test, are scarcely able to form a just estimate of slowly waning sight, and whose opinion, therefore, must be received with caution. On the one hand, I have been assured by intelligent young adults, that their power of vision has, without doubt, diminished since their boyhood; on the other, I have met with one case of the somewhat mature age of thirty-four, where no diminution of vision since childhood could be discovered. On the whole, I am disposed to think that possibly the opaque layers may gradually increase in density as age advances, though I am equally convinced that some cases remain stationary; and I still think it possible that the evidence to the contrary may be delusive, and that, as age and intelligence have advanced, and as the requirements of life have become more exacting, the vision has seemed to the patient to be undergoing a slow degenerative change. The other question is, perhaps, more important in a practical point of view, and, perhaps, equally difficult to answer; at any rate, it has received different solutions from authorities on the subject.

It has been stated that the transparent margin is always liable to become opaque, and that this is more especially the case where the radiating opaque striæ exist. Judging from my own experience, I should say that I have never known an instance in which the transparent margin has become opaque, and I have had cases under observation for several years. I should feel less confident of those cases in which opaque striæ already exist in the margin of the lens.

It will be obvious that a correct reply to these questions is important in a practical point of view. In deciding to operate, and in selecting the method of operation, if we are justified in regarding the case as stationary, and as having reached its ultimatum, we know exactly how much we are risking, or, rather, how much the patient is about to risk; whereas if the case be progressive, it assumes a graver aspect, and seems to justify bolder measures and more decisive treatment. It has been the conviction forced upon me by long experience that these cases are for the most part stationary, and not progressive, which has induced me to recommend a very cautious plan of treatment. The characteristics of this partial form of congenital cataract have been well described in various treatises on ophthalmology, I therefore merely glance at them, so as more clearly to explain my views upon treatment. The symptoms, both subjective and objective, in all these cases, are very similar in kind, differing chiefly in degree. The subjective symptoms often attract but little attention until the child has reached the age of nine or ten years; and cases are not unfrequent in which they do not come before the notice of the oculist until the age of puberty, or even after this period. The defective vision is often mistaken by parents for aggravated myopia. The patient gropes about and elects to avoid a strong light; he is very dependent upon the conditions and arrangement of light; within certain limits and under certain favourable circumstances his sight is fairly good; he can even read small print by some peculiar method of his own, which he has instinctively acquired; he is not usually assisted to any appreciable degree by the use of any kind of glasses. I have met with cases where this form of cataract existed to a marked extent; and yet the patient has passed through all the ordinary stages of an educational course, has taken a good degree at college, and commenced a professional career. It has not been until the extra requirements of an active occupation have brought home to the patient, in a painful form, the deficiencies of his sight, that the advice of an oculist has been sought. The objective symptoms are very obvious: the grey discoloration of the lens can be readily seen, either by oblique illumination or by transmitted light. If the pupil be fully dilated, the degree and extent of the opacity can then be clearly defined, as also the exact limits of the transparent margin through which the fundus of the eye may be accurately examined by means of the ophthalmoscope. It is in the extent of the transparent margin that the chief diversity is found to exist, which has an important practical bearing on the case. Sometimes we find that but little more than the nuclear half of the lens is opaque, leaving a broad, clear, well-defined transparent margin. Sometimes two-thirds of the lens will be involved in the opacity, and the clear margin is proportionately narrow; whilst occasionally the border is so thin, and the opaque part so preponderates, that for all practical purposes the opacity may be regarded as invading the entire lens.

[To be concluded.]

NORWICH MEDICO-CHIRURGICAL SOCIETY.—The fifth meeting of the Society was held at the Norfolk and Norwich Hospital on Tuesday, February 1st. The following communications were read. A Case of Puerperal Fever, by Mr. Charles Firth; a Paper on Intussusception successfully treated by Inflation, and by Abdominal Section, by Dr. Barnes; a Paper on Delirium, by Mr. Horace Turner. The next meeting will be held at the Medical Library, March 7th, at 7.30 P.M.

