1 year of age as many as four, five, or six parathyroids were discovered; between 1 year and 10 years the greatest numbers found were three and four; above 10 years the number never exceeded two. In subjects beneath the age of 20 I never failed to find parathyroids; above 20 they might be absent.

RELATION TO ACCESSORY THYROIDS.

Accessory thyroids were frequently found. Their three commonest sites are the three commonest sites of occurrence of the parathyroids. They are rarely found in subjects beneath the age of 1 year; thereafter they appear more commonly and attain a maximum between the ages of 30 and 60. The relation between the number of parathyroids and the number of accessory thyroids shows a striking fall with increasing age. Within the first twelve months after birth I found parathyroids to be more than seven times as common as accessory thyroids; between the first and fifth years three and a half times; between the sixth and tenth one and a half times; while between the eleventh and twentieth years equality is established. From the last-mentioned year onwards the preponderance goes to the accessory thyroids, and with every successive decade up to the seventh becomes more marked.

Although the present series of subjects examined is the largest recorded, its number is not great enough to allow statistics drawn from it to be accepted without any reserve. On the other hand, the relationship between the parathyroids and age, between the parathyroids and accessory thyroids, and between accessory thyroids and age, is so clear as in my mind to be strong evidence against admitting for the parathyroids that physiological value attached to them by so many experimenters.

BIBLIOGRAPHY.

Baber: *Phil. Trans. R. Soc.*, 1881. Edmunds: *Jour. Path.*, 1902. Gley: *Arch. de Physiol. normale et path.*, 1892:3. *Comptes Rend. de la Soc. de Biol.*, 1897. Hürthle: *Arch. f. die gesammte Physiol.*, Bd. 56, 1894. Koln: *Arch. f. Mik. Anat.*, Bd. 44, 1895. Moussu: *Comptes Rend. de la Soc. de Biol.*, 1897. Prenant: *La Cellule*, vol. x, 1894. Sandström: *Schmidt's Jahrbuch*, 1880. Vassale and Generali: *Riv. di patol. nerv. e ment.*, 1896. Vincent and Jolly: *Jour. Physiol.*, vol. xxxii, 1905. Welsh: *Jour. Anat. and Physiol.*, vol. xxxii, 1898. Zielinska: *Virchow's Archiv*, Bd. 135, 1894.

REPORT XCVIII.

THE INFLUENCE OF INCREASED BAROMETRIC PRESSURE ON MAN—SATURATION OF THE TISSUE FLUIDS WITH NITROGEN.

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In my last report,¹ it was stated that researches were in progress regarding the time relations of the saturation with gas which follows exposure to compressed air. It will be convenient to summarize here the chief results of our investigations relative to this problem.²

As stated in my earlier note, the urine secreted after drinking large quantities of warm water was used as a measure of tissue-fluid saturation. The subject of an experiment drank about a quart of warm water and after an interval of ten to fifteen minutes was compressed in our steel cylinder. Directly the desired pressure had been attained, he emptied his bladder; ten minutes later, more urine was passed and a sample collected in a glass bulb with rubber junctions, air and froth being carefully excluded. The junctions were then clamped and the sample preserved for analysis, the dissolved gas being pumped out by means of Hill's blood pump and measured in a finely graduated eudiometer tube. The composition of the gas was then determined by the ordinary potash and pyrogallate method. The accuracy of this process was tested by submitting a sample of boiled water to a vacuum in the Hill pump and proceeding exactly as in the urine analysis. No measurable gas was obtained, so that the error due to leakage may be regarded as inappreciable.

The object of completely emptying the bladder at each stage is to avoid the admixture of urine that had collected in the bladder while under a higher (or lower) pressure, since this would lead to serious errors. I think we have avoided this source of fallacy completely. Thus, if on arriving at a pressure of + 30 lb. the bladder is completely

emptied, then any urine passed, say, ten minutes later, must have been separated from the blood while under a pressure of + 30 lb., except the amount present in the renal tubules and pelvis. Unless the total quantity passed be very small the error due to urine from the last two sources is negligible.

A necessary preliminary was the determination of the mean quantity of nitrogen in our urine under normal circumstances. Six analyses were made, and the mean volume of dissolved nitrogen per 100 c.cm., reduced to 760 mm. Hg pressure and 0° C., was found to be 1.14 c.cm.

The individual observations, made at different times of day and under different circumstances—1.21, 1.19, 0.97, 1.10, 1.31, 1.07, 1.14—exhibit so small a range of variation that we feel entitled to conclude that in our own cases the coefficient of solubility for atmospheric nitrogen is between 0.11 and 0.12. Naturally, deviations from this value to the extent of ± 0.03 could not be regarded as necessarily significant. As will be seen below, our experiments show deviations for the most part well beyond these limits.

