that in the previous report, by including an additional year of observations. That number should replace 210 in Eq. 1 of my report, and consequently 5.03 should replace 5.51 in Eqs. 1a and 3 there. This change would imply a 5-percent decrease in the deduced field, provided that the spin-axis of the satellite has remained fixed in space. However, the spin-axis might be expected theoretically to drift slowly toward parallelism with the magnetic field, thus decreasing the magnetic component normal to the axis and the damping factor resulting therefrom. Such axis drift would produce just such a secular lengthening of the relaxation time, which should be omitted for the present purpose if new orientation data were also available to confirm it. However, without such orientation data we shall need several more months of rotation speed data as a basis for decision about the quantitative importance of spin-axis drift.

Since the steel battery cans have lately been found experimentally to have an effective permeability of only about 2 (almost nonmagnetic) for a field perpendicular to their geometric axes, it seems necessary to abandon the previous assumption that the body-orientation of the spin-axis remained, as at orbital injection, parallel to the geometric axes of the batteries. It is in agreement with mechanical theory, recently confirmed by direct evidence for the analogous case (*5*) of Vanguard II, to expect that the position of the original body-axis, about which the moment of inertia is smaller, would be unstable. Hence, within a short time after its detachment from the launching rocket, the satellite would have slipped to rotation about a stable axis near its original equator, since about this axis the moment of inertia would be a maximum for the satellite. Note that this change of body-orientation of the axis does not necessarily imply any change in its space-orientation. The new corresponding moment of inertia was measured before launching as 69,203 gm-cm^2, a 2-percent increase which would correspond to a 1-percent increase of the magnetic field. When this number replaces 67,885 as an additional revision of Eq. 3 of the report, the observed total damping coefficient in that equation and the last member of Eq. 7 becomes 0.00348 gm-cm^2 sec. This change would correspond to a 4-percent decrease in the derived field.

Direct measurements of pertinent physical properties of the satellite materials are being carried out at the National Bureau of Standards, the resistivities under supervision of James Thomas, and magnetic permeabilities under Irvin Cooter. Resulting data for the spherical aluminum shell are changed little: $1/\sigma = 4633$ electromagnetic units (emu) at the measured (*6*) mean temperature 45°C for the satellite 80 percent of the time in sunlight and a mean thermal coefficient 0.004 per degree centigrade. For the seven steel battery cans they found $1/\sigma = 13{,}600$ emu (the previously printed value should have read 78,000 instead of 78), and $\mu = 42$. That latter value is the measured effective initial magnetic permeability of the cylindrical can (which ranged from 65 along its axis down to 2 for a field normal to that line), for the mean field component parallel to its geometrical axis. Owing to the above-discussed 90° shift of body-axis orientation, the revised damping couple on all the cylindrical shells should now be computed using only Eq. 6 of the previous report. The result for the additional couples is 0.39 that due to the spherical shell, so that 1.39 should replace 2, and 2.78 should replace 4 in the second and third members, respectively, of Eq. 7. This change corresponds to a 13-percent increase in H.

Using the revised numbers and data in Eqs. 2 and 7, the satellite damping constant $K = 312{,}000$ sec-gauss$^2 = 3.61$ day-gauss^2 by Eq. 8. Solving Eq. 7 gives the mean field normal to the spin-axis as $\overline{H}_\perp = 0.125$ gauss to replace 0.115 in Eq. 9. This new value is then substituted in Eq. 17, together with the revisions of Eq. 14 discussed above which change Eq. 16 to read: $\overline{H}_V/\overline{H}_H = 175/286 = 0.6119$. The resulting new Eq. 18 for the mean total field deduced from rotational damping is $\overline{H} = 0.144$ gauss, and the agreement with either the approximate solution 0.148 or the more exact 0.143 of Eq. 15 is still satisfactory.

This revised calculation is based entirely on directly measured data, except for spin-axis orientation. Errors of 2 percent in the measured conductivity or about 3 percent in the magnetic permeability would each lead to a 1-percent error in the derived magnetic field.

