Comments on "Errors in Infrared Thermometry and Radiometry"[1]

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Lowry and Gay (1970) claim to have discovered a previously "unrecognized error" in infrared thermometry, arising from neglect of *multiple* reflections of radiation from surroundings and surface viewed. They state that Buettner and Kern (1965), Fuchs and Tanner (1966) and Lorenz (1966) have all only considered the reflection from the surface viewed of that radiation *emitted* by the surroundings. They additionally propose to eliminate this error by the measurement of $L\uparrow$ and $L\downarrow$, whereby $L_s\uparrow$ or T_s may then be obtained from Eq. (9) in their paper, i.e.,

$$L\uparrow - r_s L\downarrow = L_s\uparrow.$$

Our first comment deals with the statement that prior work in infrared thermometry has not considered $L\downarrow$ to be composed of multiple reflected radiation from surroundings in addition to primary emitted radiation. This is just not so. It should be clear from the writings of all of the investigators cited by Lowry and Gay that they would include in $L\downarrow$ both emitted and reflected radiation, if indeed multiple reflections were present. They have apparently failed to recognize that Eq. (9) in their paper is identical to Eq. (4) in Buettner and Kern (1965), Eq. (3) in Lorenz (1966), and Eq. (12) in Fuchs and Tanner (1966). Moreover, Fuchs and Tanner have outlined a specific procedure for obtaining the radiation from the surroundings, which will result in a measurement of $L\downarrow$ at the level of the surface viewed, as modified by certain filter functions of the infrared thermometer employed. In fact, if experimental radiometric means are used to obtain the radiation from the surroundings, it is *impossible* to make the error suggested by Lowry and Gay, for it would imply that the radiometer could discriminate between emitted and reflected radiation of otherwise potentially identical characteristics.

Our second comment deals with the magnitude of multiple reflections between a surface and the atmosphere. In re-deriving the well-known expression for the exchange of radiation between two infinite parallel planes, Lowry and Gay have treated the atmosphere as an opaque wall. That is, as may be verified from their calculations, they assume $r_b = 1 - \epsilon_b$. All evidence, however [see Fleagle and Businger (1963) and Gates (1965) as examples], is to the contrary. In reality, $r_b = 1 - \epsilon_b - t_b$, where t_b is the transmittance of the atmosphere, which over the range of wavelengths pertinent to most infrared thermometry work ($\sim$8–15 μ) is by far the dominant term. Although Lowry and Gay state that they did not take into account the restriction of longwave radiation to certain spectral bands, they should have realized that this consideration is of the utmost importance to infrared thermometry. Data from Gates (1965), for instance, indicate that the reflectance of the clear sky for radiation over the spectrum 8–15 μ can be at most only a few percent, if it has any non-zero value at all. In the other extreme of a complete overcast, r_b must also be extremely small, due to the near blackbody characteristics of dense clouds. Thus, it is questionable whether there even exist any significant multiple reflections between the ground and the atmosphere in this specific waveband. If there are any, they are much too small to perceptibly affect infrared thermometry work; and even if they were larger, it has long been standard procedure to make measurements in such a way as to include them.

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