SOME ANTHROPOMETRICAL OBSERVATIONS.

By PERCY BOULTON, M.D.,

Physician to the Samaritan Hospital.

LAST year, the British Association made a grant for carrying out anthropometrical observations; and, as I have for many years used the scales and rule as means of physical diagnosis, I think it may be a good opportunity to lay before the profession the results at which I have arrived, hoping, at the same time, that others may be led to work in the same field, and help to perfect what is a very extensive subject.

Dr. Hutchinson has written on vital capacity, and has published tables relating to adults from five to six feet in height, but I am of opinion that adult weight is only of value in noticing variation from an ascertained standard. Weight alone is of no value as a scientific fact; and it is a pity that height is not always taken also, for then a reference to a table of averages would at once indicate any serious discrepancy, and the weighing-machine would become a powerful agent in preventive medicine.

I have examined at the Anthropological Society, through the courtesy of Mr. Francis Galton, the statistics of the following large schools: Marlborough, Christ's Hospital, Haileybury, Birmingham, City of London, Clifton College, Liverpool, King Edward's School, Britannia, etc.; and it seems to me that all this evidence is rather chaotic till viewed by the light of some such plan of uniform development as I am about to lay down.

These school statistics show that boys of the same age may be of all weights and all heights, but they do not indicate what they ought to be. At Marlborough, boys of fourteen weigh from $4\frac{1}{2}$ to $10\frac{1}{2}$ st., and measure from 4 feet 3 inches to 5 feet 7 inches. Some explanation is, therefore, much wanted to simplify the matter; and this I think my method does.

The most important indications to be gleaned from the scales and measures are those which, so far as I am aware, have not before been noticed, and relate to infancy and childhood. It is when growth is actively proceeding that we can hope best to turn such information to account. I do not mean to argue that we can ever hope to make the child of diminutive parents a giant, or *vice versa*; for the embryo receives a stamp at the time of conception which will defy all our efforts, and we cannot undo in one, what has been the work of many generations. Children born of average sized and healthy parents frequently become stunted, or grow weedy for want of care during development, hygienic or other conditions being unfavourable; and in these cases the scales and measure offer indications second in value to none of those means of information which medical men have at their disposal. If parents would once or twice a year have their children weighed and measured by a competent person, or under the guidance of such tables as I have prepared, they would frequently gain information which would be of the utmost prospective value. They would detect, at an early stage, irregularities of development, which would act as danger signals to give warning of approaching mischief; for arrest of growth, whether in latitude or longitude, is one of the earliest appreciable signs of disease.

A subject involving so many figures and so much calculation as this, is necessarily rather dry, but I shall make it as little tedious as possible.

The first table which I have prepared has a double object.

1. It relates to the fetus *in utero*, and will be found useful as a ready means of arriving at the probable age of any fetus expelled prematurely, and may therefore be of service in a medico-legal point of view.

2. It points out the rate of development which takes place *in utero* and the apparent law which it follows. This rate of development is very extraordinary, and I fancy is not generally appreciated. Ramsbotham says: "Size is influenced by circumstances not very easily explained"; but the study of Table I will make the matter simple. I have commenced with the youngest human embryo, recorded by Professor Thomson in 1839. Two weeks after conception, it measured one-twelfth of an inch in length. I have never seen one less than three-eighths of an inch long, and have found it very difficult to arrive at the exact age of these early embryos; for, even if there have been intercourse on only one occasion, it is not possible to say the exact time when the ovum was impregnated, as the spermatozoa might be some days in arriving at the point of contact.

A fetus of twelve weeks measures three inches when stretched straight, and weighs 1 oz. This is very extraordinary; for if at two weeks it measures one-twelfth of an inch, it must multiply thirty-six

times in ten weeks. In drawing up my table, which commences from this, I have been obliged to make allowance for two sources of fallacy: Doubt as to the exact time of conception; variations in the size of the foetus, the male being generally the larger.

I find that development proceeds in the following manner.

