new bile ducts is readily demonstated. Multinucleated liver cells containing four to twelve nuclei are very abundant in the late stages. An interesting pheomenon is the englobing and removal of the hyaline remains of necrotic liver cells by large multinucleated masses of protoplasm. These giant cells, essentially foreign body giant cells, are derived in part from endothelial cells, but many have all the characteristics of true hepatic cells and are, undoubtedly, multinucleated liver cells with phagocytic properties.

The oldest lesion obtained (thirty-sixth day) presented an appearance analogous in histological structure to early cirrhosis as seen in man, differing only in that the new connective tissue surrounded the island of liver tissue persisting about the portal spaces, instead of having a distinctly perilobular arrangement. Macroscopically, this liver was much firmer than normal, deeply bile stained, and had a finely granular surface. Thus we have a form of experimental cirrhosis affecting the liver in a diffuse but uniform manner, and more typical than any previously described in the literature.

The observations thus briefly outlined, while of importance in explaining the histogenesis of cirrhosis, and incidentally of various processes of repair in liver tissue, do not aid in the elucidation of the etiology of cirrhosis in man, nor do they explain the peculiar arrangement of the connective tissue in human cirrhosis. They demonstrate, on the other hand, however, that cirrhosis may follow extensive primary destructive lesions, a view not yet fully accepted, and thus support the contention of Kretz that cirrhosis is essentially the result of a series of repair processes following repeated injuries of liver parenchyma.

The earlier lesions closely resemble acute yellow atrophy of the liver in man and appear to be of considerable importance in explaining the pathogenesis of this process.

38 (84). **"Experimental arteriosclerosis": RICHARD M. PEARCE** and **E. McD. STANTON.** (Presented by **J. E. SWEET.**)

Within the past two years several French and German writers (Josué, Erb and others) have described under the various names of calcification, atheroma or arteriosclerosis, a lesion of the aorta of rabbits produced by the intravenous injection of adrenalin.

These experiments have been repeated for the purpose of making detailed histological studies and in the hope of throwing some light upon the histogenesis of arteriosclerosis in man.

Methods. — Rabbits have received injections of a 1 to 1,000 solution of adrenalin in the ear vein. An initial dose of 3 m. repeated every other day has been the usual procedure. In other instances, the dose has been gradually raised until a dose of 20 m. to 25 m. was given every day. The animals have been killed after periods varying from a few days to eight weeks.

Results. — The vascular lesions produced are limited to the aorta and exhibit a more or less definite sequence. Rabbits receiving five to six injections show no gross lesions, but histologically important changes in the media are evident. These consist of focal areas of degeneration in which the muscle fibers are destroyed without alteration of the elastica. Later the degeneration is more extensive and involves the greater portion of the middle zone of the media. At this time changes in the elastic tissue appear; the fibers become swollen, stain irregularly and in some places appear to be fused together. Special stains show a small number of minute fat droplets in such areas. After twelve to fifteen injections very definite lesions are evident macroscopically. The aorta is more or less distorted, rigid and nonelastic. Irregular dilations alternate with elevated brittle areas of calcification. Distinct atheroma with ulceration is seldom seen. In the experiments continued for six to eight weeks, the process becomes very diffuse and small dilations of the thinner portions of the aorta assume the appearance of aneurysms. At this stage the destruction of the elastic fibers is extreme and all degenerated areas are infiltrated with lime salts. Cellular infiltration and repair about such areas have been seen in a few instances, and experiments are now under way to determine the frequency and extent of this reparative process.

The changes in other organs include enlargement of the heart, edema and congestion of the lungs, also degenerative changes in the liver and kidney, and occasionally in the heart and other muscles.

Whether the vascular changes are due to a primary toxic action of the adrenalin or whether they are the result of the increased

arterial tension which it causes, cannot be determined from these experiments. This question of etiology must be settled by other methods of investigation. The chief value of the studies herein briefly summarized lies in the application of this comparatively simple series of changes to the more complicated vascular lesions occurring in the arteriosclerosis of man.

39 (85). **"On the chemical and physiological properties of ricin,"** with demonstrations: **THOMAS B. OSBORNE** and **LAFAYETTE B. MENDEL.**

A chemical study of the castor bean has indicated that this seed contains proteins of the same character as the other oil-seeds which have been examined, namely, (1) a considerable quantity of a globulin which can be obtained in octahedral crystals; (2) a much smaller quantity of an albumin, coagulating at about 60° C. to 70° C., the temperature at which it separates depending to a large extent on the rate of the heating and other conditions; (3) proteoses which appear to belong to several of the now recognized groups of this class of substances. The satisfactory separation of the various types of proteins was accomplished largely by the use of fractional salt precipitation and dialysis.

The toxic constituent of the castor bean has been investigated under Kobert's guidance by Stillmark, who applied the name *ricin* to protein material which he separated. The product which Stillmark regarded as relatively pure must have been a mixture of proteins and have contained only a small proportion of the toxic compound. Cushny made a more careful study of ricin and obtained a substance of sufficient toxicity to produce death in animals with a dose of 0.04 mg. per kilo of body-weight. He regarded the toxic compound as protein in nature. Among subsequent investigators, Jacoby has denied the protein character of ricin. He digested his toxic preparations with trypsin and obtained solutions which retained their toxicity although apparently no longer giving protein reactions. Brieger, however, failed to prepare toxic preparations free from protein material.

The efforts of the authors have been directed especially to the possibility of isolating the toxic constituent of the castor bean and determining its chemical nature. The toxic action has been found to be associated wholly with the preparations containing the coagu-