It may appear to some that the chemical character which has been assigned to osmose takes away from the physiological interest of the subject, in so far as the decomposition of the membrane may appear to them to be incompatible with vital conditions, and that osmotic movement must therefore be confined to dead matter. But such apprehensions are, it is believed, groundless, or at all events premature. All parts of living structures are allowed to be in a state of incessant change, of decomposition and renewal. The decomposition occurring in a living membrane, while effecting osmotic propulsion, may possibly therefore be of a reparable kind. In other respects chemical osmose appears to be an agency particularly adapted to take part in the animal œconomy. It is seen that osmose is peculiarly excited by dilute saline solutions, such as the animal juices really are, and that the alkaline or acid property which these juices always possess is another most favourable condition for their action on membrane. The natural excitation of osmose in the substance of the membranes or cell-walls dividing such solutions seems therefore almost inevitable.

In osmose there is further a remarkably direct substitution of one of the great forces of nature by its equivalent in another force—the conversion, as it may be said, of chemical affinity into mechanical power. Now what is more wanted in the theory of animal functions than a mechanism for obtaining motive power from chemical decomposition as it occurs in the tissues? In minute microscopic cells, the osmotic movements should attain the highest velocity, being entirely dependent upon extent of surface. May it not be hoped, therefore, to find in the osmotic injection of fluids the deficient link, which certainly intervenes between muscular movement and chemical decomposition?

II. "Examination of the Cerebro-spinal Fluid." By William Turner, Esq., Scholar of St. Bartholomew's Hospital. Communicated by James Paget, F.R.S. Received May 18, 1854.

In the Bulletin de l'Académie de Médecine for December 1852, a paper is published by M. Bussy, containing an analysis by M. Des-

champs of a fluid, which flowed from the ear of a man who had sustained a fracture of the base of the cranium. From a comparison between the composition of this fluid and that given by M. Lassaigne as the composition of the cerebro-spinal fluid, M. Bussy arrived at the conclusion that they were identical in their origin. In addition, however, to the albumen and ordinary saline constituents, M. Deschamps found that the fluid obtained from the fractured cranium contained a certain constituent which possessed the peculiar property of reducing the blue protoxide of copper to the state of the yellow suboxide.

As this power of reducing the oxide of copper is possessed also by grape-sugar, M. Bussy arrived at the conclusion that this fluid contained a small portion of grape-sugar, and as additional evidence in support of this conclusion he quotes the experiments of M. Bernard, who, by irritating the base of the encephalon and the origin of the vagus nerve, produced an excess of sugar in the secretions. He supposes that in the present instance the fracture through the base of the cranium may have produced some irritation at the origin of the pneumogastric, and thus have excited the formation of sugar. Such a supposition would have received additional confirmation if at the same time an analysis could have been made of the blood, urine, or other secretions, so as to determine if sugar was present in those fluids—no such analysis however is given. The property of reducing the oxide of copper was also found by M. Bussy to reside in the cerebro-spinal fluid of the Horse and Dog. In none of these experiments was he able to induce fermentation. As this reducing power is not peculiar to grape-sugar, but is possessed by other organic substances, such as lactine and lactucine, this test alone should not be relied on as affording any positive indications of its presence; recourse should therefore be had to other confirmatory experiments.

With a view to determine this point, Mr. Paget, in the early part of March last, gave me for examination three separate portions of the cerebro-spinal fluid, obtained by puncturing a spina bifida in a child, several days intervening between the removal of each portion.

Those removed on the first two occasions were perfectly clear and pellucid, giving an alkaline reaction to test-paper, their spec. grav.

being 1·006, no spontaneous coagulation taking place after standing for some time; that removed on the third occasion had a slightly yellow tinge, and a distinct coagulum formed in it on standing. The presence of fibrine in this instance was owing doubtless to some slight inflammation having been set up, caused by the successive puncturings. The three specimens corresponded in the following characters:—

1st. No precipitate on applying heat, merely an opalescence being produced; on the addition of a few drops of nitric acid a white flaky precipitate subsided. Nitric acid alone, without heat, also caused a precipitate.

The non-precipitation of the albumen, until the addition of the acid, was owing to the alkalinity of the fluid.

2nd. Boiled with liquor potassæ a very faint pinkish tint was produced; a few white flakes also fell down.

3rd. Heated in a water-bath with the blue oxide of copper, in a few minutes the yellowish red powdery suboxide precipitated.

This reaction took place both in the original albuminous liquid and after the coagulation of the albumen by heat and nitric acid.

4th. A piece of flannel, saturated with the chloride of tin, was well moistened with the fluid, and then heated over a red-hot coal; no brown colour of the flannel was produced, such as occurs when grape-sugar is present. (Maumenè's test.)

5th. A portion mixed in a test-tube with some German yeast was placed for several hours in a warm cupboard, but there was no development of gas.

From these experiments it appears that of the various tests employed, only one gave any indication of the presence of grape-sugar, that test also being the one which is most liable to deception. The lowness of the specific gravity, in which respect this fluid and that analysed by M. Deschamps closely corresponded, would, *à priori*, almost lead to the assumption that no grape-sugar was present.

The presence of the reducing agent could not in this case depend upon any irritation of the origin of the vagus, for the irritation, if any, produced by a spina bifida is at the end of the cerebro-spinal axis furthest removed from the origin of that nerve. That the material however which effects this reduction is of a very changeable nature, was shown by allowing a portion of the fluid to stand for

several days until putrefaction had commenced. The fluid was then filtered so as to separate the insoluble albuminous flakes, and the clear liquid heated in a water-bath with the blue oxide of copper; when, instead of the suboxide being produced, the black anhydrous oxide was formed, just as is the case when the blue oxide is heated merely with water, thus satisfactorily showing that the reducing substance had been destroyed.