Owing to the temperature coefficient of conductivity, known to be 0.004 per degree centigrade, an error of only + 5° in the assumed mean temperature 45°C would also cause an error of + 1 percent in the calculated field. For this reason, space "weathering" by pelting meteorites and radiation, by deteriorating the satellite's temperature-controlling silicone coating, could cause the possible secular increase in the rotational relaxation time noted above.

Indeed, the wavelike variations of slope of the spin-rate curve, which correspond to variations in relaxation time between about 210 and 280 days, that is, between 9 percent below and 22 percent above the mean, may thus be fully explained by respective temperature variations of 22° below and 55° above the assumed mean. Observed temperatures (*6*) indicate a possibility of such a range. The minimum slope of the rotation curve occurred around December in both 1958 and 1959, a season when the highest satellite temperatures would be expected (*7*), owing to the annual maximum of both solar and terrestrial heating intensity. The solar maximum then is due to the earth's passing perihelion, and to the extreme solstitial solar declination causing the satellite to be in sunlight 100 percent of the time over a period of 3 weeks. The annual maximum of terrestrial heating at that season would be due to the Southern Hemisphere's being at its hottest, and the Northern, with its dominant land area, at its whitest (*8*).

RAYMOND H. WILSON, JR.
Goddard Space Flight Center, National Aeronautics and Space Administration, Washington, D.C.

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8. It is a pleasure to express my appreciation for the contributions of all persons who, by interest, suggestions, or new data, have enriched the discussion of this subject.

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Induction of Ovulation in Immature Hypophysectomized Rats

Abstract. Immature rats given minute doses of highly purified pituitary gonadotropins (follicle-stimulating hormone and luteinizing hormone) 7 to 100 days after hypophysectomy ovulated and formed corpora lutea. Neither hormone alone was effective. Luteinizing hormone repaired in part the atrophied theca interna and interstitial tissue, and follicle-stimulating hormone stimulated the development of the granulosa cells.

Until the recent availability of highly purified pituitary gonadotropins (follicle-stimulating hormone and luteinizing hormone) (*1*), it was impossible to (i) identify with clarity the real physiological actions of these hormones, (ii) induce ovulation, and (iii) produce corpora lutea in hypophysectomized rats. Up to that time, *all* of the pituitary gonadotropins tested were either too

scant in amount for assessment of their physiological activity in more than one or two laboratories or badly contaminated one with the other, or they contained rather large amounts of the other pituitary factors (for example, ACTH, growth hormone, somatotropic hormone, and thyroid-stimulating hormone). It is now possible to obtain follicle-stimulating hormone and luteinizing hormone which are quite free of noticeable contaminating effects of other pituitary tropins, as determined by biological methods. In this report preliminary announcement is made of the physiological effects of these gonadotropins.

Since it is well known that residual gonadotropins remain in the system for 10 or more hours after hypophysectomy (*2*), it was essential to obtain a series of animal controls as an indisputable base line. Preliminary experiments indicated that animals hypophysectomized at least 4 to 7 days prior to the tests proved satisfactory, but it seemed more desirable to utilize rats that had been hypophysectomized at least 14 to 100 days prior to the experiment. These rats proved extremely sensitive to the contaminating effects of the gonadotropic preparations previously used and provided the best criteria for the evaluation of the gonadotropins herein described. The rats were of the Sprague-Dawley strain, obtained from the Charles River Breeding Laboratories, and were hypophysectomized by the parapharyngeal approach. Injections of hormone vehicle and hormones were made subcutaneously twice daily for 4 days, necropsies were performed 14 hours after the last injection, and the sella turcica of each animal was inspected to determine the completeness of pituitary removal. Each group contained at least five to seven animals.

The tabulated data in the control series reveals that the saline vehicle for the gonadotropins is without effect on the entire reproductive tract. Furthermore, the atrophy of the sex tract continues from at least 7 to 100 days after the removal of the pituitary body (see Table 1).

