notes all the intersections of the boundaries of the two claims, and if the other claim is unsurveyed, its boundaries are surveyed to an extent sufficient for determining the intersection. The surveyor has no authority to decide whether a claim is valid or not; his duty is to note all adverse overlapping claims as he finds them and show them on his plan and in his field notes.

Monuments.—The monument used consists of a legal post with a mound and pits. The post must be at least four feet above ground faced on four sides at least one foot from the top. Posts in all cases are placed in the centre of the mounds.

The original location posts of a quartz mining claim are to be left by the surveyor alongside of those planted by himself. Posts Nos. 1 and 2 of a mineral claim are those at the extremities of the location line; the other posts are numbered from 3 upwards, consecutively around the claim. The post in the monument of any corner or angle is marked upon one face with the number of the lot preceded by the letter "L," and upon the opposite face with the number of the post. When an angle is inaccessible for the erection of a monument, a witness monument is erected at the nearest suitable point, bearing the marks of the corner post it is intended to represent, and in addition on a third face, the letters "WIT" followed by the distance in feet or in links, as the case may be, to the true corner or angle.

THE FAILURE OF MATERIALS UNDER REPEATED STRESS.*

By H. F. Moore and F. B. Seely.

THE behavior of materials under repeated stress shows important variations from the action under static stress. Nearly all the ideas of repeated stress have been developed from considerations of static loading. One very common idea is that for any given material there is a definite elastic limit below which the behavior of the material is perfectly elastic. Under static loads such a conception may be regarded as exact without involving serious error, though careful writers on the mechanics of materials have for a long time recognized that no absolute elastic limit has ever been fixed for any material. In structures under static load local stresses of considerable magnitude—frequently beyond the yield point of the material—exist without producing any appreciable effect on the stability or the deformation of the structure as a whole, and such stresses are frequently neglected in structures subjected to static load. If, however, the load on a structural part or a machine member is repeated many times such local overstress may cause a crack to start which, spreading, eventually destroys the member; or inelastic action too small to be detected even by delicate static tests of material may by cumulative action cause serious damage under oft-repeated loading.

An illustration of the difference between static and repeated loading is furnished by the action of wire ropes bent around sheave wheels. The fiber stress due to bending is high and frequently causes inelastic action, which, however, is confined to a small portion of each wire. This inelastic action is very difficult to detect by means of static tests, but as the wire is repeatedly bent around sheave wheels this high local stress starts cracks which eventually cause rupture of individual wires. In this case, as in many others, the conception of perfect elastic action, allowable for static loading, must be discarded for repeated loads.

Materials Under Repeated High Stress.—For a range of fiber stress extending from the yield point of the material (for brittle materials the ultimate strength) down to a stress slightly lower than the elastic limit, as determined by laboratory tests of the usual precision, repeated stress will cause failure, and there seems to exist a fairly definite relation between fiber stress and the number of repetitions necessary to cause failure. This relation was pointed out by Basquin and may be expressed by the formula: $S = KN^q$, in which S = intensity of fiber stress in pounds per square inch, N = the number of repetitions of stress to cause failure, and K and q are experimentally determined constants. A similar relation was noted lated by Eden, Rose and Cunningham and by Upton and Lewis. Whether for still lower stresses such a law holds, or whether there is an "endurance limit" below which failure will not occur under any number of repetitions of stress, however many, is a question which will be discussed later.

Within the stress limits named above, if material is subjected to a cycle of stress involving application and removal of load, delicate measurements of deformation will show that the relation between stress and deformation is represented not by a single straight line, but by two curved lines, one for application and one for removal of load. Even if such deviation cannot be detected after a single cycle of stress it has been shown by Bairstow that the deviation may become appreciable after several thousand repetitions, and that the stress-deformation curve for a cycle of stress after a few repetitions becomes a closed curve resembling the "hysteresis" curves of magnetic material; the area enclosed by the loop represents energy lost during a cycle of stress, and this loss of energy is spoken of as "mechanical hysteresis."

If mechanical energy is dissipated during a cycle of stress it would seem that the lost energy must be transformed into heat, that there must be some form of internal friction in the material, that wear and structural damage take place, and that if the action is continued long enough the material will be ruptured. It would seem reasonable to consider the amount of structural damage during a cycle of stress to be proportional to the energy transformed into heat, or, in other words, to the area of the mechanical hysteresis loop. The shape of this loop remains similar to the shape developed under early cycles of stress.

The analytical discussion of the cumulative damage done by repeated stress seems to yield results in accordance with the results of tests, and is submitted as an explanation of the failure of materials under repeated stress within the stress limits named; that is, for stresses ranging from the yield point (or ultimate strength for brittle materials) down to a stress slightly below the "elastic limit" as usually determined in static tests.

Materials Under Repeated Low Stress.—As builders of machines have to design parts to withstand many times one million repetitions of stress, a problem of greatest importance is the determination of the action of repeated stresses lower than those considered in the foregoing paragraph. Is cumulative damage done under these lower stresses, and will they finally cause failure? Or is there an "endurance limit" below which no damage is done to the material, and below which the material will withstand an infinite number of repetitions?

*From a paper read before the American Society for Testing Material, June 26-28, 1915.