Length.—Every four weeks after the twelfth to the sixteenth the foetus *in utero* grows $2\frac{1}{2}$ inches, which is the average yearly growth of a healthy child after birth. This seems surely a remarkable fact. A foetus of 3 inches in length is from twelve to sixteen weeks old; one of $5\frac{1}{2}$ inches, is from sixteen to twenty weeks old; and so on up to the full time.

Weight.—After the twelfth week half an ounce a week is added for four weeks, and the foetus of sixteen weeks weighs 3 ounces. The next four weeks one ounce a week is added, and the foetus of twenty weeks weighs seven ounces. Then two ounces a week follow for four weeks, and 15 oz. is the weight at twenty-four weeks; and this doubling every four weeks goes on till 8 oz. a week is arrived at after the twenty-eighth week. This is the maximum that an ordinary mother and foetus can accomplish, and very wonderful is this multiplication and doubling of weight in so short a space of time. If anything at all approaching it went on after birth, what a race of giants we should be! There are extraordinary children recorded weighing 12 lbs., 14 lbs., 16 lbs., and even 18 lbs., at birth; and, though they are rarely born alive, it is necessary to explain their occurrence. I think that in these exceptional cases there is what may be called *vis* enough to enable the foetus to go on doubling as before, even beyond the twenty-eighth week; and thus from 4 lbs. it would become 8 lbs. at thirty-six weeks, 16 lbs. at forty weeks, and in the one recorded case of an 18 lbs. child, it must have gone on for forty-one weeks. To say the least of this explanation, it is consistent with what we know to take place in the case of smaller children in ordinary pregnancy; and it renders simple what has hitherto been inexplicable. We know that in four weeks a child can increase from 2 lbs. to 4 lbs.; and, given the power and material, there is no reason why it should not go on building its body at the same rate, up to, or even over, the full term. After all, it is nothing compared to the rate of growth during the first twelve weeks of embryonic life, though at this period the difference is more appreciable. The condition of a foetus *in utero* is evidently that most conducive to development; and in studying growth we must remember that there is uniform heat and moisture with abundance of nourishment, and a passive condition almost devoid of waste which lead to this rapid and almost incredible rate of increase.

TABLE I.—Fœtal Length and Weight.

Days.	Weeks.	Length in Inches.	Weight.	Explanations.
14	2	— to 1-12th	lbs. oz.	Multiplies its length 36 times
84	12	— to 3	0 1	
112	16	3 to 5 $\frac{1}{2}$	0 3	
140	20	5 $\frac{1}{2}$ to 8	0 7	
168	24	8 to 10 $\frac{1}{2}$	15 (say 16)	Extraordinary.
196	28	10 $\frac{1}{2}$ to 13	2 0	
224	32	13 to 15 $\frac{1}{2}$	4 0	
252	36	15 $\frac{1}{2}$ to 18	6 0	
280	40	18 to 20 $\frac{1}{2}$	8 0	8 lbs.—1 lb. a wk. for 4 wks. = 4 lbs. + 4 bef. = 8 lbs. 16 lbs.—2 lbs. „ „ = 8 lbs. + 8 „ = 16 lbs. 18 lbs.—2 lbs. for 1 week more = 18 lbs.
287	41	20 $\frac{1}{2}$ to 23 or 24		

The foetus *in utero* is a human parasite provided for bountifully, and residing passively in the maternal forcing-house, but when it enters the world everything is changed. The child now becomes active and has to cater for itself, the cycle of waste and repair begins, and a kind of acclimatisation or hardening has to be undergone, like that of a hot-house plant when placed out of doors. Growth is at once checked, and in some cases the child is smaller when a week old than at birth.

The ordinary child, immediately before birth, grows at the rate of 40 inches a year in length, and the extraordinary child at a vastly increased rate. During the first year of extrauterine life this falls to 6 inches in length and 10 lbs. or so in weight. Taking the whole nine months together, the average foetus *in utero* grows 18 inches, whereas it takes four times as long, namely three years, to grow the next 18 inches, and seven and a half years to grow the third 18 inches, which is a further retardation of two and a half times. To repeat this more plainly: it takes *in utero* nine months to grow 18 inches, and the child is double 18 inches, or 3 feet, at three years of age, and three times 18 inches, or 4 feet 6 inches, at ten and a half years.