Histologic examination of the serially sectioned ovaries and attached oviducts of the gonadotropin-treated rats reveals that low doses of either follicle-stimulating hormone or luteinizing hormone alone (< 250 μg) do not induce ovulation under the conditions of these experiments. Throughout the entire series of experiments, irrespective of the interval between hypophysectomy and the 96-hour period of gonadotropin administration, it was observed (i) that the action of follicle-stimulating hormone is primarily one of stimulation of the granulosa cells of the Graafian follicles and secondarily the partial functional stimulation of ovarian interstitial tissue, and (ii) that luteinizing hormone acts preferentially by stimulating the theca interna and ovarian interstitial tissue, a fact well in accord with the reports by Hisaw (*3*), Greep (*4*), Fevold (*5*), and their colleagues.

Observations from the current experiments further indicate that larger doses of follicle-stimulating hormone (> 250 μg over the 4-day period) readily transform the theca cells that surround the enlarged ovarian follicles into theca lutein cells, and seemingly stimulate the interstitial tissue to produce very large amounts of estrogen. A number of rats given large amounts of either follicle-stimulating hormone or luteinizing hormone alone had numerous ovarian follicular cysts, fragmented ova, and partially stimulated but degenerating follicles and, as evidenced by large uteri, an abnormally high release of estrogen.

Ovulation and formation of corpora lutea occurred in all groups (7 to 100 days after hypophysectomy) given at least 250 μg of follicle-stimulating hormone and 100 μg of luteinizing hormone. These same amounts, injected at separate sites over the 4-day period, produced maximal stimulation of uterine growth (evident in both wet and dry weights and in percentage of uterine nitrogen) and vaginal cornification, both being effected by the release of ovarian estrogen(s) by the action of follicle-stimulating hormone and luteinizing hormone on the ovaries.

These experiments (*6*) clearly suggest that there are two distinct gonadotropins acting upon the ovaries: follicle-stimulating hormone acting on the granulosa cells, luteinizing hormone acting on the theca interna and interstitial tissue, and a combination of the two acting to produce estrogen secretion, ovulation, and corpus luteum formation. Exogenous levels above the physiologic dosages —that is, those above 250 μg—produce aberrant ovarian conditions, chief among which are cystic follicles and prodigious amounts of estrogen secretion.

Table 1. Influence of highly purified follicle-stimulating hormone (F.S.H.) and luteinizing hormone (L.H.) in female rats at different periods after hypophysectomy. Additional abbreviations: V.C., vaginal cornification; Lg. fol., large follicles; Med. fol., medium follicles; Cyst. fol., cystic follicles; Thec. lut., theca lutein; C.L., corpora lutea of ovulation; I.T., interstitial tissue (+1 to +4, minimum to maximum stimulation); Pre-ov. fol., preovulatory follicles; Sev., several; Lg. cyst. fol., large cystic follicles.

