Comments and Communications

Religion and Higher Education

THE letter of John R. Sampey, published in the September 28, 1951, issue of SCIENCE, requires some qualifications concerning the use of the word "religion." Indeed, on the basis of the references quoted, it appears that not all church-controlled colleges do contribute significantly to the training of scientists. Among the 50 institutions listed by Knapp and Goodrich (*1*) none is related to, or controlled by, one of the oldest Christian religious groups. Table 2 in the same article shows that this same religious group controls colleges that have the lowest production of scientists.

Furthermore, the studies of R. K. Merton (*2*) and D. Stimson (*3*) show that the growth of science in the seventeenth and eighteenth centuries was not equally helped by the different religious traditions of the time.

It seems unwarranted to conclude from such observations that "religion" in general goes hand in hand with science. Before anyone can make such a generalization, many more studies will be required to evaluate the influences of the different religious traditions on the development of the scientific method.

G. NAHAS

Department of Physiology
The Medical School
University of Minnesota

References

1. KNAPP, R. H., and GOODRICH, H. B. *Science,* **113**, 543 (1951).
2. MERTON, R. K. *Social Theory and Social Structure.* Glencoe, Ill.: Free Press (1949).
3. STIMSON, D. *Bull. Inst. History Med.,* III, 321 (1935).

Rejuvenation Re-evaluated

ACCORDING to a dispatch dated Sept. 4, 1951, from Lausanne, Switzerland, Serge Voronoff—who, at the height of his career, was known as "The Great Rejuvenator"—died at the age of 85, not of senility, to be sure, but after suffering two heart attacks, the second of which was fatal. The Russian-born director of experimental surgery at the Collège de France, Paris, had once gained considerable fame by attempting to graft testicular and ovarian transplants from anthropoid apes into human beings.

Thanks to such a "gerontologic intervention," one of my elderly professors at the University of Nancy, it was rumored, had been retained on the faculty beyond retirement age. He used to report to work daily astride a bicycle, "so as to restore circulation in the parts concerned," he would say. Even the ex-Kaiser's sister, who had become infatuated with a much younger commoner, the waiter Zoubkov, gladly submitted to a *greffe* at Voronoff's hands.

The effect of such attempts were never very lasting, but now that surgical science has advanced, and we understand more about the factors influencing tissue growth and cicatrization, and about the role of hormones, it is permissible to wonder whether the interspecific incompatibility could be overcome and the withering or resorption of transplants avoided. I still feel that Voronoff need not have met with so much skepticism and sarcasm when he arrived in this country shortly before World War II. He returned to Europe a broken and almost forgotten man. Perhaps I owe it posthumously to his memory to express my faith in the validity of some of his *intra*specific animal experiments, at least. These were undertaken in collaboration with his brother Georges and with Dr. Dartigues, past president of the Société des Chirurgiens de Paris (*1–4*). As a student, I was privileged to witness the operative technique and to see several of the progeny that had been sired by previously infertile males.

The Voronoff method applicable to animal husbandry consists in grafting crescent-shaped portions of, say calf or lamb testicle into the testes of a sexually worn-out male *of the same species* (Fig. 1)—

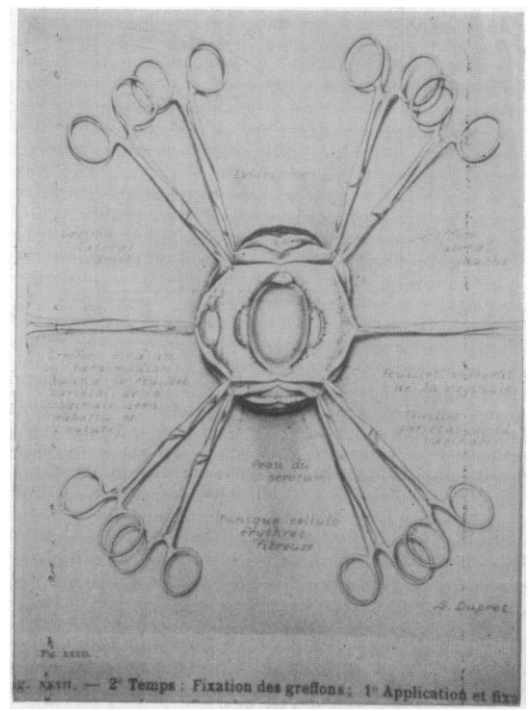

FIG. 1.

i.e., bull, ram, or other senile sire to be rejuvenated. The scion stimulates the production of testosterone and of viable spermatozoa by the subject's own testicular tissue. There is a detailed account of a number of more or less significant experiments that were performed in France, Italy, Algeria, and Brazil during the early 1920s in one of Voronoff's out-of-print publications that I am lucky enough to possess (*5*). We should not forget that the reported experiments were made 30 years too soon, when the expense involved

must have appeared excessive in relation to rejuvenating a bull for only a breeding season or two of effective service. Not so in our own era of artificial insemination and of egg implantation into foster mothers, when the reproductive power of a progenitor is spread over a much larger herd or flock.

