8271 P

Detection of Ovulation in the Intact Rabbit.*

H. S. BURR, R. T. HILL, AND EDGAR ALLEN.

From the Yale University School of Medicine, New Haven, Conn.

The determination of the electrical characteristics of living systems has been severely limited by the nature of the measuring devices available. During the past year and a half, one of us (H.S. Burr), with the help of C. T. Lane of the Physics Laboratory, has developed a vacuum tube potentiometer which is stable, draws almost no current from the living system and is independent of inter-electrode resistance up to one megohm. With this instrument, it is possible to record accurately minute voltage changes in living systems under a wide variety of circumstances. Furthermore, with the aid of L. F. Nims of the Department of Physiology, reproducible silver-silver chloride electrodes have been made, by means of which many artefacts have been eliminated.

Students of reproduction have long been searching for some external sign of ovulation in order to accurately place this event in the time sequences of the oestrous and menstrual cycles, and for use in dating and controlling conception. Ovulation was not actually observed until 1928. Walton and Hammond[1] first described this process in the rabbit. This animal was chosen for it has long been known that the rabbit ovulates about 10 hours after mating. To extend and reexamine the observations of Walton and Hammond, a moving picture of ovulation in the rabbit has just been completed.[2] This film showed the process of ovulation to be truly explosive in nature and led us to believe that such a rupture should be accompanied by electrical changes of sufficient magnitude to be measurable with the above potentiometer.

Putting this to test, it has been possible to read differences in electrical potential in the following way. Rabbits were mated and approximately 6 hours later were surgically anesthetized with sodium amytal. The abdominal hair was shaved and the animal placed on an operating board. A salt bridge leading to a silver-silver chloride electrode was placed on the abdomen. Another salt bridge led from a glass cannula in the vagina to another silver-silver

* Aided by a grant from the Research Funds of the Yale University School of Medicine.

1 Walton, A., and Hammond, J., *Brit. Exp. Biol.*, 1928, **6**, 190.

2 Hill, R. T., Allen, Edgar, and Kramer, T. C., *Anat. Record*, 1935. In press.

chloride electrode. Leads from the 2 electrodes were connected to the instrument. Then observations were made of changes in electromotive force preceding and during the known period of ovulation.

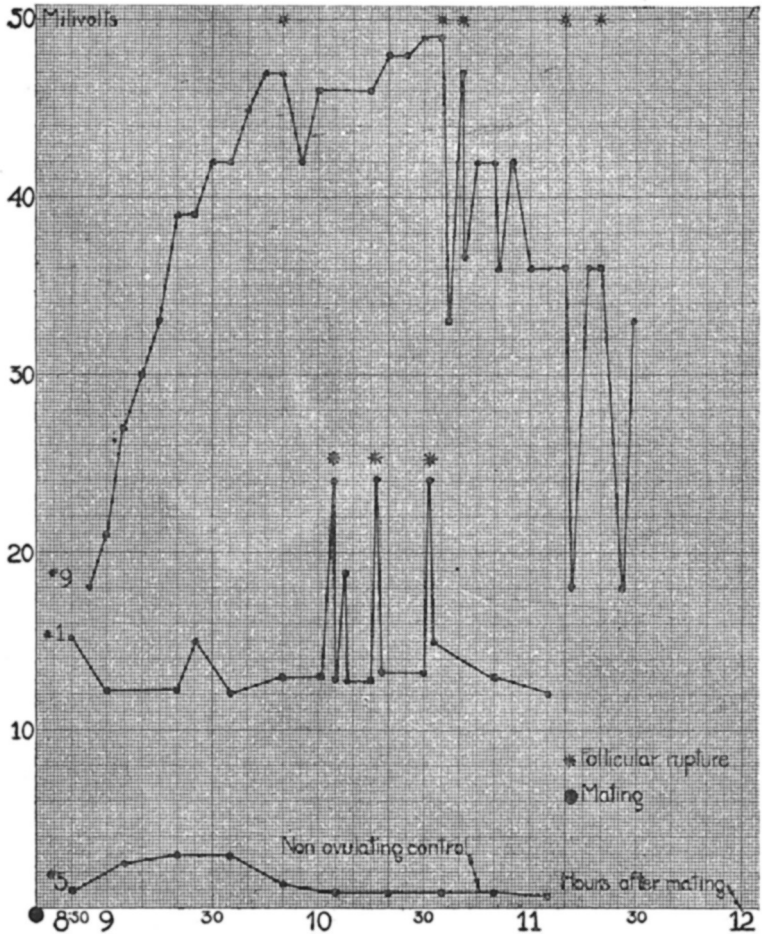

FIG. 1.
Voltage changes in the intact rabbit during follicular rupture.

Readings taken previous to the eighth hour after mating established a fairly uniform base line. Subsequently, a distinct but gradual rise from the base line occurred. In the first rabbit, as the ninth hour after mating approached, a sharp rise of potential occurred which was 4 to 5 times greater than the control variation. Twelve minutes later a similar change was repeated. A third rapid rise and fall occurred 17 minutes after the second surge. Follow-

ing these records examination of the ovaries at laparotomy showed 3 rupture points, 2 in one ovary and one in the other. In rabbit No. 3, during a 5 hour period, 5 rises in electrical potential were recorded and 5 ruptured follicles were found in the ovaries. In rabbit No. 6, observed for 3½ hours, one peak was recorded and a single follicle had ruptured.

The increase in voltages recorded during ovulation have varied from 7,000 to 20,000 microvolts; variations in the non-ovulating control were from 500 to 2500 microvolts.

In order to determine the exact relationship between the voltage surges and follicular rupture, 3 attempts have been made to record the electrical changes while the ovary was under direct observation. The first 2 attempts failed because the rabbits did not ovulate while under observation and no voltage surges appeared. The third attempt (rabbit No. 9) was successful. Distinct but gradual rises from the base line occurred coincident with observed enlargement of the follicles during the hour preceding the first rupture. Usually sharper rises were noted during the final rapid distension just before rupture. Immediately following the rupture of the follicles, the voltage dropped to the vicinity of the base line.

Five non-ovulating control rabbits observed from one to 11 hours failed to show these sharp rises. In all animals observed to date there has been an exact correlation between the number of surges in electrical potential and the number of follicles ovulated.

These findings suggest that with the aid of this new instrument it is possible to determine with great certainty in the intact animal the time and duration of ovulation, the instant of follicular rupture and the exact number of ovulations. These studies are now being extended to other animals, including primates, and to an analysis of the factors responsible for the voltage changes.