The recent investigations of Virchow* and Busk† have shown that substances of a non-nitrogenous nature exist both in the brain and spinal cord, but they hold somewhat different opinions respecting their exact characters; for whilst the former considers them to be cellulose, the latter regards them both in their "structural, chemical and optical properties" to resemble starch. In conformity with these views, it was interesting to determine if any indications of the presence of either of these substances could be found in the cerebro-spinal fluid; accordingly a portion of the fluid was evaporated nearly to dryness and then divided into two portions; to one was added an alcoholic solution of iodine and concentrated sulphuric acid, when a violet tint was produced, which after a few minutes disappeared; but it was also found that this same appearance was produced when the acid and iodine solution were mixed together alone, the violet colour being evidently owing to the volatilization of a part of the iodine and the evolution of its characteristic violet tint; to the other a solution of iodide of potassium and then nitric acid was added, when a brown colour was produced, owing to the liberation of the iodine. In neither portion could it be said that any evidence of the presence of starch or cellulose was detected.

A comparative trial was also made between the effects produced upon the blue oxide of copper by the cerebro-spinal fluid, solutions of grape-sugar, cane-sugar, starch, cellulose, and mannite, an unfermentizable sugar. These various substances were heated in a water-bath for the same length of time, when it was found that whilst the grape-sugar effected a reduction immediately, and the cerebro-spinal fluid only after the lapse of several minutes, neither the starch, cellulose, cane-sugar nor mannite effected any reduction at all.

The power of reducing the blue oxide of copper is not confined to

* Quarterly Journal of Microscopical Science, January 1854. † Ibid.

non-nitrogenous substances, for I found that if a solution of leucine* be heated along with it in the usual manner, the reduction is effected in about the same length of time, and in the same way as by the cerebro-spinal fluid. This single experiment is not of itself sufficient evidence that the reducing power in both cases depends upon the presence of the same substance. Such an assertion could only of course be proved by obtaining from the cerebro-spinal fluid leucine in the crystallized form. A proper quantity of the fluid was not, however, left to investigate this point.

From the above experiments I think it may be safely asserted that the power possessed by the cerebro-spinal fluid of reducing the oxide of copper, is not owing to the presence either of grape-sugar or any of the allied substances: whether it may depend upon the presence of leucine or other modifications of albumen of a somewhat similar nature, or whether it may be due to the presence of a substance belonging to another series, is a point that has yet to be determined.

Note by Mr. PAGET.—The patient from whom the fluid analysed by Mr. Turner was obtained, was a girl born of healthy parents. An infant cousin had lately died from the same congenital defect as she presented. The upper part of the body was well formed, but the pelvis and lower limbs were small and nearly powerless. The sac containing the fluid was seated over the last lumbar vertebra, projecting (as the examination after death showed) through an opening between its unclosed arches. It enlarged quickly after birth, but did not evidently affect the child's health, unless it were connected with a very frequent spasmodic action of the muscles closing the glottis, which, almost from the time of birth, had produced the peculiar "crowing inspiration," or laryngismus stridulus. The fluid was first withdrawn when the child was three months old. Neither on this, nor on any subsequent occasion, did its removal produce any manifest effect, although the flaccidity of the emptied sac indicated that the pressure upon the spinal cord was greatly diminished. After every

* Leucine $C_{12}NH_{13}O_4$, a weak base, belonging to the same series as glycocine and alanine, is generally obtained by the decomposition of albuminous substances. It has been obtained by Scherer from the spleen, and, according to Gregory, has been detected as a natural product in the liver of the Calf.

evacuation the sac very quickly filled again, notwithstanding pressure exercised upon it.

The examination after death showed that the fluid was collected in the expanded tissue of the pia mater, or subarachnoid spaces, about the cauda equina. The pia mater presented appearances of inflammation long past, as well as of that which had probably been the cause of death. The canal in the axis of the spinal cord was distinct in its whole length. Commencing, below a large fourth ventricle, with a diameter of about one-fourth of a line, it gradually widened, till, at the lumbar part of the cord, it had a diameter of a line and a half. Its termination at the end of the cord could not be traced in the confusion of parts caused by the distension and inflammation of the membranes.

III. "On the Oxidation of Ammonia in the Human Body." By H. Bence Jones, M.D., F.R.S., Physician to St. George's Hospital. Received June 14, 1854.

In the last edition of Professor Lehmann's Animal Chemistry, vol. ii. p. 363, a very decided opinion is expressed against the conclusion to which I arrived in consequence of some experiments published in the Philosophical Transactions for 1851.

I considered it proved that ammonia was partly at least converted into nitrous acid in its passage through the body. In opposition to this Professor Lehmann states,—

1st. That the method which I employed must of necessity give a reaction resembling that given by nitrous acid; his words are, "Es wäre nun leicht einzusehen dass schweflige Säure, durch welche bekanntlich Iodwasserstoff zersetzt wird, in die Vorlage übergeht und so jene vermeintliche salpetersaure Reaction bedingt."

2ndly. That when nitric acid was added to urine and it was distilled with phosphoric acid instead of sulphuric acid, no trace of blue colour with starch and iodide of potassium could be obtained. "Das nach Anwendung von Phosphorsäure erhaltene Destillat giebt aber auch jene vermeintliche salpetersaure Reaction nicht, ja selbst dann nicht, wenn dem Harn vorher absichtlich einige Tropfen Salpetersäure zugesetzt worden waren."