Voronoff's method should prove of especially timely importance for prolonging the usefulness of high-priced livestock, which, shipped abroad under the various ECA, Point Four, and private (e.g., IBEC) programs of aid to underdeveloped countries, may become prematurely sterile in an adverse climatic environment.

JOSEPH Y. PEARY
Biology Department, Alderson Broaddus College

References

1. VORONOFF, S. Greffes ovariennes. Presented before the 25th Congr. franç. chir. (1912).
2. ———. Greffes testiculaires. Presented before the 28th Congr. franç. chir. (1919).
3. RETTERER, M., and VORONOFF, S. *La glande génitale mâle.* Paris: Doin (1921).
4. DARTIGUES. *Greffes testiculaires du singe à l'homme.* Paris: Doin (1923).
5. VORONOFF, S. *La greffe animale: Ses applications utiles au cheptel.* Paris: Doin (1925).

Potentiometric Measurements in Colloidal Systems

THE letter by Karol J. Mysels (*1*) in some ways clarifies the issues raised by Jenny *et al.* (*2*), yet in other respects it may cause further confusion. Dr. Mysels at the time of writing probably did not have available the detailed criticisms by Marshall (*3*), and by Peech and McDevitt (*4*) of a paper by Coleman, Williams, Neilson, and Jenny, entitled "On the Validity of Interpretations of Potentiometrically Measured Soil pH" (*5*).

It seems now to be agreed that a proper criterion as to the condition under which the KCl liquid junction potential is small is that the KCl solution shall be concentrated in comparison with the colloidal system (all contributing ions included). Thus, since saturated KCl (3.5 *M*) bridges are normally employed, we may dismiss from consideration all colloidal systems having ionic concentrations below, say, 0.1 molar. More concentrated systems, such as beds of granular cation exchange resins, call for special consideration. The Teorell-Meyer-Sievers theory can well be applied to such cases when a proper steady state has been reached (see below).

As Mysels points out, a crucial factor in concentrated colloidal systems is the contact with the KCl bridge. However, he seems to have missed one important aspect; namely, that the salt solution should make contact with a representative cross section of the system as a whole. Valid potentiometric interpretations depend greatly on this condition being fulfilled. Different results may readily be obtained in coarse granular systems, depending upon the kind of contact attained.

This was well illustrated here some months ago in an experiment performed by Wm. J. Upchurch. A column of 60-mesh cation exchange resin IR 120 (potassium-saturated) was supported on a sintered glass filter disk. The pores of the latter were filled with saturated KCl solution, with a reservoir under the filter connected to a side tube. By raising the level of KCl in the side tube it could be brought into contact with a complete cross section of the exchanger. After this was done, a saturated calomel electrode was inserted in the side tube. Then a second saturated calomel electrode of the Beckman type was pushed into the upper part of the column of exchanger after the manner of Jenny *et al.* Thus we apparently had the simple system, Calomel | Sat. KCl | K Exchanger | Sat. KCl | Calomel, which of course should give zero potential under proper conditions. This Beckman type of electrode, however, furnishes KCl for the liquid junction by a very slow gravity flow down an asbestos fiber in a glass capillary. The conditions were evidently very far from ideal because a maximum potential of 35 mv was observed, which slowly came down to zero over a total time of 10 days.

When electrodes of improved design were employed, this time interval was greatly reduced; but any kind of small-bore, upturned tip that depends on diffusion to make contact requires hours for the true steady state to be reached. Granular systems thus require special design of the KCl junctions in order to give a truly representative contact in a short time.

Colloidal suspensions of particles $< 1\mu$ naturally do not cause difficulties of this order of magnitude. Nevertheless, instantaneous readings cannot always be relied upon, and the KCl should be given time to form a true boundary. In our experience 15–20 min amply suffice, where the KCl makes contact at the end of a well-defined tip of ½–2-mm cross section.

The "perched" potential at first obtained with the resin exchanger evidently includes the average work done in moving an ion from the granular system to a layer of water interposed between the KCl and the granules. Because the granular system contains water as well as resin, this "perched" value does not represent the total phase potential of the resin against water; it will be somewhat less, depending on the porosity.

Finally, as regards the potentials to be expected when saturated KCl bridges come into true steady state contact with concentrated colloidal systems, the Meyer and Sievers theory indicates relatively low values compared with the phase potentials and "perched" potentials just discussed. If the effective cationic concentration A of the resin continuous phase is taken as equal to that of the ions in saturated KCl, then the Donnan potential according to the Meyer and Sievers theory is about 12 mv. Higher values than this could only arise if A effectively exceeded 3.5 *M*, and in view of the distribution of ionizing sites in exchange materials this would be barely possible. The liquid junction potential in the interior of the resin is proportional to the difference in mobility between the ions of the salt and can therefore be made