My next table links I and III together, and relates to children from birth up to three years of age.

I have not had any experience of monster children,* as they generally die at birth; and I have had great difficulty over this table, as at so early an age mothers do not often bring their babies to our consulting-rooms, and when there, they are so restless or shy, that it is almost impossible to get them to mount the weighing machine, and stand still and straight long enough to take correct note. For this reason I have disconnected this table from the next, as it is not so practically useful, though it is necessary that I should give it, in order that the whole series may be complete.

TABLE II.

Age.	Height.	Weight.	Rate per inch of total height.
Years.	Feet. In.	st. lbs.	
1	2 0	1 4	3 lb.
	2 1	1 5 $\frac{1}{2}$	
	2 2	1 7	
	2 3	1 8 $\frac{1}{2}$	
	2 4	1 10	
	2 5	1 11 $\frac{1}{2}$	
	2 6	1 13	
	2 7	2 0 $\frac{1}{2}$	
2	2 8	2 2	1 $\frac{1}{2}$ lbs. per inch added
	2 9	2 3 $\frac{1}{2}$	
	2 10	2 5	
	2 11	2 6 $\frac{1}{2}$	
3	3 0	2 8	1 lb. per inch

A child 24 inches in length should weigh 18 lbs., which is $\frac{3}{4}$ lb. for every inch of height. Every additional inch that it grows it increases $1\frac{1}{2}$ lbs. in weight up to 3 feet, when it should weigh 2 st. 8 lbs., which is exactly 1 lb. per inch of total height.

Taking an average, I find that a child should be 2 feet 4 inches at one year, 2 feet 8 inches at two years, and 3 feet at three years. As the body grows longer, it increases in thickness also, and the ratio is shown in these tables, for what was $\frac{3}{4}$ lb. at 2 feet becomes 1 lb. at 3 feet, and this gradual increase of weight per inch of transverse section goes on regularly as we ascend the scale of healthy humanity.

In studying the physical development of children, it is necessary to note the weight per inch of total height, and how this increases as we ascend. From 1 lb. at 3 feet, it becomes $1\frac{1}{4}$ lbs. at 4 feet, and $1\frac{1}{2}$ lbs. at 5 feet, etc. The increase per inch from 3 to 4 feet should be 2 lbs.; and from 4 to 5 feet, $2\frac{1}{2}$ lbs. The average child should, after three years of age, grow $2\frac{1}{2}$ inches a year; and, therefore, at a certain age should attain a certain height. With an ever changing latitude and longitude, these three points are important; and, in order to appreciate the proper balance of healthy development, and to recognise deviations, they should be thoroughly mastered. With adults it is different, for growth is finished, and there is only a stationary height to be taken into consideration.

TABLE III.

Age.	Height.	Weight.	Rate per inch of total height.
Years.	Feet. In.	st. lbs.	
3	3 0	2 8	= 1 lb. per inch of total height
	3 1	2 10	
	3 2	2 12	
4	3 3	3 0	2 lbs. per inch added
	3 4	3 2	
	3 5	3 4	
5	3 6	3 6	2 lbs. per inch added
	3 7	3 8	
	3 8	3 10	
6	3 9	3 12	2 lbs. per inch added
	3 10	4 0	
	3 11	4 2	
7	4 0	4 4	= 1 $\frac{1}{2}$ lb. per inch of height
	4 1	4 6 $\frac{1}{2}$	
	4 2	4 9	
8	4 3	4 11 $\frac{1}{2}$	2 $\frac{1}{2}$ lbs. per inch added
	4 4	5 0	
	4 5	5 2 $\frac{1}{2}$	
9	4 6	5 5	2 $\frac{1}{2}$ lbs. per inch added
	4 7	5 7 $\frac{1}{2}$	
	4 8	5 10	
10	4 9	5 12 $\frac{1}{2}$	2 $\frac{1}{2}$ lbs. per inch added
	4 10	6 1	
	4 11	6 3 $\frac{1}{2}$	
11	5 0	6 6	= 1 $\frac{1}{2}$ lb. per inch of height
	5 1	6 8	

Table III shows these points at a glance, and gives the height, corresponding weight, and the age at which an average healthy child should arrive at any place in the table. Four feet is attained at some time under eight, and 5 feet a little before thirteen years.

