$$E'_0 = E_0 + \frac{RT}{F} \ln (H^+)$$

which becomes, at 23°C.,

$$E'_0 = 0.7007 + 0.05872 \log (H^+)$$

Aside from its theoretical interest, this new arrangement is open to several practical possibilities. Of these 2 may be mentioned. First, in the determination of the oxidation-reduction potential of many quinone-hydroquinone systems, the formation of quinhydrone-like complexes often introduces difficulties in mathematical analysis of the results. With the present arrangement there is no danger of the formation of such complexes. Second, when the 2 components of an oxidation-reduction system to be studied are in separate vessels, the pH values of these two solutions do not have to be the same. Variation of the pH of only one solution at a time may facilitate the study of the dissociation constants of either component.

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Effect of Carbon Arc Radiation on Bone Healing.

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Ultraviolet radiation and the addition of irradiated materials to the ration are powerful aids to the absorption and utilization of calcium and phosphorus. That such radiation and vitamin D (irradiated ergosterol) induce beneficial effects in the healing of bone fractures is supported by some[1] and denied by others.[2]

This report deals with the results of a study of 38 experimental fractures of the fibula in 25 dogs, and of 80 fractures in 80 albino rats. An open osteotomy technique similar to that of Lindsay and Howes[3] was used. All the rats were of the same size and age and with like fractures. They were grouped for comparison according to the type and amount of carbon arc radiation received during the healing periods. The fractures in the dogs were paired for comparison only when 2 were proved to be very similar or identical

[1] a. Knoflach, I. G., *Wien. klin. Woch.*, 1928, **4**, 739.
b. Cuthbertson, D. P., *Biochem. J.*, 1930, **24**, 1244.

[2] a. Coulter, J. S., and Smith, E. M., *Radiology*, 1931, **16**, 737.
b. Swart, H. A., *J. Bone and Joint Surg.*, 1930, **12**, 360.

[3] Lindsay, M. K., and Howes, E. L., *J. Bone and Joint Surg.*, 1931, **13**, 491.

by means of roentgenograms: In the same dog serially (12 cases) and in 2 dogs of similar body build and size (7 cases). Measured amounts of carbon arc radiation were given to the dogs during the healing period of one of each pair of fractures, while the other served as a control in 15 of the 19 pairs (38 fractures).

Roentgenography was the criterion used for following the healing process. In the rats the percentage healed per group after a certain length of time, was ascertained, while in the dogs the total length of the healing process in days was found. During the total healing period allowed the rats (about 10 weeks) 73.9% of the animals irradiated with "A" carbons (having received 550 gm. cal. per sq. cm. with an average distribution of 3.6% ultraviolet, 32.2% luminous, and 64.2% infrared). 26.9% of those irradiated with "C" carbons (having received 290 gm. cal. per sq. cm. with an average distribution of 5.0% ultraviolet, 11.5 luminous, and 83.5 infrared), and 41.3% of the controls healed. Omitting 2 very abnormal healing periods in the dog work, the average healing time was 55.7 days, or 3.7 days shorter when the animals were irradiated, than when they were not (59.4 days). Both "A" and "C" carbons (see average distribution above) were used on the dogs. The daily amounts given varied from 5 to 28 gm. cal. per sq. cm. with a mean of 18. The total amount varied with the length of the healing period for they were irradiated until healed.

It made little or no difference in the healing time whether the irradiated or control fracture was the first followed, thus the rapidity of healing was not a function of the duration of the experiment. There was no demonstrable correlation between serum calcium and inorganic phosphorus and length of healing time.

Why the healing process of the rats irradiated with "C" carbons was actually retarded is of considerable interest. Although the percentage of ultraviolet emitted by the "C" carbons is greater than for the "A", the total amount in this work was never as much. The "C" carbon has been shown to emit a larger percentage of the short ultraviolet, erythema-producing wave lengths which lead to more marked superficial vasodilatation and possibly increased volume flow of blood. Jones and Roberts[4] believe that an increased flow of blood is detrimental to a bone healing process.

Thus it may be said that in our hands the doses of carbon arc radiation given were of no outstanding importance in accelerating the healing of fractures in dogs and the effect varied with the type of radiation in the rat work.

[4] Jones, R. W., and Roberts, R. E., *Brit. J. Surg.*, 1933-1934, **21**, 461.