

oped following inoculation of virus. Unmistakable Gram-staining cocci and diplococci of varying size, shape and grouping, were found in or adjacent to lesions in 54 of the 60 monkeys. The lesions in the 6 in which diplococci were not demonstrable in the sections available were relatively slight. Three of these 6 died, 12, 18, and 21 days, respectively, after onset of paralysis; the remaining 3 had mild attacks of poliomyelitis and were despatched by anesthesia, respectively on the tenth, eleventh and fourteenth day after the onset of the disease. Of the 54 monkeys in which diplococci were found, 31 were despatched by anesthesia and 23 died from paralysis.

A similar search was made for bacteria in sections of the central nervous system of 60 monkeys in which there were no active lesions of poliomyelitis. These 60 animals were used as controls; 32 were despatched by anesthesia and 28 died from various causes other than poliomyelitis. In none of the sections from the 60 monkeys used as controls were diplococci demonstrable.

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#### The Determination of Surface Area of Living Children.

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Three major methods for obtaining surface area have been applied to both the living body and the cadaver. The first is the geometric. The second is to cover the body with pieces of paper of known area or with a thin sheet of pliable but non-elastic substance which is later measured with a planimeter, by direct weighing or by weighing pieces of paper of the same area as the coating. The third method is the application of the surface integrator.

A variation of the coating method has been devised and applied to plaster of Paris casts of living children.<sup>1</sup> This use of the intermediate stage of a model permits a check on the reliability of the coating method through *seriatim* measurements.

The casts were obtained as follows: The child, after having his body coated with stearine and his hair covered with a close-fitting silk stocking top, was placed on his back in a thick layer of semisolid,

<sup>1</sup> Boyd, E., and Scammon, R. E., *Anat. Record*, 1927, xxxv, 5.

quick-setting plaster of Paris with his legs apart, arms away from the sides and the fingers spread apart. The child was removed when the plaster was sufficiently set to hold its form. While the half-matrix cooled and hardened, its rough edges were smoothed, and its entire surface greased. Then the child was replaced in it and a thick layer of plaster of Paris spread over the body to the chin. This upper matrix was removed in several segments. To obtain the face, the neck segment was refitted leaving the rest of the body free, the closed eyes covered with vaseline and soft tissue paper, and then thick plaster spread over the face, leaving only the anterior nares uncovered. It is essential to grease the child thoroughly, to remove him before the plaster becomes uncomfortably hot, and to keep him sufficiently interested so that he will remain quiet voluntarily. The



FIG. 1.

A photograph of subject P. L., age 4 years 11 months, lying in the lower matrix of the cast preparatory to the application of the upper matrix.



FIG. 2.

A photograph of the same subject at Fig. 1, with the upper matrix *in situ*.

plaster used set in 3 to 15 minutes depending on its consistency when applied. Figures 1 and 2 show 2 steps in the process.

The cast of the child was made by greasing the inner surface of the shell, reinforcing with iron rods, sealing the segments, filling the cavity with liquid plaster and then chiseling the matrix from the resulting cast. Several days are required between each step of the process for drying and hardening of the plaster.

The areas were determined by wrapping the entire cast with overlapping layers of surgical adhesive tape. The ears and fingers were covered separately. The toes were separated by sawing through the indicated divisions and the adhesive pressed into these cuts as far as possible. The edges of the adhesive were colored with crayon, so that any slipping would be apparent. The coating was removed according to the regions of the body described by Du Bois and Du Bois.<sup>2</sup> The adhesive was cut through to the cast with a microtome knife and the lowest layer of adhesive grasped and stripped off. The curved coating of each region was cut into sufficiently to flatten it. These pieces were placed on paper covering sheets of "Kodaloid No. 3"<sup>3</sup> spread on a flat surface. The outlines of the pieces were traced with a microtome knife pressing hard enough to cut through the paper and underlying Kodaloid. The area of each region was determined by weighing the Kodaloid pieces.

The results of repeating this process 2 or 3 times on each cast are given in the accompanying table with the mean relative deviation and total range of relative deviation for the average surface area of each cast.

These give a rough measure of the variability in the coating process but not of the casting. To test the reliability of both procedures, a cast was made of a bowling ball (used for the same purpose by Sawyer, Stone and Du Bois<sup>4</sup>). The areas of both the ball and its model were computed from determinations made with 2 standard physical instruments, the cathetometer and the spherometer, as well as from the adhesive coat.

As shown in Fig. 3, the variability in readings of the surface area for both balls is smallest by the cathetometer, intermediate by the coating method and largest by the spherometer. Thus, the coating method appears to be of the same order of reliability as the methods commonly employed for determining the area of spherical surfaces.

<sup>2</sup> Du Bois, D., and Du Bois, E. F., *Arch. Int. Med.*, 1915, xv, 868.