* I once delivered a child weighing 14 lbs., but it was cyanotic; no doubt from patency of the foramen ovale, the result of pressure during birth.

Children, however, vary immensely in comparative size for age; and I must explain how to reconcile all discrepancies. Some healthy children, slow growing, and, perhaps, of short parentage, increase at the rate of 2 inches a year instead of $2\frac{1}{2}$; and, if such a child be up to the average weight for its size, nothing unhealthy is indicated, but prospectively a short adult stature.

In the same way, quick growing strong children of large parentage may grow at the rate of 3 inches a year, and without harm, so long as the weight tallies with that shown in this table.

The slow growing short child will attain 5 feet and weigh 6 st. 6 lbs. at fifteen years of age, whereas the fast growing one will do the same at eleven, and the average one at a little under thirteen years. All three are healthy children that should be left to go on developing at this their normal rate. Any attempt to make the short child grow taller would either fail, or do more harm than good. Gymnastics, plenty of exercise, and good hygienic conditions are all that is necessary or allowable.

Arrest of development, whether in latitude or longitude, is an early sign of disease, and is as demonstrable by the weighing-machine as anything shown by the thermometer, which is an equally homely instrument only of late years used in clinical research.

By means of Table III, it is easy to tell whether a child is overgrowing or undergrowing, either in height, weight, or thickness.

Perhaps it most frequently happens that a child grows up to the average height, but does not weigh accordingly, the limbs and chest being ill-developed. There are no other morbid signs, and consequently such a child is left to grow up in this state, if some disease do not first carry it off, which is more than likely.

What I insist on as the chief value of weight and measurement is, that we gain information during childhood which puts one in a position to combat an unhealthy manner of growth, often the forerunner of disease, resulting in a delicate and debilitated manhood. Some cases will baffle every effort; but a large percentage will repay the care bestowed upon them. Many will grow up big and strong that would otherwise be small and weak; and some live that otherwise would die.

In treating of children over 5 feet, we meet with several difficulties, for we have arrived at a point where fixed adult standards mix in with those of growing children.

As the difference between the weight of a growing child of more than 5 feet and an adult of the same height should be 2 st., and as this proportion holds good for any size, the simplest way of getting over what would require another overlapping table is to give the adult weights, with the understanding that before maturity 28 lbs. should be deducted from that stated in Table IV.

TABLE IV.

[N.B.—For a growing person, deduct 2 st. from any of the above weights.]

Height		Weight.	Rate per inch of total height.
Feet.	In.	st. lbs.	
5	0	8 8	2 lbs. per inch of stature
5	1	8 13	
5	2	9 4	
5	3	9 9	
5	4	10 0	
5	5	10 5	5 lbs. per inch added
5	6	10 10	
5	7	11 1	
5	8	11 6	
5	9	11 11	
5	10	12 2	2½ lbs. per inch of stature
5	11	12 7	
6	0	12 12	
6	1	13 4	
6	2	13 10	
6	3	14 2	6 lbs. per inch added
6	4	14 8	
6	5	15 0	
6	6	15 6	
6	7	15 12	
6	8	16 4	3 lbs. per inch of stature
6	9	16 10	
6	10	17 2	
6	11	17 8	
7	0	18 0	

For instance, a boy of 5 feet 5 inches would weigh 8 st. 5 lbs. instead of 10 st. 5 lbs. as given, and if this boy never grew any taller he would attain the latter weight when a fully developed man. I think no tables could be drawn up to show the rate of transition; but I have hopes that we may be able by statistics to tell beforehand of what height a child will be when fully grown, from the age at which he passes 5 feet.

