Additional observations on the static lung tests / [William A. Guy].

ADDITIONAL OBSERVATIONS

ON THE

STATIC LUNG TESTS.

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In a former number (No. 148) of the Edinburgh Medical and Surgical Journal, I examined the static lung tests by the aid of a larger number of observations than had previously been made available for that purpose, and I arrived at conclusions extremely unfavourable to the future employment of these tests in medico-legal inquiries. I now proceed to contrast the smaller groups of observations, collected by the several authors whose works I have laid under contribution, and to detail a few facts of interest which have come under my own notice. By this means some of the objections which lie against the conclusions contained in my former essay may be removed, and such statements as are well-founded may be confirmed. I shall treat the static lung tests in the same order as in the former essay, beginning with the absolute weight of the lungs.

The following table presents the highest, lowest, and average weight of the lungs of mature still-born children, and of children who survived their birth one month or less. The sex is either not stated, or the two sexes are thrown together.

TABLE XXX.

Name of Author.	No. of Obs. Before Resp.	No. of Obs. After Resp.	Before Respiration. Max.	Before Respiration. Min.	Before Respiration. Mean.	After Respiration. Max.	After Respiration. Min.	After Respiration. Mean.
Haartmann, .	4	7	1534	1066	1257	1619	1023	1327
Jörg, . .	2	3	677	612	645	1133	766	945
Eisenstein and Zebitsch,	7	18	1185	369	812	1537	616	980
Schmitt, .	36	27	1661	553	1056	2132	695	1271
Lécieux, . .	29	237	1636	340	773	2440	432	1048
Procès Verbal, &c.	5	13	1112	463	685	1514	476	976
Orfila, . .	5	5	586	448	528	1344	619	884
Devergie,* .	5	2	1011	360	771	1262	1019	1140
Taylor, . .	5	4	687	586	645	774	562	676
Dr Guy, .	3	3	1480	632	920	1178	510	805
Table I. and IV. .	109	322	1661	340	874	2440	432	1072

A single glance at this table will show the great difference which exists between all the values derived from small groups of observations, the insufficiency of the data hitherto employed in discussing the value of the static lung tests, and the consequent necessity for a more extended induction. My former essay was intended to supply this want as far as existing materials would permit; the present essay may serve to show that the necessity for a larger number of observations has not been exaggerated. On a closer inspection of the table it will be seen that the maximum weight of the lungs of still-born children is, according to the observations of Schmitt, as high as 1661 grains, and according to Orfila, as low as 586; the former number being nearly three times as great as the latter. In like manner the smallest weight observed in four still-born children by Haartmann is 1066 grains; the smallest number recorded by Lécieux is 340; the former number being more than three times as great as the latter. The average numbers present, as might be expected, less disparity, but the highest number is more than twice as great as the lowest.

If we now examine the second column of the table, we discover differences of nearly the same amount. The column of maxima presents 2440 as the highest number, and 774 as the lowest; the former being more than three times as great as the latter. In the column of minima, the highest number is more than twice as great as the lowest, whilst the least average is little less than half the highest.

That these differences are entirely due to the small number of facts collected by the several authors, and not to any error of cal-

* In the former essay, the maximum 1800 is given on the authority of Devergie. This is an error, the highest number observed by him in healthy lungs being 1011. In a case of œdema of the lungs the weight was 1537. The maximum before respiration, therefore, is on the authority of Schmitt, 1661.

culation, will at once appear if we compare the numbers in the several colmns. Thus, if 1661 appear too high a value for the lungs of a still-born child, the fact that Lécieux and Haartmann have recorded numbers as high as 1636 and 1534 respectively will at least lessen the improbability; and if these latter numbers, reduced from French and German weights, seem exaggerated, they receive strong confirmation from the highest number which has fallen under my own notice, viz. 1480. In like manner, the small numher 586, (the maximum recorded by Orfila on his own authority), is to a certain extent confirmed by the low values obtained by Jörg and Mr Taylor. The same observations apply to the other columns. Hence it appears that the different values presented in the table are due solely to the cause now assigned,—the small number of facts from which they have been obtained.

A comparison of the weight of the lungs before and after respiration shows differences not less worthy of note between the values obtained by different observers. The maxima in the still-born, in more than one instance, fall but little short of the maxima in children who had lived one month or less, whilst in one case, the highest number in the still-born greatly exceeds the highest number in those born alive. This occurs in my own observations, which give 1480 before, and 1178 after, respiration. Again there are no less than three instances in which the minima in the still-born exceed the minima in those born alive. In one instance (that of my own observations) the average number before respiration exceeds the average after respiration by no less than 115 grains. In other instances, the difference, though on the other side, is extremely small. To show the total insufficiency of small numbers of facts, it will suffice to compare the observations of Mr Taylor with my own. The highest weight in five facts collected by Mr Taylor is 687 grains; the maximum of three observations of my own is 1480, or more than twice that number. Mr Taylor's average before respiration falls short of his average after respiration by 31 grains; my own average for the still-born exceeds the average in children born alive by no less than 115 grains.

