protein fractions were changed but slightly by the presence of calcium in the buffer. This change in mobility of the leading component can be explained by assuming that calcium combined with this component and thus changed the charge of the protein molecule. The result was a marked reduction in the mobility of component 1.

Previous evidence has shown that the rise in the nondiffusible calcium of chicken serum caused by the administration of diethylstilbestrol was paralleled by a rise in two of the electrophoretic components (*5*). This extra binding ability may be attributed to the leading, phosphorus-rich component. Utilizing buffer solutions containing Ca^{45} and an electrophoretic cell modified to determine its activity, we are now investigating the distribution of calcium in the various electrophoretic components of chicken blood serums. A more detailed discussion of this investigation is in preparation.

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8. This work was aided by a research grant from Eli Lilly Co., Indianapolis, Ind. This paper is contribution No. 515, department of chemistry, Kansas Agricultural Experiment Station. This paper is also a portion of a dissertation to be presented by A. T. E. as partial fulfillment of the requirement for the Ph.D. degree.

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Agglutinating Strains of Trypanosomes Obtained with Oxophenarsine

In the course of producing oxophenarsine-resistant strains of *Trypanosoma equiperdum,* we observed the development of strains with a marked tendency to agglutinate when infected blood containing them was diluted 1:100 with physiological saline in a red-cell-counting pipette at 20° to 30°C (*1*).

The agglutinated masses of trypanosomes, which varied in size up to clumps that contained hundreds of organisms, were so firmly bound together that individual cells did not break away, although they were actively motile. When they were first seen, it was thought that the smaller agglutinated masses represented a failure of cell division, but further observations of the trypanosomes in warm saline (38°C) and in stained, dried blood films proved that the clumps were formed *in vitro*. When warm saline was used and the pipette and counting chamber were warmed to 38°C, the agglutinating tendency was greatly weakened and reliable counts could be obtained, something quite impossible at room temperature. Furthermore, the clumps were dispersed when the pipette in which they were contained was warmed in an incubator at 38°C. This behavior is reminiscent of cold hemagglutination, and cold hemagglutinins have been observed in trypanosomiasis (*2*), but there was no evidence of hemagglutination with serums from mice containing our strains, even at 4°C.

The unmodified strain from which the agglutinating strains were derived was observed in saline at 4°C, and no evidence of agglutination was found. At room temperature the unmodified strain formed evenly dispersed suspensions that were easily counted in a hemocytometer and they showed no tendency to stick together.

All the agglutinating strains have appeared in mice treated with subcurative doses of oxophenarsine when the infection was at levels of 50,000 to 1 million trypanosomes per cubic millimeter of blood. The first strain was obtained on the second day after treatment was started, and other strains developed up to 2 mo after treatment was started. During this period the dose was increased until a strain with 80-fold increased resistance to oxophenarsine was obtained.

In the first strain the agglutinating characteristic persisted in a highly developed form through at least eight passages that were made at 2- to 3-day intervals in untreated mice, but between the 8th and the 17th passages it almost disappeared, being replaced by a predominately nonagglutinating strain. It was possible, however, to recover partially the agglutinating characteristic by centrifuging diluted, infected blood and using the sediment to infect other mice.

On two out of two trials the agglutinating component was destroyed by treating infected mice with somewhat larger doses than the ones that were given just before the strains appeared; their relapse strains were nonagglutinating. Blood obtained from a mouse carrying an agglutinating strain but cleared of trypanosomes by treatment with oxophenarsine did not agglutinate the normal strain. An agglutinating strain was passed to rats, and the characteristic remained well developed in this species.

Although the agglutinating tendency seemed to be related to drug treatment, it was not difficult to obtain highly resistant strains that were completely free of the characteristic by always maintaining several substrains; this was because the incidence of the agglutinating characteristic was relatively low. Most of the mice were treated repeatedly, some as many as 10 times, without inducing any change other than a gradual increase in oxophenarsine resistance.

