cost a few cents and will handle some 5 amp. at 115 volts (a-c).

For all ordinary purposes a visit to the local radio store will uncover a variety of relays (both a-c and d-c types), of quite remarkable sensitivity and endurance, costing in the order of $5.00 or less. A slightly more expensive instrument and one that I have found by experience to be an almost ideal laboratory tool, is the type 29XAX in the collection of fine relays made by Struthers-Dunn, of Philadelphia. This compact device operates on 5 Ma. at 115 a-c and is rated to carry 2 amp. at that same voltage. It actually carries heavier loads quite comfortably, providing circuit interruption is not too frequent. This type of relay has the advantage of working directly off the house current. If for some reason the high voltage is objectionable at the control point, a similar relay, wound for a lower voltage used with a step-down transformer, can be used. Both relays and transformers are now readily available and obviate very largely the use of batteries. (O. S. GIBBS, *1544-46 Netherwood, Memphis, Tennessee.*)

Reflection on the mechanism of action of chemotherapeutic drugs has led to the concept of specific bacterial enzyme inhibition. The exact mechanism of the inhibition is not yet known [see reviews by Henry (*Bact. Rev.*, 1943, **7,** 175), Frieden (*Texas Rep. Biol. Med.*, 1945, **3,** 569), and Mudd (*J. Bact.*, 1945, **49,** 527)].

Obligate intracellular organisms are dependent on some of the enzyme systems of the host cells, and their growth is affected and can be influenced by varying enzyme metabolism of the host cells. It has been shown by Greiff, Pinkerton, and Moragues (*J. exp. Med.*, 1944, **80,** 561) that rickettsial growth is depressed by the host cell enzyme activator, p-aminobenzoic acid (PABA). Presumably, the metabolic stimulation of the host cells by PABA makes it an unfavorable environment for rickettsial proliferation, which proceeds at an accelerated rate under conditions of lowered cellular metabolism as produced by sulfonamides, sodium fluoride, or deficiency of riboflavin.

For the control of rickettsial infections it is desirable to increase cell metabolism, inasmuch as rickettsial growth is increased in slowly metabolizing cells whether produced by vitamin, protein, or oxygen deficiencies or following radiation trauma. PABA has been found effective in endemic and epidemic typhus, Rocky Mountain spotted fever, and scrub typhus [see review by Anigstein and Bader (*Texas Rep. Biol. Med.*, 1946, **4,** 260)].

Sprunt (*J. exp. Med.*, 1942, **75,** 297) confirmed Rivers' clinical impression that vaccinia virus "is less able to multiply in the poorly nourished cells than in the well nourished one."

Foster, Jones, Henle, and Dorfman (*Proc. Soc. exp. Biol. Med.*, 1942, **51,** 215; *Science*, 1943, **97,** 207; *J. exp. Med.*, 1944, **79,** 221; 1944, **80,** 257) demonstrated that deaths from poliomyelitis virus (Lansing strain) and especially paralysis decreased in mice subjected to thiamine deficiency, restricted food intake, or both. Rassmussen, Waisman, Elvehjem, and Clark (*J. inf. Dis.*, 1944, **74,** 41) reported similar findings for the Lansing strain of poliomyelitis virus as well as for Theiler's virus. Presumably, the host cell metabolism (cocarboxylase) is so inhibited as to be insufficient to support poliomyelitis virus growth, although it seems to be sufficient for cell survival in most instances.

It seems to date that the therapeutic implications of these observations have not been sufficiently emphasized and investigated, although Mudd (*J. Bact.*, 1945, **49,** 527, footnote 2) implies the use suggested below. An attempt might be made to produce a vitamin (coenzyme) deficiency in the early stages of the disease which will make host cells an unsuitable environment for further virus proliferation. Possibly this is analogous to the action of sulfonamides in certain infections with the ornithosis and lymphogranuloma group of viruses (although a direct effect on the virus is difficult to exclude, since virus does not multiply demonstrably apart from living cells).

A thiamine deficiency may be produced by feeding such homologues as pyrithiamine, 2-n-butyl thiamine, or o-aminobenzyl-methyl thiazolium chloride. Possibly this deficiency in susceptible cells might be brought about rapidly, severely, and safely enough in the early stages of infection, thereby depressing further multiplication of poliomyelitis and possibly other neurotropic viruses (increasing "natural resistance") until the acquired immunity mechanisms are brought into operation.

Other intracellular infections might respond to vitamin-deficiency-producing drugs. It has been shown by Seeler and Ott (*J. inf. Dis.*, 1944, **75,** 175) that riboflavin deficiency in chickens produces lighter infections with *Plasmodium lophurae* malaria than in normal controls. In this case galactoflavin or isoriboflavin may be efficient in producing such riboflavin (flavoprotein dehydrogenase enzyme) deficiency. Mudd has also pointed to the structural similarity of riboflavin and atabrine, the antimalarial drug.

Some of the other vitamin antagonists (homologues, vitagonists) are pyridine-3-sulfonic acid and β-acetylpyridine for nicotinic acid; 4-desoxypyridoxine for pyridoxine; desthiobiotin, biotin-sulfone, and imidazolidone caproic acid for biotin; phenylpantothenone and pantoyltaurine for pantothenic acid; dicumarol, iodinine, and salicylic acid for vitamin K (see Woolley, *Science*, 1944, **100,** 579; *Adv. Enzymol.*, 1946, **6,** 129; Roblin, *Chem. Rev.*, 1946, **38,** 255).

Species differences with respect to the response to vitamin deficiencies have been observed. Rats could be protected against a hemolytic streptococcus by pantoyltaurine, whereas mice, whose blood pentothenate level is 5–10 times higher, could not be so protected (McIlwain and Hawkins, *Lancet*, 1943, **1,** 449). Thiamine deficiency did not significantly effect poliomyelitis infection (Lansing strain) in cotton rats (Weaver, *Amer. J. Dis. Child.*, 1946, **72,** 6), whereas mice were markedly protected by such deficiency. This is perhaps significant, inasmuch as the Lansing strain from primates must be passaged through cotton rats before it produces infection in mice. Perhaps the enzyme systems in the cotton rat and monkey support poliomyelitis virus proliferation more easily; there is a larger "margin of survival" with correspondingly decreased possibilities to effect a critical degree of inhibition.

The enzyme system of the host cells upon which each particular intracellular organism depends must be identified and inactivated by enzyme inhibitors. Metabolic studies such as those by Kabat and others (*J. exp. Med.*, 1944, **80,** 247; 1942, **76,** 579) may point the way. Host cell enzyme inactivation can be achieved biologically (virus interference) as well as chemically (vitagonists, amino acid homologues). Viral enzyme inactivation can be effected by penicillin and possibly sulfonamides. An approach along these lines, although hypothetical, may be in a promising direction. (J. K. FRENKEL, *University of California Medical School, San Francisco.*)