These remarks have an important practical bearing. In a court of law, a medical witness may be asked for the result of his own experience—his personal experience—as to the weight of the lungs before and after respiration, and the consequent value of a given weight of lungs in an individual instance as a sign of live or still-birth. If this question were addressed in turn to each of the authors named in the table, how widely different would be their answers! If the word experience has any precise meaning, the numbers in the table represent that experience in the case of the several authors whose names are mentioned; and the answer which

they must give to the question proposed is already expressed by the figures themselves. The decision of the majority would be, that the weight of the lungs is not much greater after respiration than before it; one author, at least, would be bound to represent the weight as nearly the same before and after respiration; and my own personal experience would be opposed to that of all the rest in representing the weight of the lungs before respiration as exceeding by a considerable fraction their weight after respiration. It appears, then, that no medical witness can be justified in laying any stress whatever on his own personal experience in questions of this kind; and that if his personal experience be appealed to, he is bound to guard against the errors to which it may lead by pointing out its utter insufficiency. When it is recollected that the table contrasts the weight of the lungs of still-born children with that of the lungs of children who have lived one month or less, and that the crime of infanticide is generally committed soon after birth, when the process of respiration has often barely commenced, and is extremely imperfect, it will be quite unnecessary to say more in condemnation of the absolute weight of the lungs, as a test of respiration. The personal experience of all observers, if it do not condemn the general statement, that the weight of the lungs is materially increased by respiration, will at least reject the application of the theory to individual cases, and for medico-legal purposes.

According to the general and loose statement of authors, the weight of the lungs before respiration is about one ounce, or 480 grains, and after respiration, two ounces, or 960 grains. It is always extremely difficult to determine on whose authority such general statements as these are put forth. The only author whose observations give any countenance to such an estimate is Orfila, whose averages are not very remote from the assumed weights before and after respiration; but if the much higher authority of Schmitt be taken as our guide, the weight before respiration will be nearly doubled, and that after respiration increased by little less than one-half. A mere inspection of the table will show how far this general estimate of authors is remote from the truth.

As this subject is one of too much importance to be dismissed so long as any means remain unemployed by which its true bearings may be ascertained, I have endeavoured still farther to test the value of the static lung tests by arranging the numbers before and after respiration in children at full term in two columns, and comparing them with each other. This comparison, as might be expected, shows that by far the majority of the numbers occurring in the still-born have their counterparts in observations made in children who have survived their birth. Thus, the numbers 1534, 1492, 1480, 1449, 1364, 1297, &c. occur both before and after

respiration. In like manner, the numbers 494, 510, 541, 556, 571, &c. are met with both in the still-born, and in those born alive. Again, there are only eight observations on children who have survived their birth one month or less, in which the number exceeds 1661, the maximum before respiration; in other words, assuming 1661 to be the real maximum in the still-born, there are only eight instances on record in which we should have been justified in asserting from the weight of the lungs alone that the child had survived its birth; and if we limit the comparison to those who have lived one day or less, this number dwindles down to one. On the other hand, there are only three instances recorded, in which the weight of the lungs in the still-born fell short of their weight in those who survived their birth; or, in other words, only three cases in which, assuming 432 to be the real minimum after respiration, the weight of the lungs alone would have sufficed to decide the question of live or still-birth. It is impossible to place in a more striking light the utter inutility of the average absolute weight of the lung as a test of respiration.

I now proceed to examine the weight of the lungs compared with that of the body, or Ploucquet's test, and in doing so shall follow the same steps which I have already taken in discussing the value of the absolute weight of the lungs. The following table presents the values obtained from the observations collected by the several authors whose names are given. Here, as in the former table, no distinction of sex is made,—the observations on males and females being all thrown together:—

TABLE XXXI.

Name of Authors.	No. Obs. Bef. rn.	No. Obs. af. rn	Before Respiration. Max.	Min.	Mean.	After Respiration. Max.	Min.	Mean.
Haartmann,	4	7	1 : 40	1 : 65	1 : 57	1 : 39	1 : 77	1 : 54
Jörg, .	2	3	1 : 61	1 : 64	1 : 62	1 : 39	1 : 64	1 : 49
Schmitt, .	36	28	1 : 34	1 : 81	1 : 58	1 : 23	1 : 78	1 : 43
Lécieux .	29	237	1 : 24	1 : 176	1 : 65	1 : 19	1 : 132	1 : 37
Procès Verbal, &c.	5	13	1 : 27	1 : 86	1 : 58	1 : 21	1 : 71	1 : 45
Orfila, .	5	5	1 : 50	1 : 99	1 : 72	1 : 32	1 : 53	1 : 44
Devergie, .	5	2	1 : 34	1 : 176	1 : 74	1 : 38	1 : 49	1 : 43
Taylor, .	5	4	1 : 49	1 : 91	1 : 63	1 : 41	1 : 82	1 : 53
Dr Guy, .	3	3	1 : 46	1 : 74	1 : 60	1 : 55	1 : 65	1 : 60
Table XX. XXIII.	96	314	1 : 24	1 : 176	1 : 57	1 : 19	1 : 132	1 : 38

This table, like the former one, places in a strong light the insufficiency of small numbers of facts, and of the personal experience founded upon them. The several values differ widely from one another; some giving nearly the same proportion before and after respiration, and others presenting a difference nearly as great as that laid down by Ploucquet, viz. 1 : 70 before respiration and