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Science, Population, and Arid Lands

It is becoming increasingly clear as world population soars to new heights that population pressure aggravates the struggle to maintain high living standards. The outcome of this struggle will depend not alone on available resources but also on the race between population increase and the research that makes resources more usable.

The world population is estimated to have doubled from 100 million to 200 million in the first 1000 years A.D., more than doubled from 500 million to 1200 million in the 200 years from 1650 to 1850, and again doubled from 1200 million to 2400 million in the century from 1850 to 1950. The curve of increase has been rapidly climbing, and if it is projected into the future it promises still higher increase rates.

With such increases, population pressures within densely populated areas are certain to push people into marginal, less densely populated areas. These are mainly the arid lands of the world, where lack of water is the critical factor in making them marginal or less usable in character.

It was shown at the Arid Lands Meeting in New Mexico in late April 1955 that arid zones occupy nearly one-third (32 percent) of the land surface of the earth, and that about 14 percent of the Americas was included. These lands are arid from a variety of causes but mainly because of the planetary wind patterns of the earth, which bring prevailingly dry winds to certain areas. Others lie in the rain shadow of mountains.

Rainfall on arid lands is usually inadequate to produce runoff (except quick heavy showers); hence, most water available in deserts comes in streams from distant mountains or regions of heavier precipitation. Such water, concentrated

in streams, usually requires manipulation by engineering to make it available for human use. Arid lands are especially subject to erosional damage when the sparse cover is disturbed by human use.

One such arid region lies in the southwestern United States. It is comprised of the Great Basin, the Colorado River System drainage, and the Rio Grande drainage areas. The streams in this region do not provide enough water to supply the needs of people who might fill the otherwise habitable portions of the area. The making of homes and communities, the development of mining operations, the needs in industrial uses, and water for irrigation of arid lands can be provided only in part, even with widespread storage and careful efficient use of the water inherent within the area. Much of the land will be doomed perpetually to nonuse or only partial use unless additional water supplies can be provided.

Additional sources of water might lie in the Columbia River Basin, the ocean, or perhaps the Mississippi River Basin. Technology is not far enough advanced at the present time to use the ocean. How long we will have to wait for this source, we do not know. Techniques are available for obtaining water from the Columbia and Mississippi rivers, but until costs of diversion and transmission become economical, they are not likely to be used.

A proposed national attempt to develop the Upper Colorado River for use of part of its waters in the interior states of Utah, Wyoming, Colorado, and New Mexico, an area very difficult to supply from other sources, is now before the Congress of the United States. This proposal unfortunately is being bogged down by diversionary tactics that miss the main point at issue: Shall the arid lands of the interior be made habitable and provide better distribution of dense populations, or shall they be doomed to remain arid with sparse populations?

These diversionary tactics include such questions as apportioning the water between the upper and lower portions of the basin, whether this or that dam site should be used, whether it will improve or ruin recreation, whether we are setting a precedent of invading a national monument, and various other minor matters. All conservation is ultimately directed toward supplying human wants to good advantage and in balanced proportions. Paul B. Sears [*Science* **121**, 5A (29 Apr. 1955)] has called attention to the futility of this political argument.

Would it not be better for the Congress to authorize the development of the river basin, determine the policy of water use, provide funds for operation, and refer minor items of dispute to some fact-finding scientific body for final adjudication, as Sears suggested? There, recommendations or decisions about these items could be made under calm, dispassionate consideration with minimum influence of such emotion-packed articles as "The Wiley and wasteful proposal of the Echo Park Dam" and the "The Echo Park Dam must be stopped." Perhaps even such a proposal as turning water from Yellowstone Lake through the divide into Snake River and diverting it into the Great Basin could be evaluated without the fury of emotional conservationists beclouding the issue.

