temperature is determined exactly as described in Comm. N°. 83.

The cryostat described could be relatively simple, because a vacuumglass of large dimensions was used. Excellent though a vacuumglass may be, it is still always to be feared that it bursts unexpectedly and so damages the measuring apparatus. Indeed, one of the series ot measurements was put an end to in this way. Hence, when measuring apparatus are used to which we attach great value, because, for instance, many other measurements have been made with them, it is advisable when we want to bring them in baths of constant temperature below — 210° C., to use the cryostat described in Comm. N°. 83 III, where, though it is much more complicate than the one described here, no vacuum glasses are required, and in this the oxygen can be evaporated at a very low pressure, also with the aid of the above mentioned large vacuumpump.

Physics. — "*Methods and apparatus used in the cryogenic laboratory. IX. The purifying of gases by cooling combined with compression, especially the preparing of pure hydrogen.*" Communication N° 94c from the Physical Laboratory at Leiden by Prof. H. KAMERLINGH ONNES.

§ 1. To separate less volatile elements from a gaseous mixture by cooling with liquid air belongs now to the ordinary operations in laboratories. At Leiden it is applied on a fairly large scale to reobtain ethylene in its pure form after it has been mixed with air. In the experiments it repeatedly occurs that ethylene is contaminated with air; from time to time when in the ethylene cycle of the cascade process the condensation pressure of the ethylene increases, the gas which remains behind after the greatest part of the gas used in the cycle is liquefied, is blown off and replaced by pure ethylene, in order to reduce the condensation pressure to its ordinary amount. All such mixtures and remnants with a larger or smaller proportion of ethylene are collected in a large gasholder because of the expensiveness of this gas. The ethylene is afterwards frozen out from the collected gas in a vessel cooled by liquid air.

By cooling at a normal pressure we can from a mixture of gaseous substances which differ very much in volatility, separate a large portion of the least volatile substance when we go to temperatures which though lying above the boiling point of the one, reach far below that of the other substance. How much of the impurity is still in the remaining gas is then fairly well determined by the

vapour pressure of the less volatile element at the temperature of cooling. The separation will be much more perfect when we can also avail ourselves of compression, as it is the case, for instance, when the gas which we want to purify, at the lowest temperature to which we can cool, is still above its critical temperature.

If we do not take the pressure too high we may assume roughly that the degree of purity which we can reach with long continued cooling, is at the same temperature directly proportional to the pressure to which we compress. In cases where the gas flows through a cooled tube, other factors come into consideration, but even then compression offers a great advantage.

I have availed myself of this operation for a last and thorough purification of the electrolytic hydrogen (prepared as described in Comm. N°. 27, May '96), which is used for piezometers and thermometers, when it appeared that notwithstanding it was led through drying tubes with phosphorus pentoxide, traces of water still occurred in the gas. This purification was effected by cooling hydrogen under strong pressure in liquid air.

A similar method may be recommended to free, for instance, helium from admixtures of neon and hydrogen. The degree of purity of the helium can be raised considerably by causing the bath (liquid hydrogen) to evaporate in vacuo; for this purpose an apparatus is being constructed [1]).

§ 2. *Pure hydrogen for thermometers and piezometers.*

Several improvements have been made to the apparatus for the preparation of pure hydrogen (described in Comm. N°. 27). Some of them are described in Comm. N°. 60, Sept. '00. Later the plate *f* of fig. 6, Pl. II, Comm. N°. 27, was riveted to a platinum wire (instead of being soldered to the copper wire *e*) and melted in a glass tube which is bent down under the mercury on the bottom of the apparatus and is itself filled with mercury. Further the cock *d* was sealed to the bell-jar *c*, and the sealing place *k* is kept under mercury to be cooled by it; finally the shutting of the apparatus was made easier as the india rubber stoppers in the cover were replaced by cone-shaped ones which are pressed on to it by means of a small plate and tightening screws and as six tightening rods *t* instead of three as in the above mentioned figure have been made.

[1]) After this had been written and published in the Dutch Proceedings of the Academy I found that DEWAR in his Bakerian Lecture, Proc. Roy. Soc. Vol. 68, 1901, recommended the method of adding compression to cooling for purifying helium.

