inwards during the processes associated with excita-
tion-contraction coupling is derived from super-
fi cially-located sites within or close to the cell mem-
brane. The hypothesis that the cardiotimuliant effect
of adrenaline results from a cell-membrane located
action is supported by the finding that its positive
inotropic effect is abolished by processes which
render the cell membrane freely permeable to Ca\(^{2+}\).

19. RELATIONSHIP BETWEEN CARBOHY-
DRATE AND FAT METABOLISM IN THE
NORMAL AND DIABETIC DOG HEART IN
VIVO
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Randle and his colleagues have described the relation-
ship between glucose and fatty acid metabolism,
the so-called glucose fatty acid cycle, whereby fatty
acid oxidation inhibits glycolysis at the level of PFK
and pyruvate dehydrogenase. This concept has
derived from in vitro work and until recently had not
been confirmed in vivo. Experiments were therefore
carried out on anaesthetized beagle dogs weighing
8–10 kg. The coronary sinus was catheterized under
radiological control and simultaneous arterial and
coronary sinus blood samples were taken throughout
all experiments. The elevation of free fatty acid levels
from infusion of intralipid and Heparin inhibited
glucose lactate and pyruvate lactate by the dog heart.
The inhibition of lactate and pyruvate uptake was
reversed by sodium dichloroacetate, a substance
which activates pyruvate dehydrogenase. Similar
data was obtained on dogs rendered diabetic with
Alloxan. The significance of these results will be
discussed.

20. WATER VAPOUR EXCHANGE WITHIN THE
LUNG
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Expired air contains more water vapour than inspired
air, though the water content of the latter may vary
within very wide limits. How far expired gas represents
alveolar gas remains a matter for discussion in respect
of oxygen and carbon dioxide, but there is much
evidence to suggest that expired gas is in no way
representative of alveolar gas in respect of its water
vapour content.
There is a tacit assumption that the water vapour
tension within alveoli is the vapour tension of lung
water at body temperature. Since lung water contains
solutions this tension will be somewhat less than the
value for distilled water, but only by about 0.5 torr
so that at 37°C body temperature the expected tension
would be 46.5 torr.
Measurements made of expired water vapour
tension indicate values of less than 40 torr, equivalent
to a temperature of 33°C at full saturation. Direct
measurements of temperature confirm this value.
In the present study water vapour tension was
measured directly with a Quadropole mass spectro-
meter (20th Century Electronics Q806) at a mass/
charge ratio of 18.
Twenty-two normal subjects were studied, their
mean end tidal water vapour tension being 37.9 torr
(male subjects, 38.6±3.3 torr (s.D.); female subjects
37.1±3.3 torr). At the end of a vital capacity this
increased to 39.7 torr (males, 40.4±2.8 torr; females
38.7±2.8 torr), and did not alter when preceded by a
10 s breath-hold.
Inspired water vapour tension was then increased
to about 80 torr when the end tidal tension rose from
45.4 torr in the first breath to 47.7 torr in the third
breath. A vital capacity in the first breath yielded a
value of 48.7 torr not increasing with repetition.
Thirdly, the ambient air was warmed to 80°C and
the end tidal and end expiratory tensions measured.
These did not differ significantly from those breathing
ambient air at 23°C.
The explanation of these observations is thought
to be as follows: during inspiration of water vapour
at a tension of about 10 torr, water vapour is added
so that in the alveoli it has a tension around 47 torr.
Water evaporates from the fluid lining the bronchial
tree and requires the latent heat of change of state and
also the heat required to raise the inspirate to body
temperature. The mucosal surface of the bronchi is
thereby cooled and a gradient of temperature then
exists down the airways from ambient in the mouth
to core temperature in the alveoli. The anatomical
site of this gradient is undefined.
On expiration the gas saturated at core temperature
is cooled by the mucosal surface which is itself warmed
by latent heat of condensation and by temperature
difference.
Thus the airways retain both heat and water vapour
during ventilation. During breathing of air heated to
80°C the subjective sensation is of coolness, because
of the large heat transfer resulting from latent heat of
evaporation.
The flux of water vapour occurring at an undefined
part of the airways and of the order of 35 torr has
important consequences for the measurement of other
gases during the course of an expiration.

21. THE EFFECT OF VARIATION IN ALPHA 1-
ANTITRYPSIN PHENOTYPE UPON THE INCI-
DENCE OF RESPIRATORY ILLNESS IN A
WORKING POPULATION
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An increased liability to chronic obstructive lung
disease occurs in the few individuals who have
inherited severe alpha 1-antitrypsin (alpha 1-AT)