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Measurement of Activity of Compounds Traced with Low-Energy Beta Emitters

Belcher has described (*1*) a 4π technique for measurement of the activity of β-ray emitters in absolute units. Unfortunately two successive extrapolations are involved—one to zero pulse discrimination, the other to zero source envelope thickness. These extrapolations bring about an uncertainty that is the larger, the lower the energy of the particles. We have thought that, for compounds traced with C^{14} and S^{35} dissolved under low concentrations in highly efficient liquid scintillators, a 4π geometry might, for all purposes, be considered as achieved without the enclosure of the sample in any foil whatsoever; the work reported here was meant to verify this hypothesis.

As a scintillation source we took a mixture of variable proportions of C^{14}-traced and inactive toluene to which was added terphenyl at a concentration of 5 g/lit and traces of α-naphthylphenyloxazole as a wavelength shifter, the emission of which coincides well with the sensitivity of our Electrical Musical Industries (E.M.I.) 6262 photomultiplier. The solution was introduced into a modified version (*2*) of our former sample changer (*3*). The pulses coming from the anode of the photomultiplier were fed through a 100 μμf condenser to our Atomic Instrument 1070 scaler with a 0.1-μsec resolving time; no amplification was required because of the particularly high multiplication factor of our light detector (5×10^8 at a potential difference of 160 v between the dynodes). The number of counts per minute is plotted against the tension applied to the phototube in Fig. 1*a*; the curve shows only an inflexion point at the expected value.

Rosenthal and Anger (*4*)—using C^{14}-labeled cholesterol dissolved in a 5 g/lit solution of terphenyl in xylene to which diphenylhexatriene was added as a wavelength shifter, a Du Mont type K 1177 photomultiplier, a laboratory-made preamplifier, cathode follower, and scaler the description of which is not given—found an effect similar to our own; they considered that it was caused by double-pulsing in their scaler. We have tested our own system with a generator giving pulses of 5-μsec duration and 10-v maximum amplitude at a frequency of 2 kcy/sec; no double pulsing was evidenced.

Wells (*5*), counting Co^{60} gamma rays with stilbene and an E.M.I. 5311 photomultiplier, also found an effect similar to our own; he greatly improved the situation by using a scaler with a 100-μsec resolving time instead of the initial 0.25 μsec and consequently attributed the effect to after-pulses originating in the photomultiplier. Taking this into account we have switched in, before the scaler, a univibrator as described by Chance (*6*) that gives us a discrimination of the pulses controlled by *P* (Fig. 2) and a resolving time of approximately 20 μsec. With such an arrangement we get curves of the type reproduced (for two discriminator settings) in Fig. 1*b*, which shows a characteristic plateau at the expected value of 4400 counts/min.

Table 1 gives the results of measurements made with 10 different activities; the measured values are corrected for

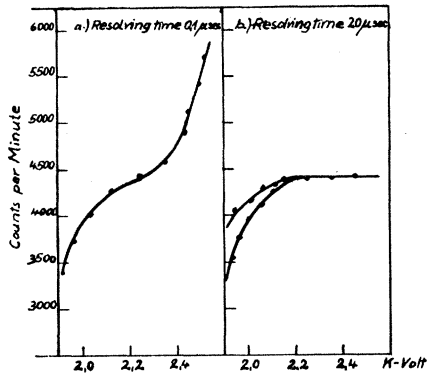

Fig. 1. Variation of counting rate of C^{14} with photomultiplier tension.

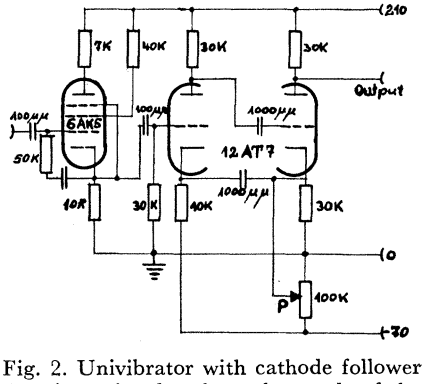

Fig. 2. Univibrator with cathode follower (the input is taken from the anode of the photomultiplier).