<sup>3</sup> A celluloid composition used for photographic films. For tests of its accuracy, see Scammon, R. E., and Scott, G. H., *Anat. Record*, 1927, xxxv, 269.

<sup>4</sup> Sawyer, M., Stone, R. H., and Du Bois, E. F., *Arch. Int. Med.*, 1916, xvii, 855.

TABLE I.  
Determinations of Surface Area of Living Children.

Subject and sex	Age (yrs. and mo.)	Weight (kg.)	Length (cm.)	Surface area			
				Single readings (sq. cm.)	Means (sq. cm.)	Relative deviations (per cent)	
						Mean	Range
E. H. (f)	3:3	15.63	100.3	6753.6	6805.6	0.8	2.0
				6891.2			
				6771.9			
" "	3:4	15.76	100.2	6708.8	6809.9	1.5	3.0
				6911.0			
" "	3:5	16.20	101.5	6877.5	6928.0	0.5	1.2
				6945.8			
				6960.8			
" "	3:6	16.55	102.9	6973.5	6979.1	0.3	0.9
				6950.1			
				7013.7			
" "	3:10	16.90	104.8	7039.3	6955.9	0.8	2.4
				6871.5			
				6956.9			
R. C. (f)	4:4	15.75	101.7	6565.1	6539.2	0.4	0.8
				6513.2			
" "	4:9	16.69	104.1	7399.6	7354.2	0.5	1.3
				7301.8			
				7361.0			
" "	4:10	16.40	105.2	7406.6	7360.0	0.6	1.3
				7313.4			
P. L. (m)	4:11	17.20	111.5	7347.1	7420.9	0.7	1.8
				7436.1			
				7479.6			

The error in casting is probably best indicated by the comparison of the areas by the cathetometer of both the bowling ball and its model. The latter is 1.5% larger. The ratio of the difference in size of these 2 objects to its probable error is 13.9. This is a significant difference. But the areas of the cast both by the cathetometer and by the coating method are not significantly larger than the area of the bowling ball by the spherometer.

There is apparently a close agreement in the estimates of the area of the cast, as determined by the spherometer, and the area of the bowling ball, as determined by the cathetometer. In this case the larger size of the model (due to the expansion of the plaster) is probably offset by the sinking of the sharp-pointed legs of the spherometer into the softer cast. Moreover, the ratio of probable

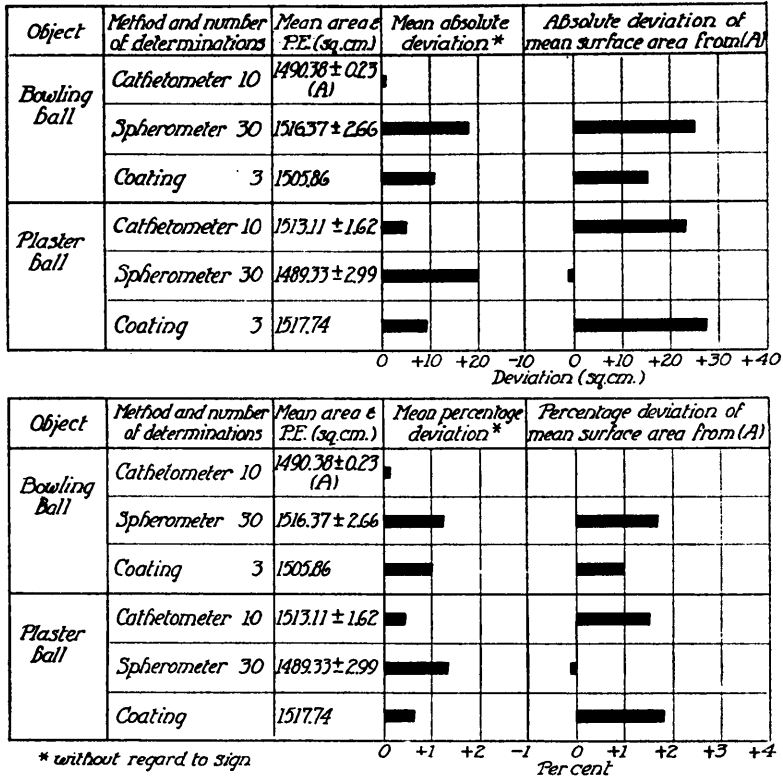


FIG. 3.

A histogram illustrating the variability of the method used on test subjects to determine the precision of the casting and coating method.

error of the difference shows that the area of the plaster ball by the spherometer is significantly less than its area by the cathetometer.

These comparisons indicate that the total error of the casting and coating method is of the order of 2%.

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The Relation of Surface Area to Body Weight in Postnatal Life.

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The 9 determinations of surface area on 3 children from 2 to 5 years reported in the first paper of this series, are not sufficient to warrant the computation of a formula for surface area at this age