1 : 35 after respiration. The most marked differences exist in the observations of Lécieux, Orfila, and Dévergie; the remainder are much less considerable. The small group of facts collected by Haartmann gives nearly the same values before and after respiration, and the same remark applies to the results of my own observations. The average values obtained from Mr Taylor's facts and from my own are worthy of notice, and of comparison with the numbers in the first table. On referring to this table it will be seen that the average weight of the lungs before and after respiration differs very slightly in Mr Taylor's observations, whilst in my own the weight of the lungs in the still-born infant greatly exceeds that of children born alive; but a reference to the last table shows that the proportion which the weight of the lungs bears to that of the body in Mr Taylor's observations is much less before than after respiration, and that in the case of my own observations the proportion is exactly the same. This circumstance is easily explained by the aid of a fact established in my former essay, viz. the greater weight of the body of the still-born infant. The average weight of the bodies of the five still-born infants examined by Mr Taylor greatly exceeds the average weight of the four who survived their birth, the former being to the latter as about 41 to 36; and in my own observations the weight of the still-born is to that of those born alive as 10 to 9 nearly. It is this great disparity of weight which has made the average proportions before and after respiration to differ much more than the absolute weight of the lungs in Mr Taylor's observations, and this same disparity has equalized the proportions obtained from my own facts. Here, then, is an obvious advantage of Ploucquet's test over the absolute weight of the lungs; and if the question to be decided was, which of the two should be preferred, there can be little doubt to which the superiority ought to be assigned.

The superior value of Ploucquet's test is still further shown by comparing the several proportions before and after respiration, in the same manner as the absolute weights of the lungs before and after respiration have already been contrasted. From this comparison it results, that whereas there were only eight instances in which the maximum weight of the lungs after respiration exceeded the maximum weight before respiration, there are no less than 29 instances in which the proportion which the lungs bear to the body is greater after respiration than before; that is to say, there are 29 instances in which, assuming the proportion 1 : 24 to be the true maximum, we could state with certainty that respiration had taken place. On the other hand, there is only one instance in which the proportion of the lungs to the body is less before respiration than the least proportion observed in children born alive;

in other words, there is only one case recorded in which, assuming 1 : 132 to be the real minimum after respiration, we should have been justified in asserting that respiration had not taken place. It appears, then, that Ploucquet's test has some advantage over the absolute weight of the lungs. But this advantage is gained, so to speak, at the expense of the very principle on which a numerical test ought to be founded, viz. an exact equality in all those particulars in which equality is attainable. In employing the weight of the lungs, or their weight as compared with that of the body, as a test of respiration, we compare an individual observation with an average previously ascertained; but this average has been shown to vary with the weight of the body, the weight of the lungs increasing more slowly than the weight of the body, and the proportion which the one bears to the other diminishing as the weight of the body increases. Hence, in order to construct a correct standard of comparison, we ought to contrast the weight of the lungs, both absolute and relative, before and after respiration for different weights of the body. This is done by combining tables XIV. and XV. *

TABLE XXXII.

No. of Obs. Before Resp.	No. of Obs. After Resp.	Weight of Body.	Average weight of Body Before Resp.	Average weight of Body After Resp.	Weight of Lungs Before Resp.	Weight of Lungs After Resp.	Proportion Before Resp.	Proportion After Resp.
1	60	20000—30000	27030	26888	541	869	1 : 50	1 : 31
23	138	30000—40000	35263	34638	714	1061	1 : 49	1 : 32
27	69	40000—50000	44932	43549	744	1141	1 : 60	1 : 38
21	29	50000—60000	55555	54021	996	1332	1 : 56	1 : 40
17	14	60000—70000	64679	64251	1032	1431	1 : 63	1 : 45
4	9	70000—80000	77382	76127	1317	1379	1 : 58	1 : 55
1	2	80000—90000	87336	88041	1226	2193	1 : 71	1 : 40
2	3	90000 & upwards	96330	113783	1491	3273	1 : 64	1 : 34

If, after the observations which have been made on the static lung tests, any doubt temains of the inutility of these tests, and it is thought advisable still to employ them for medico-legal purposes, a table on the principle of the foregoing, but founded on a larger number of observations, will form by far the most accurate and unexceptionable standard of comparison.

I now proceed to detail a few facts which have come under my own notice, and to inquire how far the weight of the lungs and their weight as compared with that of the body corresponds with the general statements of authors, and with the numbers contained in the tables.

Obs. 1. Female at full term, still-born.

Weight of lungs, right lung, 356 grains; left lung, 276 grains; both lungs, 632 grains.

* Some corrections have been made in this table.

Weight of body, 46735 grains.
Ploucquet's test, 1 : 74.

Obs. 2. Female at full term, still-born.
Weight of lungs, right lung, 372 grains; left lung, 275 grains; both lungs, 647 grains.
Weight of body, 38172 grains.
Ploucquet's test, 1 : 59.

Obs. 3. Male at full term, still-born.
Weight of lungs. Right lung. ℥i. ʒvi. Troy = 840 grains.
Left lung, ℥i. ʒii. ℈ii. Troy = 640 grains.
Both lungs, ℨiii. ℈ii. = 1480 grains.
Weight of body, lb. ix. oz. 11½ avoirdupois = 68031 grains.
Ploucquet's test, 1 : 46.