A typical example of our results is the following:

Experiment 31 (May 31st, 1906).

M. G., compressed to + 30 lb. in ten minutes (2.50 p.m.). The bladder was then emptied, and at 2.55 emptied again, 135 c.cm. of urine being passed, and Sample 1 was collected.

2.36. Decompression commenced.

3.20. (+ 15 lb.) the bladder was emptied again (320 c.cm.).

3.45. Decompression completed, bladder emptied again (310 c.cm.).

4.1. Another sample taken (135 c.cm. passed).

At 4.55 and 6.10 other samples were taken.

Analysis.

Sample.	Time and Pressure.	Percentage of Nitrogen.	Calculated N ₂ per Cent. supposing Urine followed the Pressure.
1	Passed after 5 mins. under 30 lb.	2.522	$1.1 \times 3 = 3.3$
2 and 3	Were spoiled	—	—
4	At normal pressure 16 mins. after decompression	2.373	1.1
5	70 mins. after decompression.	1.107	1.1
6	245 mins. later.	1.023	1.1

The mean results of our whole series of experiments are given in the next table.

TABLE I.—Urine Analysis from Hill and Greenwood's Individual Observations.

Pressure and Exposure.	Mean Percentage of Nitrogen Found.	Calculated Percentage supposing Urine followed the Pressure.
+ 0 (Normal)...	1.14	1.1
+ 30 lb. for less than 10 mins. ...	1.99	3.3
+ 30 lb. for more than 10 mins....	3.32	3.3
+ 45 lb. for less than 10 mins. ...	4.29	4.4
+ 45 lb. for more than 10 mins....	4.23	4.4
+ 30 lb. during decompression...	3.63	3.3
+ 15 lb. during decompression...	2.75	2.2
+ 0 lb. on decompression ...	1.99	1.1
+ 0 lb. 15 mins. after decompression ...	1.64	1.1
+ 0 lb. more than 15 mins. after decompression ...	1.13	1.1

A glance at this table makes it clear that although saturation of the tissue fluids with nitrogen up to the theoretical value is rapidly attained, desaturation is a slow process. Even with a decompression rate of twenty minutes for each atmosphere of positive pressure, equilibrium has not been established on leaving the air chamber, nor is it complete fifteen minutes later; that is

to say, the body fluids are in a condition of super-saturation. The explanation of these remarkable results cannot at present be satisfactorily formulated.

Experiments carried out by us on the behaviour of colloidal solutions exposed to increased air pressure, seem to throw light on the phenomenon, but further work is necessary before a definite statement can be made.

In any case, that our results do not depend upon personal idiosyncrasies is shown by the fact that analyses carried out by us on samples obtained from caisson workers, and divers agree with our own observations.

TABLE II.
A. *Rotherhithe Tunnel Workers.*

Source of Sample.	N ₂ per Cent. Found.	N ₂ per Cent. Calculated, supposing Urine followed the Pressure.
In tunnel (+ 17 lb.)...	2.38, 1.83	2.35
After decompression (decompression time, 3½ mins.)	1.60, 1.66, 1.51, 1.41, 1.75, 1.74, 1.31, 1.63	1.1

B. *From Admiralty Diver C.*

Depth.	Time Below and N ₂ per Cent. Found.	N ₂ per Cent. Calculated.
80 ft.	Below 46 mins. 20 secs. Ascended in 6 min. 50 secs. Sample taken 20 mins. 30 secs. after ascent N ₂ =1.73	1.1
84 ft.	Below 46 mins. Ascended in 5 mins. Sample taken 11 min after ascent. N ₂ =1.60	1.1
72 ft.	Below 44 mins. Ascended in 6 mins. Sample taken 5 min. after ascent. N ₂ =2.11	1.1
	Sample 20 min. after ascent. N ₂ =1.03	1.1
80 ft.	Below 46 mins. Ascended in 4½ mins. Sample taken 4 mins. after ascent. N ₂ =2.50.	1.1
	Sample taken 20½ mins. after ascent. N ₂ =1.38	1.1

It will be seen that these observations are in essential agreement with our own results.

As there is such a considerable excess of nitrogen dissolved in the tissue fluids, even with so slow a rate of decompression as twenty minutes per atmosphere, it may be asked whether even this rate is slow enough for safety. It is true that, even under these conditions, fatal cases are said to have occurred; but it may well be that a certain steepness of pressure slope between dissolved and free gas is necessary for the formation of bubbles sufficiently large to produce injury; hence, we cannot, without further inquiry, regard the excess of gas present as necessarily dangerous.

I may note, finally, that our results agree in principle with those deduced by v. Schrötter³ from theoretical considerations.

REFERENCES.

