a heavy fibrous coating. That part of the coat against the inner aspect of the envelop came from, and completely surrounded, the intestinal segment. A considerable amount of slightly turbid, serofibrinous fluid bathed the envelop within these walls. The envelop was loose, much looser than at first because the gut was greatly narrowed. At 5 days (with injection), the cross-sectional area of the lumen was about 6% of normal and, from the 8th day on, the lumen was fully collapsed. At 8 days, water could trickle easily through; but at 10 days, it had to have at least 8 to 12 cm. H_2O pressure to get through at all, and at 20 days, it failed entirely to pass, even with pressures as high as 60 cm. H_2O. Cross-sections always showed the walls of the enveloped segments to be much compressed and the mucous and muscular layers to be thickened. The mucosa was closely and deeply folded. The muscularis was easily separable from the capsule; and neither mucosa nor muscularis presented evidence of inflammation, necrosis, or other cellular change. The capsule was sharply demarcated and was composed of young fibroblasts, loosely arranged in the earlier specimens and compactly laid in the later ones.

During the first few days, the intestinal narrowing was probably due to the pressure of the encysted surrounding fluid, perhaps assisted by local muscular spasm; but thereafter it was certainly maintained and probably also advanced considerably by the fibrous capsule.

7521 P

Determination of Oxidation-Reduction Potential with Double Electrodes.

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According to the electrode equation,

$$E = E'_0 - \frac{RT}{nF} \ln \frac{[S_r]}{[S_0]}$$

the oxidation-reduction potential, E'_0, of a given oxidation-reduction system at a given pH can be calculated from the potential observed, E, when a blank noble metal electrode is placed in a mixture in which the ratio of the concentration of the total reductant, $[S_r]$, to

that of the total oxidant, $[S_o]$, is known. For the benzoquinone-hydroquinone system, the equation becomes

$$E = E'_o - \frac{RT}{2F} \ln \frac{[\text{hydroquinone}]}{[\text{benzoquinone}]}$$

Theoretically the potential is independent of the total concentration of the two components of the system and independent of the size of the electrode.

The mechanism through which the electrode responds to the composition of the mixture is not clear, but in a homogeneous solution the number of the reductant particles acting upon any unit area of the electrode must bear to the number of the oxidant particles acting, the same ratio as that in the solution. Slight difference in the uniformity of the electrode surface should make no difference in the electrode behavior. Assuming the surfaces of the electrode on both sides to be identical, we should obtain the same potential, if we could separate the 2 species of particles and place only pure species on each side of the electrode. Similarly if we could split one electrode into 2 identical halves and immerse them separately in 2 solutions, one containing the pure reductant and the other, the pure oxidant, the potential observed should not differ from that observed when the original electrode is placed in the solution made by mixing the 2 pure solutions.

In the present experiment, this hypothesis was tested using the benzoquinone-hydroquinone system. Instead of splitting one electrode into 2 identical halves, 2 electrodes as nearly identical as possible were prepared. One of them was placed in a solution of benzoquinone of known concentration while the other was placed in a solution of hydroquinone of the same or different concentration. Both solutions were prepared with the same buffer mixture. The 2 electrodes were connected to a common potentiometer lead outside the solution. The results as summarized in Table I are in agree-

TABLE I.
Relation of oxidation-reduction potential to pH of the benzoquinone-hydroquinone system. Temperature: 23° C.

pH	E'_o observed	E'_o theoretical	Difference
1.08	.639	.637	+.002
2.02	.583	.581	+.002
3.01	.523	.524	—.001
4.00	.463	.466	—.003
4.98	.409	.408	+.001

ment with the hypothesis. In the table the theoretical potential was calculated from the equation,

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

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.

7522 P

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

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