In the first two of these observations the absolute weight of the lungs, and their weight as compared with that of the body, are such as to render it more probable that the children were still-born than that they were born alive; the absolute weight of the lungs in both instances being much less than the average weight before respiration, viz. 874, and the proportion in both cases also falling below the average proportion, 1 : 57. Both values are also considerably less than the averages given in Table XXXII. Thus in the first observation, the weight of the lungs is 632, the average in the table for a body weighing between 40,000 and 50,000 grains being 744, and the proportion of the lungs to the body is 1 : 74, the average in the table being 1 : 60. In the second case, again, the values are 647 and 1 : 59, those in the table for bodies weighing between 30,000 and 40,000 grains, being 714 and 1 : 49. But it must be borne in mind that the numbers in the tables are merely averages, and that precisely the same numbers and the same proportions might be met with in children who had been born alive; so that taken alone, the static lung tests will furnish a very low presumption.

In the third case, the weight of the lungs is so much greater than the averages before and after respiration, as to raise a presumption in favour of respiration much stronger than the presumption in favour of still-birth in the first two cases. The average before respiration is 874, after respiration 1072; the weight of the lungs in this case was 1480, being 606 grains more than the average before respiration, and 408 grains more than the average after respiration; whilst it falls short of the maximum before respiration by only 181 grains. As far, then, as the absolute weight of the lungs goes, it would seem nearly decisive of respiration having taken place; Ploucquet's test again tends to strengthen this conclusion, for the proportion which the lungs bear to the body, (1 : 46) falls little short of 1 : 38, the average after respiration has continued one month or less. On referring to Table XXXII,

we have fresh reason for concluding that respiration has taken place for the absolute weight of the lungs corresponding to bodies, weighing from 60,000 to 70,000 grains, is 1431 after respiration, or somewhat less than the weight of the lungs in this case and Ploucquet's test gives 1 : 45 as the proportion after respiration being as nearly as possible the proportion in this instance. Hence, then, both the absolute weight of the lungs, Ploucquet's test, and the modified test of Ploucquet, would strongly incline us to the belief that the child had breathed; and yet, in this instance, respiration had certainly not taken place.

Obs. 4. Male, full term; survived its birth a few seconds, and was distinctly seen to respire more than once. Both lungs, however, sank, when placed in water, and the air-cells were not developed.

Weight of lungs, right lung, 300 grains; left lung, 210 grains; both lungs, 510 grains.
Weight of body, 31063 grains.
Ploucquet's test, 1 : 61.

Obs. 5. Male, full term; respiration imperfect, and of short continuance; air-cells developed in parts of the upper lobe of the left lung; and of the middle lobe of the right lung; the remainder of the lungs in the fœtal condition.

Weight of lungs, right lung, 690 grains; left lung, 488 grains; both lungs, 1178 grains.
Weight of body, 11 pounds avoirdupois = 77,000 grains.
Ploucquet's test, 1 : 65.

Obs. 6. Male, full term; respiration imperfect, but more extensive than in Obs. 5. The child had lived about an hour.

Weight of lungs, 726 grains.
Weight of body, 39,812 grains.
Ploucquet's test, 1 : 55.

Obs. 7. Male, eight months and a-half, lived two days. Respiration perfect in right lung, extremely imperfect in left lung. Blood effused in spots of variable size on the surface of both lungs. These spots small and few in number in the right lung, more numerous and larger in the left lung, especially on its posterior surface.

Weight of lungs, right lung, 295 grains; left lung, 251 grains; both lungs, 546 grains.
Weight of body, 32,375 grains.
Ploucquet's test, 1 : 59.

The first of these four observations is classed with those in which respiration has taken place, though the effects of respiration did not manifest themselves in the lungs. The air probably did not penetrate beyond the bronchial tubes, and left the lungs, to all appearance, in the fœtal condition. The small weight of the lungs,

and the low proportion which the lungs bear to the body, afford a probability in favour of still-birth. The child, however, was born alive, and was distinctly seen to respire.

In the next case, (Obs. 5) there was abundant evidence of respiration, and the appearance of the lungs corresponded with the statement of the midwife, that the child had breathed. The lungs weighed 1178 grains, which exceeds the average weight in children who have lived one month or less by more than 100 grains. The absolute weight of the lungs, therefore, furnishes a low probability in favour of respiration. This probability is strengthened if the weight of the lungs is compared with the mean weight of the lungs of children who have lived less than one hour, the average being 918 grains, or with the average weight in cases of imperfect respiration, which for males is 1010 grains, (see Table X.) On the other hand, it must be borne in mind that the body of this child weighed no less than 77,000 grains. Ploucquet's test, therefore, gives the proportion of 1 : 65, which affords as strong a probability in favour of still-birth, as the absolute weight of the lungs did in favour of respiration. By comparing the weight of the lungs with the average weight for bodies exceeding 70,000 grains in weight (see Table XXXII.) this probability in favour of still-birth is still further increased.

The weight of the lungs in Obs. 6, viz. 726 grains, though below the average weight before respiration, is not low enough to afford a very strong presumption either way, and the proportion 1 : 55 gives a slight probability in favour of still-birth, (see Tables XXXI. and XXXII.) In the last case, (Obs. 7,) the weight of the lungs, and the proportion which the lungs bear to the body, are such as to give a strong presumption in favour of still-birth; but in this instance, the child had lived two days, and the weight of the lungs was increased by the effusion of blood on the surface of the lung, around the superficial air-cells, and beneath the pleura. I may observe in passing, that this is the only case out of twenty-two which I have had an opportunity of inspecting, in which any disease of the lungs existed, and in this case, with the exception of the pulmonary apoplexy, the structure of the lungs was perfectly healthy.