Period (days*)	Total dose‡ (μg)		Ovarian		Uterine		V.C.
	F.S.H.	L.H.	Wts. (mg %)†	Histology	Wts. (mg %)†	Histology	
			Control series, given 0.2 ml. of saline daily				
7	0	0	25.0	Atrophied	31.0	Atrophied	−
14	0	0	14.0	Atrophied	21.0	Atrophied	−
21	0	0	14.0	Atrophied	18.0	Atrophied	−
50	0	0	8.3	Atrophied	14.3	Atrophied	−
100	0	0	6.2	Atrophied	14.6	Atrophied	−
			Experimental series				
7	250	0	47.0	Lg. fol. + 2 I.T.	110.0	+4	+
7	250+2000§	0	72.2	Cyst. fol., thec. lut. + 3 I.T.	113.0	+4	+
7	250+1000§	1000	76.0	Lg. fol., C.L., + 3 I.T.	142.0	+4	+
14	100	0	18.0	Med. and lg. fol.	23.0	Atrophied	−
14	250	0	24.0	Lg. fol. + 2 I.T.	40.0	+2	Initial
14	500	0	33.0	Pre.-ov. and cyst. fol. + 3 I.T.	68.0	+4	+
21	100	0	14.0	Atrophied, few med. fol. + 1 I.T.	19.0	Atrophied	−
21	250	0	24.0	Sev. lg. fol. + 2 I.T.	53.2	+2	+
21	0	100	15.0	Atrophied	18.0	Atrophied	−
21	0	250	19.0	Few healthy med. fol. + 2 I.T.	19.0	Atrophied	−
21	0	500	50.0	Pre-ov. fol., sev. with ovum and corona free, + 3 I.T.	88.4	+2	+
21	100	100	19.0	Atrophied, sev. med. fol. + 2 I.T.	28.0	+1	−
21	250	100	45.0	13 hr. C.L., 24 hr. C.L., lg. cyst. fol. + 4 I.T.	98.0	+4	+
21	250	250	49.0	C.L., pre-ov. fol. + 4 I.T.	124.0	+4	+
50	250	0	11.5	Few med. fol. + 2 I.T.	33.7	+2	+
50	0	250	13.8	Few med. fol. + 2 I.T.	20.0	+1	+
50	0	500	19.4	Sev. lg. fol. + 3 I.T.	44.0	+3	Initial
50	250	250	20.3	C.L., lg. fol. + 3 I.T.	57.4	+4	+
100	250	0	13.5	Sev. med. fol., several lg. fol., + 2 I.T.	34.1	+1	+
100	0	250	12.1	Sev. med. fol. + 2 I.T.	22.5	+1	?−
100	0	500	18.0	Many med. fol. + 3 I.T.	61.1	+4	+
100	250	250	17.4	Many lg. fol., C.L., + 4 I.T.	84.6	+4	+

* After hypophysectomy. † By mg % is meant organ wt. divided by body wt., with the quotient multiplied by 100. ‡ In all cases except those marked §, total dose was administered over a period of 4 days in two subdivided doses daily. § Smaller dose was administered in 4 days, and the larger dose was administered on the 4th day.

JOSEPH THOMAS VELARDO
Department of Anatomy,
Yale University School of Medicine,
New Haven, Connecticut

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New Technique for the Collection and Isolation of Airborne Microorganisms

Abstract. Pure cultures of airborne microorganisms are obtained by simple electrostatic attraction to small glass and plastic cylinders which are rolled over the surface of nutrient agar medium. Little equipment is required, and the necessary materials are inexpensive. Satisfactory qualitative sampling is possible under varying conditions of relative humidity.

The difficulty and expense involved in sampling microorganisms in the airborne state by conventional means has made the development of a simple inexpensive method desirable. Such a method has been developed by taking advantage of simple electrostatics. A small plastic rod, electrostatically charged by rubbing, is exposed to the air for a short time and then rolled over the surface of nutrient agar.

Table 1. Data from qualitative sampling for *Staphylococcus pyogenes* in a hospital. Volume of air sampled by liquid impinger, 25 lit. Period of exposure of charged glass rod, 30 seconds. Ratios, number of qualitative "positive" samples compared to number of samples taken. Temperature 75°F; relative humidity 56 percent.

Area sampled	Ratios for	
	Impinger technique*	Charged rod technique
Ward 1	2/4	6/8
Ward 2	4/4	4/8
Ward 3	2/4	1/4
Fracture room	2/4	5/8
Recovery room	2/4	6/8
Operating room	1/4	1/4
Linen room	0/2	2/4
Stores room	1/2	2/4
Physiotherapy	2/2	1/4
Laboratory	1/4	1/8
Bathroom	2/2	1/4
Main corridor	2/2	0/4
Total	21/38	30/68

* Impinger collections were assessed by the "drop plate" dilution method (*4*). One colony per plate (1/8 ml neat dilution) normally equals 3.2 organisms per liter (flow rate for Shipe impinger, 12.5 lit. per minute).

The materials (Fig. 1) required for simple electrostatic sampling are easily obtained at very low cost. In our experience 2-inch lengths of ¼-inch extruded plastic rod (dimpled at the ends) or tubing (inside diameter, ⅛ inch) or 7.5-mm glass capillary tubing have proved most satisfactory. In the laboratory, the rod or tube can be held for charging and exposure by any holder such as a hemostat, gut clamp, or pinch-type clothespin. A suitable rolling clip can be made by bending a length of No. 16 baling wire. For charging the rods, 2-inch squares of folded cotton cloth or gauze or short-pile fur are all that is required.