The electrolytic hydrogen prepared under excess of pressure in the improved generating apparatus flows off through a fine regulating cock (see *R*, Pl. I, Comm. N°. 27). It is, however, not directly admitted into the mercury airpump and the measuring apparatus which is to be filled, but is first led through a steel capillary to the piezometer in a pressure cylinder where pressure is exerted by compressed air, as was used in the experiments on the condensation of gaseous mixtures (see Comm. N°. 92, Sept. '04, Pl. I, fig. 1). The stem of this piezometer carries a three way stopcock (Comm. N°. 84, March '03 Pl. I figs. 2 and 3), to which are connected on the one side the above mentioned capillary, on the other side a copper cooling tube (a platinum cooling tube with platinum capillaries would still have been better), which at either extremity ends in steel capillaries with connections. A high pressure cock, which admits of a fine regulation, connects the cooling tube with the mercury air pump and the measuring apparatus. All the packings are made of cork, the gas itself has no contact with anything but the metal of the cooling tube and the capillaries, with glass, or with twice distilled mercury. After all parts between the generating apparatus and the mercury airpump have been carefully exhausted, the gas is admitted from the generating apparatus into the piezometer with the cooling tube, then the latter are shut off from the generating apparatus and the mercury in the piezometer is forced up until a pressure of 60 atm. is reached, the cooling tube being immersed in liquid air up to the steel capillaries. At the same pressure the gas is then led through the regulating cock into the measuring apparatus that are to be filled.

§ 3. *Hydrogen for the cycle with liquid hydrogen.* The commercial electrolytic hydrogen is as a rule too much contaminated with oxygen and air to serve for a circulation of hydrogen. In order to separate these admixtures we may compress it in a cooling tube immersed in oxygen, which evaporates in vacuo. The following operation is simpler still. The hydrogen is compressed and led through a cooling tube immersed in liquid air under normal pressure into the apparatus where liquid hydrogen is prepared by means of a regenerator spiral, which apparatus together with a gasholder, the compressors and drying apparatus forms a cycle. The pressure of compression is now regulated so that the compressed gas flows out without blocking the delivery cock of the regenerator spiral, at least not as long as this cock is opened and shut alternately. The pressure is gradually raised higher and higher, while the temperature of the outflowing gas falls, and this is continued until the cock is blocked, and the pause during

which we are waiting for the cock to be free again, is used to remove that which is deposited at the place intended for the liquid hydrogen. Thus it is not difficult to prepare from the commercial hydrogen large quantities of hydrogen with less than 1 pro mille of admixture.

Anatomy. — *"On the development of the Cerebellum in Man"*. (Second Part). By Prof. L. BOLK.

In the first part of this communication the development of the Cerebellum is described until the stage in which the sulci appear typical for the mammalian cerebellum. In this stage it is divided by the sulcus primarius into an anterior and posterior lobe. The first of these lobes is separated by three grooves into four lobules, corresponding with the lobuli 1, 2, 3 and 4 of the mammalian cerebellum. The posterior lobe is also separated by three grooves (sulcus praepyramidalis, fissura secunda and sulcus uvulo-nodularis) in four lobules, corresponding with the lobuli A (nodulus), B (uvula), C_1, (pyramis) and C_2 (declive + folium vermis + tuber vermis), which, with a few exceptions, are to be found in the other mammals. In these exceptions the sulcus praepyramidalis, which separates the lobuli C_1 and C_2, is missing, as in Erinaceus (ARNBÄCK CHRISTIE LINDE), Notoryctes (ELLIOT SMITH), Vesperugo (CHARNOCK BRADLEY), Chrysochloris (LECHE). In this case the posterior lobe is only built up of three lobules. The missing of the sulcus praepyramidalis in these cerebella of extremely simple construction gives rise to the supposition that this fissure is phylogenetically the youngest of the primary sulci of the cerebellum. This supposition is corroborated by the fact that in man the sulcus praepyramidalis is ontogenetically the last that appears.

After the development of these primary sulci, grooves appear characteristic for the cerebellum of the primates, and whose homologa are wanting in other classes of mammals.

In embryos of a length from 16 to 22 c.M. arises a groove on the posterior surface of each of the hemispheres, the lateral part of which is directed to the obtuse angle of the lateral border of the cerebellum (Fig. 11 χ). The mesial ends of these grooves approaching each other, penetrate into the narrow lobule which is bordered by the sulcus primarius (1) and by the sulcus praepyramidalis (4); afterwards these grooves unite and divide the lobule in an upper and lower half. This differentiation however not always proceeds symmetrically, so that it may happen, that these grooves do not meet,