The question of respiration in the seven cases which have been mentioned would have been decided by means of the static lung tests as follows. Of the three still-born children, two would have been pronounced probably still-born; in the third there would have been a strong presumption in favour of respiration. Of the four children who had survived their birth, the first would have been pronounced still-born; in the second, the absolute weight of the lungs would have furnished a strong probability in favour of respiration, and Ploucquet's test, as well as the modified

test, (see Table XXXIII), as strong a presumption against it; in the third case, there would heve been a slight presumption in favour of still-birth; and in the child who survived its birth two days, a still stronger presumption on the same side. Thus out of the seven cases, the static lung tests would have given correct indications in two, they would have left two others doubtful, and would have led to erroneous conclusions in the remaining three. These remarks apply to the average weight of the lungs, and the average proportion which the lungs bear to the body when used as tests of respiration; but if the highest and lowest weights and proportions had been employed as standards of comparison, the question whether the child had or had not breathed would have remained unanswered. Now it admits of great doubt whether it is allowable to employ an average value as a standard of comparison in medico-legal inquiries. Even in the practice of medicine, where many low probabilities are allowed to assist us in our diagnosis, average values are amongst the least useful and the least trusted of our standards of comparison, and very few physicians would be hardy enough to rest any important conclusions upon so insecure a basis. What medical man, for instance, would think of placing much reliance on an average frequency of the pulse, or the average proportion of the pulse and respiration as a standard of comparison in a case of disease? They would furnish a low presumption, and nothing more. On the other hand, a comparison between the frequency of the pulse in a given case of disease, and the highest or lowest ascertained frequency in a state of health, would furnish important indications on which he would be justified in laying great stress. A mode of reasoning which would be inadmissible in a case of disease where a low probability derived from one symptom is confirmed by the presence or absence of a considerable number of other signs, can scarcely be trusted to in medico-legal inquiries, which demand a much higher accuracy, and a much stricter logic. If in a court of law, a medical witness were to state that, in a certain case, he had found a certain weight of lungs, and a certain proportion between the weight of the lungs and that of the body, and that he regarded this as a proof of respiration or of still-birth, or even as a presumption in favour of one or the other, he would be immediately met by the question—has not precisely the same weight of lung, or the same proportion, been met with in cases where the exact reverse of your inference was known to have existed? To this question an answer must be given in the affirmative, except in those instances in which the weight exceeded the highest recorded weight or proportion, or fell short of the lowest; and these cases have been shown to be extremely few in number. But even when the extremes are employed as our standard of comparison, our inference in individual cases

is open to the obvious objection, that the real extremes have not yet been ascertained. The force of this objection must be allowed, and to obviate it, it would be necessary to strengthen the presumption by collateral evidence derived from other signs.

If the static lung tests were always regarded in the same light as the symptoms of a disease; that is to say, as furnishing merely one element of our diagnosis or prognosis, little mischief could arise from attaching some slight value to them. The low presumption which this test, taken by itself, would furnish, might be increased by other collateral evidence, so as to amount to a high probability, or even to certainty. But this is not the case, for not only are the static lung tests employed in combination with other tests, such as the size and shape of the chest, the position of the diaphragm, the size, position, consistence, and appearance of the lungs, (all of which furnish their presumptions in favour of or against respiration,) but they are also recommended, as one of the surest means of distinguishing the effects of respiration from those of inflation. It is obvious that the lungs are not increased in weight by inflation, and, taking one case with another, it is as certain that their weight is increased by respiration, for this reason, the weight of the lungs has been regarded as a means of diagnosis. Now it has been already shown that the static lung tests are not to be relied on as a means of distinguishing lungs which have respired from those which have not; and as inflated lungs are assumed to remain as far as weight is concerned in the condition of lungs which have not breathed, it follows that the weight of the lungs is not a sufficient diagnostic mark of respiration and inflation. Whatever value is assigned to these tests as tests of respiration, exactly the same value must be given them as tests of inflation. How slight this value is has already been shown.

Those who are familiar with the changes produced in the appearance of the lungs by respiration, will readily admit that, in at least ninety-nine cases out of a hundred, the question of respiration is nearly decided by the first glance at the surface of the lungs themselves, without having recourse to the static lung tests at all, or even to the hydrostatic test. Simple inspection is sufficient to show that either respiration has taken place, or that inflation has been practised. The static lung tests, therefore, are not required to distinguish respiration from non-respiration, but merely to serve as a diagnostic mark between respiration and inflation. Here, then, where alone these tests are wanted, they fail us, just as they fail us in almost every instance in which they are used to determine the question of respiration. If we had as certain means of distinguishing respiration from inflation, as we have of determining that one or the other has taken place, the static lung tests would be as unnecessary as they are useless. Whether or

not we possess a means of diagnosis in the effects of pressure must be left for future consideration.