For routine field use a simple collection kit has been designed. This consists of a plastic tube mounted on a shaft to provide a handle and permit rolling; a charging sleeve: and a compartmented container for different media. These items are sealed within a package to keep the charging materials dry and the entire kit sterile.

The laboratory technique consists of grasping a dry, sterile rod or tube at one end with the clamp; with firm, wrap-around finger pressure, rubbing the rod five or six times with the charging material; holding the rod for the desired length of time (5 seconds to 2 minutes) in the atmosphere to be investigated; grasping the rod by means of the wire clip and rolling it back and forth over the flat smooth surface of the nutrient agar (preferably dried previously for 1 hour).

Relatively large numbers of organisms can be rolled onto the agar surface. With care in rolling, an even distribution of isolated colonies can be obtained. If it is anticipated that larger numbers of organisms will be collected, the rod is shaken in a small volume of diluent and the organisms are washed off the rod; dilution assessment by any of various methods follows.

This method of collecting and plating-out airborne microorganisms has been successful under varying conditions of temperature and relative humidity. Although electrostatic charges soon dissipate from glass at relative humidities above 70 percent, charges on plastics such as styrene, cellulose acetate butyrate, and acrylics provide sufficient attraction for successful collection at relative humidities ranging from 15 to 95 percent.

Collections of airborne organisms have been made in many atmospheres —in animal rooms, laboratories, vestibules, motor vehicles, elevators, and aerosol chambers (*1*), within dynamic aerosol equipment (*2*), and out-of-doors.

Under controlled conditions of temperature and humidity (temperature, 70°F; relative humidity, 53 percent), collections of washed cells of *Serratia marcescens* have been made from dilute, dynamic aerosols by means of positively charged styrene rods. From aerosols containing 84.5, 12.1, and 1.5 organisms per liter, respectively, as determined by the liquid impinger method (flow rate, 16 lit. per minute), satisfactory samples (20 to 1 colonies per rod) were collected; the ratios of the number of "positive" samples to the number of samples taken were 12/12, 9/12, and 2/12, respectively, for these three aerosols.

Table 1 shows recoveries under uncontrolled conditions in a hospital. Included for comparison are results obtained by a standard air-sampling method.

In experimental use of the method of sampling airborne microorganisms by an electrostatically charged rod, the findings are as follows. (i) The amount of rubbing seems to have very little effect on collection, provided the whole surface has been charged. (ii) The number of aerosolized microbiological particles collected depends upon the concentration of these particles in the atmosphere and the effective electrostatic charge on the sampler during the sampling period. (iii) Firm rolling, with gentle pressure, six or eight times across the agar surface in the petri dish will assure an even distribution of isolated colonies, and nearly all the organisms collected will be removed from the rod.

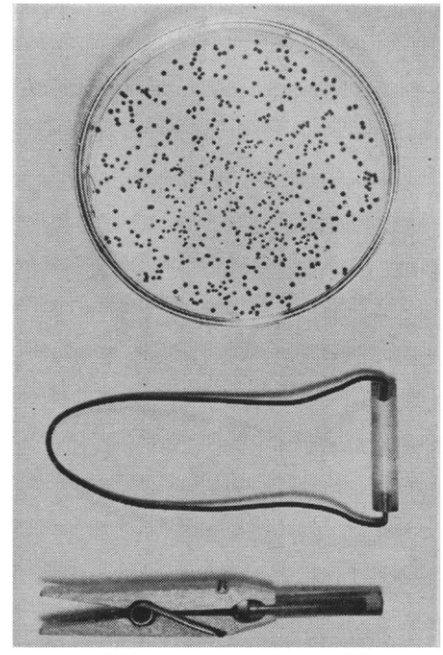

Fig. 1. Materials required for electrostatic rod sampling and a rolled plate showing isolated colonies of *Serratia marcescens*.