Table IV has resulted from hundreds of my own carefully taken

records, and is not simply theoretical; nevertheless, it will be seen to follow certain laws which enable one to calculate what would be the proportional weight of a giant of any number of feet.

The weights and measurements which I give are the nearest to what I find consistent with the most perfect development. Perfection is not, perhaps, often attained, but is to be aimed at.

I have said before that *adult* tables are not of the value that has been supposed, and that each individual should be judged only by comparison with his own previously ascertained healthy weight.

Great variations are met with in perfect health, due to temperament or diathesis, for there are human varieties. I know two men of the same height and in perfect health, whose weights differ by 10 st.; and it is, therefore, absurd to talk of vital capacity being affected when weight is 7 per cent. over the average. Captain Webb, when he swam across the Channel, stood 5 feet 8 inches, and weighed $14\frac{1}{2}$ st.; and Dr. Hutchinson only allows 11 st. 12 lbs. to be consistent with health. Samuel Brock, who on October 6th, 1835, swam fifteen miles, and was in the water for seven and a half hours, stood 5 feet 5 inches, and weighed 14 st. Immense power and endurance seem generally to reside in a person of short, thick, bull-dog frame. Large bones and muscles do not injuriously affect vital capacity, but they weigh heavily, and do not usually accompany ideal symmetry. The possessors of them are exceptionally powerful as a rule; but, being exceptional, do not fit into this my last table.

I had not intended to publish this paper in its present crude condition; but the circumstances which I have named at the commencement lead me to think that it may be particularly interesting and *à propos* at this time.

A WORD ON THE ORIGIN OF BACTERIA, AND ON ABIOGENESIS.

By WILLIAM ROBERTS, M.D., F.R.C.P.,

Physician to the Royal Infirmary, and Professor of Medicine in Owens College, Manchester.

DR. BASTIAN has cited my name and quoted my experiments in a way that might make it appear that my investigations lend some support to his views on the origin of bacteria in organic infusions; this is, however, not the case. On the contrary, the weight of my experiments is entirely against him and in favour of Pasteur's conclusions. I found, as others have done, that some infusions and organic mixtures produced bacteria after having been boiled for a certain time; but I also invariably found that, if the boiling were sufficiently prolonged, no such result followed. All were rendered permanently barren—even Dr. Bastian's favourite turnip-and-cheese mixture. In quoting my experiments on alkalised infusion of hay, Dr. Bastian omitted to add, that in the same paper from which he was quoting, I furnished decisive *experimental proof* (not a mere explanation) that the germination which took place after boiling was due to a survival of pre-existing germs, and *not* to a *de novo* generation.

The results obtained by me were in substance identical with those obtained by Pasteur and Professor Tyndall. The circumstance that Professor Tyndall did not encounter those examples of great resistance to sterilisation by heat that I encountered, involves no contradiction in our results. His procedure was different from mine, but our results were the same. We both succeeded by boiling in sterilising our infusions without impairing their aptitude for the growth of bacteria. As well might we say that two chemists contradict each other when they obtain the same metal from the same ore by different processes.

It appears to me, that the attitude of Dr. Bastian on the question of the origin of bacteria arises from what I may call the inverted significance which he attaches to the two contrasted results—barrenness or fertility—which follow after boiling an organic infusion. Throughout the controversy, Dr. Bastian speaks of the barren tubes and flasks as “failures” or “negative results”; and he evidently regards the fertile tubes and flasks as “successful” experiments, having the force and authority of “positive” results. The true view is just the reverse of this, and his misunderstanding on this point makes him blind to the overwhelming cogency of the case against him. When the matter is duly considered, it is the barren flask that has the character of a positive result. For what does the experimenter set himself to do in these experiments? He seeks to destroy by boiling all pre-existing bacteria in these infusions, and to leave unimpaired their powers of promoting the growth of bacteria. And it is found in fact that this latter quality is perfectly preserved in boiled infusions; for they breed bacteria with the utmost luxuriance when they are reinfected from an extraneous source.