chopped with what is effectively a cold chopper, and it also receives 40 mW of power from the c.w. laser at the frequency of interest. The detector is followed by a high radiofrequency amplifier broad banded from 10 to 600 MHz, which amplifies the beat signal between the infrared sources. This device is then sensitive to radiation $\pm$ 600 MHz ($\pm$ 0.02 cm^{-1}) from the laser with the exception of a narrow central gap. Providing in the absence of the emitter gas the source seems to be appropriately cold, a condition ensured in the laboratory by a cold surface beyond the back window of the sample cell, appropriate reference levels may be set and calibration provided.

The gas under study must, of course, emit at the frequency of the laser. Using a CO_2 laser at 1,109 cm^{-1} (9.02 μm) for SO_2 samples at room temperature, the emission was as little as 10^{-2} atm cm for the product of the partial pressure of SO_2 and the cell length. For ethylene at 950 cm^{-1} (10.53 μm), the figure was 5×10^{-5} atm cm in the presence of an atmosphere of nitrogen in each case. There is little doubt that these figures could be appreciably improved with tunable lasers to ensure operation at the peak of the gas line and also if the gas to be detected formed a major component of the sample so that lower pressures could be used.

Oestrogen and progesterone binding

from our
Steroid Biochemistry Correspondent

It is well established that the steroid hormones oestrogen and androgen bind to specific receptor proteins in mammalian reproductive tissues. Binding of progesterone and receptors for it, however, have been more difficult to demonstrate. In rat uterus the progesterone binding protein seems to be the same as the corticosteroid-binding globulin of rat plasma. In guinea pig uterus, however, a progesterone-binding protein (not corticosterone-binding globulin which has only a low affinity for progesterone in this species) is easier to demonstrate.

Two types of binding for oestrogens and androgens exist in the mammalian reproductive tract; one has a high affinity and a limited number of binding sites and, conversely, the other has a low affinity and an unlimited number of binding sites. Progesterone binding in the guinea pig uterus seems to follow the same pattern.

The presence of progesterone receptors has been revealed mainly by sucrose gradient centrifugation. As in the case of uterine oestrogen receptors, two components seem to exist; one has a sedimentation coefficient of 6.7S and the other has one of 4–5S. In addition to sucrose gradient centrifugation which measures directly the concentration of binding protein, binding of progesterone can be shown by simpler methods involving *in vitro* measurements of bound progesterone after removal of free hormone with adsorbents (Freifield *et al.*, *Steroids*, **23**, 93–103; 1974; Atger *et al.*, *Enclocrinology*, **94**, 161–167; 1974).

In both rats and guinea pigs these authors found that treatment with oestrogens increased the uterine binding of progesterone. In the guinea pig the increase began within 4 to 12 h and after 4 days the concentration of high-affinity binding sites per cell showed a ten-fold increase; no further increase occurred if treatment was continued for up to 2 weeks. On stopping oestrogen treatment, binding activity declined with a half life of about 3 days which suggests that the progesterone receptor is a relatively stable protein but that it is dependent on oestrogen stimulation. Further evidence for oestrogenic control of the receptor is the change in the binding protein during the oestrous cycle; the concentration of binding sites is highest at pro-oestrus when oestrogen production is high and the receptor is present mainly in the 6.7S form and lowest at dioestrus when more of the 4–5S receptor is present.

The vagina and uterine cervix of guinea pigs also contains a receptor protein which can bind progesterone. The properties of the receptor in these tissues are similar to those of the uterus although the vaginal receptor seems to be much more dependent on oestrogen than the uterine one.

This effect of oestrogen seems to be antagonised by progesterone. Administration of progesterone to oestrogen-treated castrated guinea pigs caused a rapid decline in uterine binding which reached a minimum by 6 h and which had not increased again by 24 h. The loss of binding activity was not apparently caused by a failure of labelled hormone to exchange with the endogenous bound hormone under the conditions of the test. Similarly, during pregnancy in the guinea pig, progesterone binding in the uterus is low and this may be due to the high circulating levels of progesterone.

In most circumstances synergism exists between oestrogen and progesterone and progesterone only produces a biological response in tissues which have been exposed to oestrogen. This is explainable if oestrogen stimulation is required for the synthesis of progesterone binding protein. The decreased binding activity on progesterone administration, even when oestrogen is present, might suggest that the action of progesterone is self-limiting—once a sufficiently high level of progesterone in plasma is attained, binding of the hormone in the uterus is decreased. More work is, however, required to determine these relationships.

Anomalous Kapitza resistance

from Peter V. E. McClintock
Condensed Matter Correspondent

The Kapitza resistance between liquid He II and a solid exhibits anomalous behaviour near 2 K according to a report in *Physical Review Letters* (**32,** 658; 1974) by Cheeke, Hebral, Richard and Turkington of the Centre National de la Recherche Scientifique (CNRS) at Grenoble.

When heat is passing from one solid to another one made of a different material there is always a jump in temperature across the interface which separates them. The phenomenon can be accounted for reasonably well in terms of an acoustic mismatch theory: by analogy with the partial reflection of light which occurs at an interface between two materials with different refractive indices, there is a partial reflection of the lattice waves (phonons), which constitute the flux of heat, as they try to pass between two materials in which the velocity of sound is different. The temperature discontinuity caused by this reflection of phonons is proportional to the heat flux, the constant of proportionality being known as the thermal, boundary resistance.

The velocity of sound in liquid helium is a factor of one twentieth smaller than in most solids, so that the thermal boundary resistance, between liquid helium and a solid would be expected to be particularly large. In fact, the boundary resistance, called in this case the Kapitza resistance after its discoverer, is indeed relatively very large, although, for temperatures above 1 K not nearly as large as would be predicted on the basis of the acoustic mismatch theory. There is, as yet, no really satisfactory theory of the Kapitza resistance above 1 K.

In all previously reported experiments, however, the phenomenon has seemed to behave linearly: that is, the temperature discontinuity ΔT has always been directly proportional to the heat flux Q, within experimental error. The CNRS group has measured, to a high precision, ΔT between copper or lead and liquid helium. They find that, although a plot of ΔT against Q yields an accurate straight line at small values