The conclusions drawn from the examination of the seven mature children are fully borne out by observations made at earlier periods of fœtal life. Some of these observations will find a place in a future essay on the hydrostatic test. I shall content myself for the present with detailing a case of some interest in more than one point of view, and instructive in its relation to the static lung tests. For an opportunity of inspecting the lungs, and for the minute particulars which give completeness to the case, I am indebted to the courtesy of Mr Streeter, who has kindly allowed me to copy from his note-book that part of the case which came under his own notice.*

" Mrs J. R., aged 28. Her second pregnancy. She menstruated last on Whitsunday, June 7th 1840, and was taken with pains, December 1, about ten A. M. She came to bespeak my attendance for March next. I gave her an opiate mixture to take on her return. Of this she took one dose, but the pains continued increasing till she sent for me between two and three P. M. On my arrival I found on examination, in the intervals of the pains, that the *os uteri* was open to the size of an orange, and a bag of waters protruding. At half-past four, the bag broke, and a very large quantity of waters came away. The head of one fœtus was expelled through the *os externum*; the body was extracted after some slight resistance, and the funis tied. A second gush of waters now took place, and I found the placenta occupying the vagina. I slowly brought this through the *os externum*, but, as it was still retained, I again examined, and found the arm and face of the second fœtus presenting. Fixing the arm steadily with the finger and thumb of my left hand, I passed the fore-finger of the right hand over the neck of the fœtus, and so succeeded easily in dislodging it from the upper part of the vagina, without causing much pain. The uterus was found firmly contracted above the pubis.

Both fœtuses were females; they made respiratory efforts, but without oral sound, and, of course, shortly expired. The largest is marked 1, the smallest 2.

Weight of body, -	1. 21½ oz. avoirdupois. 2. 10½
Circumference of the head, -	1. 8½ inches. 2. 7
Abdomen, - -	1. 7½ 2. 5
Length, - - -	1. 12½ 2. 10
Length of cord, - -	1. 16 2. 11

* This case was detailed at one of the meetings of the Westminster Medical Society, and is reported in the Lancet 1840—41.

To the foregoing extract from Mr Streeter's note-book, I add the following account of the *post mortem* examination, which took place December 6.

Both fœtuses were found contained in a common chorion, but in distinct amnia. * The placenta belonging to the larger fœtus was of the common size; that corresponding to the smaller fœtus was about half as large, and had the cord inserted into its edge. Both placentæ were quite healthy. Having secured the vessels of the lungs by ligature, those organs were weighed, and the following numbers were noted down on the spot.

Largest Fœtus.—Weight of lungs, right lung, 73 grains; left lung, 55 grains; both lungs, 128 grains.

Weight of body, 9406 grains.

Ploucquet's test, 1 : 73.

Smallest Fœtus.—Weight of lungs, right lung, 23 grains; left lung, 15 grains; both lungs, 38 grains.

Weight of body, 4594 grains.

Ploucquet's test, 1 : 121.

The lungs of the larger fœtus, when placed in water, sank at once to the bottom, without showing any degree of buoyancy. All the lobes and the several portions into which they were divided, likewise sank, and the lungs presented no trace of respiration. The lungs of the smaller fœtus presented the following appearances:—On the convex surface of the upper lobe of the right lung the air-cells were distinctly developed in four or five different points, and nearly the whole of the concave surface was studded in the same manner. The inferior and middle lobes of the same lung had a great number of such points on the convex surface, and also on the concave surface, especially along the anterior margin. This lung, however, on being placed in water, sank at once to the bottom. The left lung presented no trace of respiration, the surface of the lung being perfectly uniform, with not a single air-cell developed. This lung also sinks on being placed in water. The right lung was now divided into its three lobes, and each lobe submitted to experiment. They all sank to the bottom of the vessel. On cutting off a small portion of the lower lobe of the right lung, containing several developed air-cells, and placing it in water, it sank rapidly to the bottom. A portion of the middle lobe, towards the posterior margin, being placed in water, floated. Very strong pressure applied to this portion did not destroy its buoyancy, but, on increasing the pressure with the finger and thumb, the buoyancy was somewhat diminished. After the entire destruction of the texture of the lung by repeated pressure, this portion slowly sank to the bottom.

* This fact was verified by a very careful examination, and admitted by more than one competent authority.

This case is interesting and instructive in so many points of view, that I have given it entire, though my present business is merely with that part of it which refers to the static lung tests. The ages of these fœtuses might have been six months at the most, five months at the lowest calculation, and five and a-half months reckoning from the middle period between the last menstruation and the next menstrual period. Mr Streeter thought five and a-quarter months the most probable age. In any case the abortion took place in the sixth month. Both fœtuses had made efforts to respire, the larger one without success, (for if any air did reach the lung, it did not expand any of the air-cells,) the smaller one successfully, the air-cells being developed in large numbers on the surface of the right lung. The small quantity of air admitted was insufficient to give buoyancy either to the entire lung, or to any of its lobes, but it caused a small portion of one lobe to float. As inflation was not practised in this case, there is no room to doubt that the child had breathed. Here, then, we have two twins of the same sex, inclosed in a common membrane, and the product of the same conception, the one more than twice as large as the other, and, to appearance, far better prepared to respire, both making respiratory efforts, and yet the smaller and feebler child alone succeeded in drawing air into the lungs. The lungs of the larger child were found filled with blood, those of the smaller almost bloodless; the one weighed 128 grains, or $\frac{1}{7}\frac{1}{3}$ of the weight of the body, the other 38 grain, or $\frac{1}{121}$. The weight of the bodies were as 2 to 1, that of the lung as 3 to 1. Is it not at least probable that the comparatively large quantity of blood contained in the lungs of the larger child was an obstacle to the admission of air; whilst the almost bloodless condition of the lungs of the smaller was peculiarly favourable to respiration? If this supposition be not allowable, and the larger quantity of blood contained in the lungs of the larger fœtus was not in the lungs previous to the efforts made to respire, then these efforts must themselves have caused an influx of blood, whilst in the smaller child the same efforts led to the admission of air. My own experience, as far as it goes, has led me to the conclusion, that the presence of a large quantity of blood in the lungs is a frequent occurrence in still-born children, and in cases of extremely limited and imperfect respiration; and that where respiration has been most complete, the quantity of blood is often small as compared with their bulk. The case of the smaller fœtus is peculiarly interesting, as the weight of the lungs is much less than in any other instance on record. The smallest recorded weight which I have met with occurred in a six months' child entered in Lecieux's tables. It is 93 grains. It is stated that this child made efforts to respire, but the lungs were compact. The body weighed 10,040 grains, and Ploucquet's test

