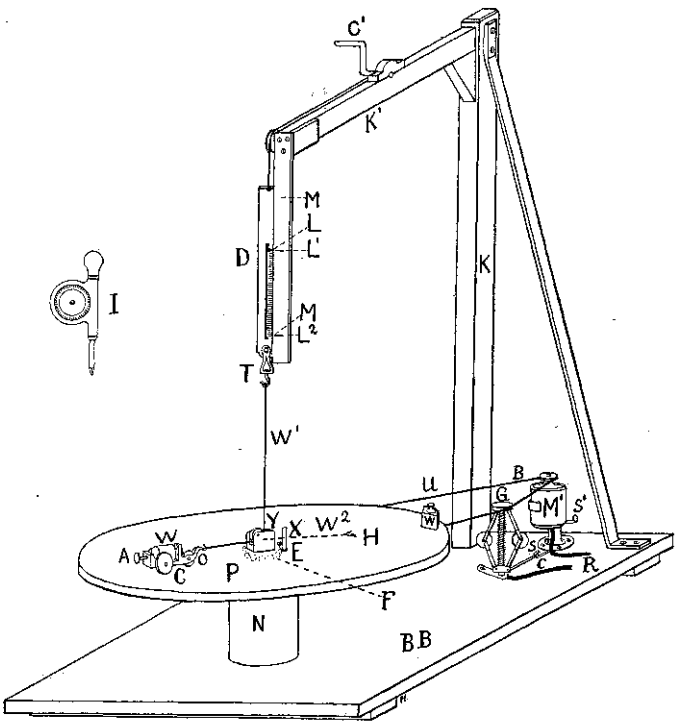
CENTRIFUGAL FORCE.

The apparatus for this experiment was made and the experiment worked out by two boys in the second year class of the Arlington High School, Arlington, Massachusetts.

The object of the experiment was to verify the formula for centrifugal force which is: $F = \frac{M(VV).}{gR}$ When M = mass of rotating body; V = velocity; g = acceleration due to gravity; R = radius of circumference through which mass is rotating.



Apparatus consists mainly of wooden disk P about 2 ft. 6 in. in diameter, mounted on the base BB and rotated on ball bearings F; an inverted L shaped arm K, 3 ft. long, placed so that the end of its arm comes directly over the disk. A three wheel car C, on the disk receives the weight W. A wire W′ passes from the car through the pulley Y to the swivel T, which is connected to the dynamometer D, that being suspended by a rawhide cord K′. The other end of K′ is made fast to crank C. The disk is

rotated by means of the electric motor M′, which communicates motion to the disk by means of belt B. A governor g is also run by B, which makes a "make or break contact" of electricity at c. The Z-shaped part XE near the center of the disk is used as clutch for the speed indicator I, and for convenience can be swung aside, with E as an axis, when not in use.

The following is some of the data obtained with the use of this apparatus:

READING	1	2	3	4	5
MASS In kilograms	.335	1.135	1.135	1.135	.567
VELOCITY c.m. per sec.	210	282.75	282.75	141.35	282.75
RADIUS In centimeters	15	15	30	15	15
CENTRIFUGAL FORCE by FORMULA In kilograms	1.005	6.16	3.08	1.54	3.08
CENTRIFUGAL FORCE by APPARATUS In kilograms	.997	6.27	2.85	1.69	3.
DIFFERENCE Average .058	.008	.11	.23	.15	.08

In operating this apparatus, the first thing to be done is to unhook W′ from swivel T and hook it at H, at the same time swinging X on axis E so that X will be above center of the disk P. A weight is placed in the guide U heavy enough to balance weight of car C. The approximate speed is decided upon and the governor G is set accordingly at S. Wire R is connected to electric light circuit, and controller S′ is closed. When sufficient speed is acquired, the speed indicator I is placed on X. The speed having been taken for one minute, the motor is again shut off. Having once set the governor at S, the speed will always remain constant, regardless of any weight the disk may be subject to. X may again be placed in its former position. Also W″ is replaced in position W′ again. The desired weight is placed in car C. This car is so constructed that the center of gravity of the car plus the weight therein is in the two larger wheels; this is made possible by the adjusting screw A

and the auxiliary wheel O. Sufficient weight is placed in U to balance the weight of the car and its load on the opposite side, thus eliminating all possibility of vibration. The motor is again started. The two circumferences L′ L″ are shown to represent the paths that the car may be made to revolve in. Indicator M, which is also supported by the upright K, is marked L′ and L″ and represents 15 cm. and 30 cm. respectively, when they coincide with J of the dynamometer D. In order that this may be so, as the centrifugal force increases, the dynamometer must be elevated, for which the crank C is provided. The centrifugal force is registered on the dynamometer when the radius mark (L′, for instance) coincides with J.

Therefore this experiment shows that the formula for centrifugal force, $F=\frac{M(VV)}{GR}$, may be verified as follows:

The centrifugal force varies *directly* as the *mass,* when the *radius* and *velocity* are constant. Shown by readings 2 and 5:

2 M=1.135 kg. V=282.75 cm. R=15 cm. F=6.27 kg.
5 M= .567 kg. V=282.75 cm. R=15 cm. F=3 kg.

The centrifugal force varies as the *square* of the *velocity,* when the *mass* and *radius* are constant. Shown by readings 2 and 4:

2 M=1.135 kg. V=282.75 cm. R=15 cm. F=6.27 kg.
4 M=1.135 kg. V=141.35 cm. R=15 cm. F=1.69 kg.

The centrifugal force varies *inversely* as the radius, when the *mass* and *velocity* are constant. Shown by readings 2 and 3:

2 M=1.135 kg. V=282.75 cm. R=15 cm. F=6.27 kg.
3 M=1.135 kg. V=282.75 cm. R=30 cm. F=2.85 kg.

GENERAL SCIENCE.

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Science teachers of the high schools have been endeavoring for some time to plan a graded course in science. They have claimed quite naturally that the pupil should have the easier science first, to be followed by the more difficult sciences, just as the easier branches of mathematics come first. The earlier result of their attempts was to have physical geography the first year, botany or zoölogy the second year, chemistry the third, and physics the last year of high school. It was then apparent that