- ¹ BRITISH MEDICAL JOURNAL, July 7th, 1906, SUPPLEMENT, p. 7.
² For full details see The Influence of Increased Barometric Pressure on Man, No. II, by Leonard Hill and M. Greenwood, jun., *Proc. Royal Society (B)*, 1907. ³ V. Schrötter, *Sauerstoff in der Prophylaxe und Therapie der Luftdruckkrankungen*, Berlin, 1904, pp. 35-39.

As already announced, a competition will take place in connexion with the International Red Cross Conference to be held in London from June 10th to 14th for the Empress Marie Teodorovna Prizes. The awards will be made by an international jury for the inventions which present "in whole or in part the best solution of the problem of aid to the wounded, the quickest and surest method of discovering and lifting the wounded on the battlefield on land and at sea, the best types of stretchers, and of vehicles for conveying the wounded to the bandaging posts with the greatest possible rapidity and with the least suffering, or methods of rescue at sea, the best installations in ambulances, railway carriages, on board ship, etc., for the final removal." A sum of about £2,000 is available for three prizes, at the discretion of the jury. Persons intending to compete can obtain particulars from the Secretary, British Red Cross Society, 9, Victoria Street, London, S.W.

MEMORANDA: MEDICAL, SURGICAL, OBSTETRICAL.

TYPHOID FEVER SIMULATING CEREBRO-SPINAL FEVER.

On April 2nd, 1906, the case of a coal-miner's labourer who had been ill for about two weeks was brought under my notice as probably being one of cerebro-spinal fever, and, as the house where he lived was very crowded, I had him removed to the isolation hospital, where I saw him the same night. He was then rather delirious, but at intervals was more sensible and could answer questions. He complained of fearful headache, chiefly in the temporal, but also in the occipital, region. There was marked retraction of the head and photophobia, and the posterior cervical muscles were tense and very tender. The abdomen was retracted and both legs drawn up. Kernig's sign was well marked on both sides. No enlargement of the spleen could be made out; there was slight vomiting of bile-stained liquid at intervals. The temperature was 101.5° F., pulse 80, full and strong. There was no diarrhoea and no rash of any sort. Lumbar puncture was performed, but no cerebro-spinal fluid was obtained.

On the following day I again performed lumbar puncture with a longer needle, but again failed to get any fluid. As I suspected the case might be one of typhoid of an anomalous type, a sample of blood was sent to the Lister Institute for Widal's test, and also another sample to be tested for cerebro-spinal fever. Widal's reaction was positive, complete agglutination being obtained in one hour with dilutions of 1 in 20 and 1 in 50. The agglutination test with the paratyphoid A bacillus was slight, and with paratyphoid B partial. It was also reported from the Lister Institute that it was practically impossible to isolate the *Diplococcus intracellularis meningitidis* from the blood, but from the result of recent experiments upon animals the agglutination test was probably of some value. Agglutination tests with a forty-eight-hour agar culture of the diplococcus were negative.

Patient's Serum:

- Dilution 1 in 2, partial agglutination in 1 hour.
- Dilution 1 in 20, no agglutination.
- Dilution 1 in 50, no agglutination.

Control—Normal Serum:

- Dilution 1 in 2, partial agglutination in 1 hour.
- Dilution 1 in 20, no agglutination.
- Dilution 1 in 50, no agglutination.

On making inquiries at the patient's home it was found that several members of the family had been ill with sore throat during the previous four weeks, and that the mother, after three weeks' illness, had died two weeks before the onset of the patient's illness, the death being certified "perityphilitis, gastritis."

The patient died on April 4th, and a *post-mortem* examination was made the same day. The mucous membrane of the last 3 feet of the small bowel was in an inflamed and catarrhal condition, the solitary glands being large and projecting, and one doubtful ulcerated Peyer's patch was seen. The caecum, with 12 in. of the large bowel, was then examined, and a large ulcer, about 1½ in. to 2 in. in diameter, with soft, swollen edges, was found 6 in. from the ileo-caecal valve. The mesenteric glands were enlarged; the spleen slightly enlarged, soft, and friable. On opening the skull the membranes showed extreme congestion, and pus was seen on the surface of the brain in the temporal region. At the base of the brain a sero-purulent fluid was found in large quantity, and a specimen of this under the microscope showed pus cells and a number of diplococci, and also diplococci in rows.

A specimen of the cerebro-spinal fluid was sent to the Lister Institute for examination, and the report showed that neither the *Bacillus typhosus* nor the *Diplococcus intracellularis meningitidis* were present, but a Gram-positive diplococcus occurring in chains was isolated. Two c.c.m. of a broth culture of this diplococcus were injected intravenously into a rabbit, but as the animal was quite well after two days the diplococcus was proved to be non-virulent.