gave the proportion of 1 to 108. I have not admitted this into the tables, as there is not sufficient evidence of respiration having taken place. 38 grains, then, is by far the smallest weight yet reported in a case where respiration has taken place, and there can be no doubt that the static lung tests, taken alone, would have led to the conclusion that the child was still-born.

There are other points of interest in this case on which it is not my present object to enlarge; such as the existence of a common chorion; the evidence thereby afforded of contemporaneous conception; the unequal weight of the two bodies, in the absence of any disease in the placenta; the correspondence of the size of the bodies with that of the placentæ to which they were attached; and the absence of buoyancy in lungs in which the air-cells were so visibly developed by the entrance of the air; these points, as they do not belong to my present inquiry, I content myself with merely alluding to, and shall, therefore, conclude what I have to say upon the static lung tests, reserving the hydrostatic test for a future occasion.

The following short summary will embody the principal conclusions which I have been led to form, and will at the same time give me an opportunity of correcting some errata contained in my former essay.*

* The calculations contained in the former essay were, with one exception, originally correct, and I can only attribute the alterations which I was induced to make to my great anxiety to avoid all sources of fallacy, and the pressure of an unusual number of engagements at the time when the proof-sheets reached me. From these causes I was induced to make alterations which I subsequently found to be uncalled for. I discovered my mistake almost as soon as I had made it, and wrote to the editor, begging that he would allow the tables to remain as they were, but the proof-sheets had already gone to press. Finding that I had committed one error, I carefully reviewed my observations, and tested the accuracy of all my calculations from the French and German weights, and I discovered one other error. The maximum weight before respiration in mature children was stated on the authority of one of Devergie's observations at 1800. On examining the case from which this number was taken, I found that I had taken the weight of the heart, lungs, and thymus, instead of the weight of the lungs alone. Those who are familiar with Devergie's work, and with the manner in which his cases are recorded, will not attribute this mistake to mere carelessness. The discovery of this error has led me to convince myself of the accuracy of the rest of my calculations. I have taken considerable pains to correct this error, as well as the more important one just mentioned, and have reconstructed the whole of the tables. The corrections, with the exception of the observation from Devergie, are not material, and in no way affect the general reasoning employed. I subjoin a list of the errata.

P. 47, omit the passage beginning "In reducing, &c." and ending with "calculations," the grains in the table are Troy grains.

Table I., *for* 1800 *read* 1661; *for* the average values substitute 950, 809, 874. In the paragraph succeeding the table omit 1800 and 1726.

Table II. *For* the mean values, substitute 382, 340, 361, 600, 678, 625, 695, 690, and 686.

P. 50, line 5, *for* more than 300 *read* nearly 200.

Table III. *For* 1800 *read* 1661; *for* the mean values write 361, 625, 686, and 874.

Table IV. The averages are 1121, 982, 1072.

Table V. The averages are 320, 441, 401, 589, 694, 638, 761, 734, 751.

Weight of the Lungs.—1. The weight of the lungs of still-born hildren of the same age varies within wide limits; the chief cause of difference being the sex and the weight of the body.

2 The weight of the lungs in mature still-born children is as follows: greatest weight, 1661; least weight, 340; average weight, 874.

3. The weight of the lungs in mature still-born children of the male and female sex respectively is as follows: greatest weight, 1661, 1492; least weight, 360, 340; average weight, 950, 809.

4. The weight of the lungs in children who have respired also varies within wide limits; the chief causes of difference, in addition to those which affect still-born children, being the degree and duration of respiration.

5. In children who have survived their birth one month or less, the highest recorded weight is 2440 grains; the lowest 432 grains; and the average 1072 grains.

6. The weight of the lungs for males and females respectively, at the same ages, is as follows: greatest weight, 2440, 1745; least weight, 432, 479; average weight, 1121, 982.

7. The weight of the lungs increases with the increasing perfection of the respiration, but is very slightly augmented by imperfect respiration.

8. The weight of the lungs also increases with the duration of the respiration; but appears to be less when respiration has continued more than one hour and less than twelve, than when it has lasted less than one hour.

9. The mean weight of the lungs in mature children who have

Table VI. The averages are 401, 638, 751, 1072.

Table VII. The averages are 911, 780, 918, 955, 726, 853; 1001, 1018, 1000.

