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

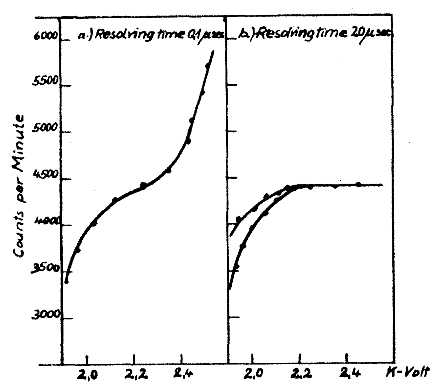

Fig. 1. Variation of counting rate of C^{14} with photomultiplier tension.

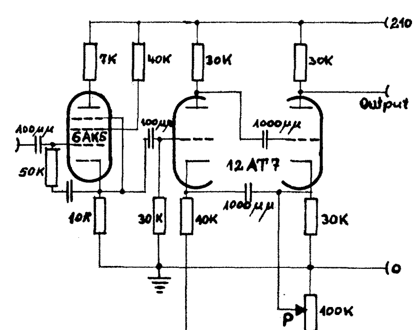

Fig. 2. Univibrator with cathode follower (the input is taken from the anode of the photomultiplier).

Table 1. Results of measurements

Measured values (counts/min)	Actual values (disintegrations/min)	Difference (%)
1,090	1,110	2
2,100	2,220	5
4,490	4,440	1
6,430	6,660	3
9,230	8,880	4
11,550	11,100	4
12,600	13,300	5
15,050	15,500	3
18,200	17,800	2
21,700	22.200	2

background but not for resolving time; the actual values are computed from A.E.R.E. data and our own dilutions; one can see that our precision averages 3.1 percent, which is deemed satisfactory for our purpose. At 100-percent efficiency our background reaches 2000 counts/min; if 1 hr is allowed to measure the sample and a 2-percent relative standard deviation is accepted, 2.0×10^{-10} c can be measured.

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7 March 1955

Latex Micro-Molding and Latex-Plaster Molding Mixture

Two refinements of the basic technique for molding objects in liquid rubber—a method for making minutely detailed replicas of small and intricate surfaces and a method for quickly filling undercuts and building up mold thickness—have proved exceedingly useful in research. This discussion is intended to supplement my earlier paper on latex-molding techniques (*1*) and Quinn's basic manual (*2*).

Micro-molding. The process of micromolding grew out of a need for high-fidelity positive replicas of diminutive Carboniferous amphibian skeletons that are preserved in exquisite detail as natural molds in coal-shale. The replicas must be relatively permanent and suitable for photography and study at magnifications of 30 diameters and greater. They must furthermore be made without damage to the delicate specimens. Such standard methods as making plasteline squeezes fail to meet these requirements, and ordinary latex-molding methods do not fill crevices properly or achieve bubble-free surfaces.

For micro-molding the standard Von Fuehrer latex compound, a thick aqueous suspension of prevulcanized rubber particles, is diluted to the consistency of milk with water previously deaerated by distillation or boiling. I have found an opaque red latex best for study and photography. For optimum surface contact, a liquid detergent such as Rohm & Haas' surface-active agents Tamol N or Triton X-100 (*3*) may be added to the latex or brushed over the surface beforehand. Because of their limited tendency to form bubbles these compounds, particularly the first, have proved superior to the household detergents that are sometimes added to latex (*4*).

The first coat is applied with a small brush or rod moved slowly over the surface so as not to override the advance of the wetting agent; this is done best under a low-power binocular microscope. Latex that collects in depressions should be blown out gently with a blowpipe, and any bubbles that form can be broken by blowing on them. Successive thin layers can be applied hourly and dried by the heat of an electric or an infrared lamp. Deep cavities must be filled gradually with several layers, for a solid plug of latex will shrink as it dries. When the latex coating is thick enough to mask the color of the specimen, a layer of undiluted compound is applied to fill minor depressions. For building up thickness, pure latex or latex-plaster mixture is preferable to inelastic fillers such as cheesecloth.

When the backing coat has dried thoroughly, the mold can be loosened at one corner and carefully peeled. Stretching and flexing the rubber during the peeling process serves to minimize damage to the specimen. For convenience of labeling, handling, and storage, flat molds or casts that will not be used for plaster-casting can be cemented with a little latex to heavy 3 by 5-in. or 5 by 8-in. cards on which the data are typed. The backs of other molds can be labeled indelibly in a contrasting color of dilute latex.

Latex-plaster mixture as filler. The great disadvantage to latex molding is the long drying time required. Backing layers of preshrunk cheesecloth or mixtures of latex with sawdust or ground cork speed the drying only moderately. Plaster of paris, however, makes a highly effective filler and drying agent, since it absorbs moisture both physically and chemically, as water of hydration. The method described here was taught to me by Robert G. Caffrey, sculptor and technician at the Carnegie Museum in Pittsburgh.

Plaster is so active a dehydrator that the mixture must be made in small batches and applied immediately, for it sets in about 1 min. I put a flat dab of latex about the size of a half-dollar on the palm of my hand, dump plaster over it from a small jar, and dump back whatever fails to adhere. The rest is hurriedly mixed with a small spatula and applied to the mold in a layer some 2 mm thick. The proper percentage of plaster varies with the job at hand and the consistency of the latex. The mold surface must be kept free of powdered plaster if succeeding layers are to adhere. Excess compound that solidifies on hands or tools is easily rubbed off.

If mild heat is applied, the mixture dries in an hour or less; when the surface fails to retain a fingernail impression, the next layer may be added. Even in thicknesses of 1 cm or more the mold remains pliable enough to pop out of undercuts and peel easily. With this process, molds may, if necessary, be started and peeled the same day. Heavy and fragile plaster mother-molds are less often needed. The simplicity of these molding methods and the excellent results obtainable should recommend them to workers in several fields.

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References and Notes

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9 May 1955