group 1. In deep hypothermia. Late January	0.659 ± 0.053 (7)	0.187 ± 0.005 (6)
Group 2. 'Arousing'. TB + 6 °C. Late January	1.381 ± 0.057 (7)	0.333 ± 0.039 (6)
Group 3. 'Arousing'. TB + 15 °C. Late January	1.156 ± 0.102 (7)	1.440 ± 0.210 (4)
Group 4. 'Fully aroused animals'. Late January	0.993 ± 0.074 (7)	0.436 ± 0.043 (7)
Group 5. Entering hypothermia. TB + 20 °C. Late January	0.517 ± 0.042 (7)	–
Group 6. Entering hypothermia. TB + 10 °C. Late January	0.613 ± 0.057 (7)	0.228 ± 0.036 (4)
Animals awake in late spring-summer (18.V-11.VI)	0.412 ± 0.024 (13)	–
Animals awake in summer (16.VI-8.VII)	0.399 ± 0.034 (10)	–