Table VIII. In the male *read*, 911, 955, 1001, 1067, &c.; in the female 780, 726, 1018, 725, 980, 913, &c.; and in the third line *read* 918, 853, 1000, 985, 1001, 1128, &c.

Table IX. Under the head one day and less, *read* male 943, female 826, m. and f. 925.

Table X. *For* 1800, *read* 1661. In the first column of the line of averages, write 950, and in the last but two 874.

Table XI. *For* 1800 *read* 1661. The average values are 874, 918, 853, 1000.

P. 9, in text following table XI., *for* 38, *read* 44, and *for* 34, *read* 21.

Table XII. The averages are 361, 401; 625, 638; 686, 751; 874, 1000.

P. 54, 9 lines from bottom, *for* "exceeds," *read* "falls short of," *for* 75, write 64; for 1800, *read* 1661, *for* 37 *read* 21, *for* 38 *read* 44, and *for* 122, *read* 126.

Tables XIV. and XV. are connected and combined in table XXXII. of the present essay.

P. 60, *for* 1800, *read* 1661.

Table XX. The averages are 1 : 53, 1 : 63, and 1 : 57.

Table XXI. The averages are 1 : 40, 1 : 41; 1 : 41; 1 : 41, &c.—1 : 46

Table XXII. The averages are 1 : 41, 1 : 41, 1 : 46, 1 : 57.

Table XXVIII. The averages are 1 : 57, 1 : 51, &c. In the text *read* 57 *for* 56.

Table XXIX. The averages are 1st column, 1 : 41, 5th column, 1 : 46, 7th column, 1 : 57.

Many of the above corrections are merely repetitions, and some are typographical errors, which were unavoidable in so large a mass of figures.

lived one month or less exceeds the mean weight in mature still-born children, by somewhat less than one-fourth, the numbers being 574 and 1072.

10. The average and extreme values drawn from small numbers of facts differ widely from each other, and cannot be depended upon for medico-legal purposes.

11. The average values cannot be safely employed as standards of comparison, and the extreme values admit of very rare application.

12. If the absolute weight of the lungs is employed as a test of respiration, the value obtained in an individual case ought to be compared with the average or extreme numbers obtained for the same weight of body. (See Table XXXII.)

The following propositions have an important bearing on Ploucquet's Test.

1. The weight of the lungs both before and after respiration increases with the weight of the body; but the proportion which the lungs bear to the body decreases as the weight of the body increases.

2. For the same weight of body the weight of the lungs varies within wide limits, and *vice versa*, for the same weight of lungs the weight of the body varies within wide limits. This variation is more considerable after respiration than before it.

3. The weight of the body in still-born children is greater than in children born alive; the former exceeding the latter by nearly one-third.

4. The weight of the lungs is subject to much greater variation than that of the body.

5. The weight of the lungs is much greater in the male than in the female.

1. *Ploucquet's Test.*—The proportion which the weight of the lungs bears to that of the body, like the absolute weight of the lungs, varies within wide limits; the proportion in mature still-born children being as follows: greatest proportion, 1 : 24; least proportion 1 : 176; average proportion, 1 : 57.

2. The proportion in males and females respectively is as follows; greatest proportion, 1 : 24, 1 : 36; least proportion, 1 : 176, 1 : 119; average proportion, 1 : 53, 1 : 63.

3. In children who have survived their birth one month or less, the highest recorded proportion is 1 : 19; the lowest, 1 : 132; and the average, 1 : 38.

4. The proportion for males and females respectively at the same ages is as follows: greatest proportion, 1 : 19, 1 : 19; least proportion, 1 : 132, 1 : 96; average proportion, 1 : 35, 1 : 43.

5. The proportion which the lungs bear to the body increases

with the increasing perfection of the respiration, but is very slightly augmented by imperfect respiration.

6. The proportion also increases with the duration of the respiration, but appears to be less when respiration has continued more than one hour and less than twelve, than when it has lasted less than one hour.

7. The average proportion in mature children who have lived one month or less, exceeds that in mature still-born children ; the numbers being 1 : 57 before respiration ; and 1 : 38 after respiration.

8. The proportions calculated from a small number of facts differ widely from each other, and cannot be depended upon for medico-legal purposes.

9. The average proportions cannot be safely employed as standards of comparison, and the extreme values, though more to be depended on than the highest and lowest weight of the lungs, are of very limited application.

10. If the average or extreme proportions are employed as standards of comparison. the proportion obtained in any individual case must be compared with the average or extreme numbers calculated for the same weight of body. (See Table XXXII.)

The observations contained in the present essay lend strong confirmation to the unfavourable opinion expressed on a former occasion of the static lung tests as tests of respiration. Whether employed to distinguish respiration from non-respiration, or respiration from inflation, they are alike insufficient, except in cases of extremely rare occurrence, where we can make use of the extreme values. On the supposition that the question of inflation has no place, the static lung tests are as unnecessary as they are useless ; if we have proved that either respiration or inflation has taken place, they can only be employed with advantage in the extremely rare instances just alluded to, viz. where we can employ the extreme values. Hence, then, the proposition which concludes my first essay requires to be slightly modified, and will stand thus.

The static lung tests are utterly useless for all practical purposes, and ought not to be relied on in medico-legal inquiries, except in rare instances, where the extreme values can be employed.

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