BALL-BEARING FOR ONE INCH SHAFT—CONTINUED.

(Oil Used.)

No.	Weight on Scale. Ounces.	Weight. Pounds.	Rev. Spindle.	Time. Seconds.	Heat.	Coefficient F.
10	3/8	130	256	30	None.......	.0018
11	3/8	130	431	30	None.......	.0018
12	3/8	130	758	30	None.......	.0018

Three sets were made for each load, and, with the weights used, the coefficient of friction varied from .0017 to .0022, as averages for the three sets. Of course, the width of this range may be due to inaccuracy in reading from the scale, as the variation in pull on the scale arm caused a rapid vibration of the scale index.

The bearings used were those supplied on the market for carrying shafts, and the principal cause of the jar in the apparatus during the test was due to slight inaccuracies in grinding the races.

In another set of tests, where the load was increased to seven hundred pounds, it was found that somewhere between the six hundred and the seven hundred pounds load the balls and races had become pitted, small pieces of the hardened steel being torn from the surfaces. These pieces were found in the race-way or in the oil that was used. It was found, further, that the tendency to heat was much reduced when oil was used and that the whole movement was smoother and steadier.

Further Studies in the Propagation of Sound. By A. Wilmer Duff.

[Abstract.]

In a previous paper the writer gave a theoretical discussion of the propagation of sound in spherical waves, allowing for the effect of the viscosity of the air and the conduction and radiation of heat from the condensations and to the rarefactions. It resulted from this investiga-

tion that at short distances from the source the intensity of the sound varies as

$$\frac{1}{r^2}\left(1+\frac{a^2}{n^2\,r^2}\right),$$

while at great distances from the source the intensity varies as

$$\frac{e^{-2\,m\,r}}{r^2}.$$

In these formulæ r stands for the distance from the source, a for the velocity of sound, and n for the number of vibrations per second, while m is a constant that depends on viscosity conduction and radiation.

In the previous paper the author described experiments made to find the value of m. The method was confessedly not altogether satisfactory. Later another method was devised and applied during the summer of 1898. As before, the work was performed in the open air at a very quiet part of the River St. John, New Brunswick, Canada. The season was very unfavorable, and only the few results hereafter described were obtained.

The greatest difficulty in such work is in finding a variable standard of intensity of the same pitch and quality as the sound studied. In the present case this was overcome by using the sound conveyed through a telephone as the standard, the transmitter being placed near the source of sound and the receiver held at such a distance from the ear that the sound heard directly and that heard through the telephone were of equal intensity. Only one ear was used, the other being filled with wool and closely covered by a heavy pad. This use of a telephone receiver at different distances from the ear as a standard implied a knowledge of the law of intensity of the sound at different distances from the receiver. This point, the law of intensity at short distances, was first tested by using the receiver in two states of intrinsic sensitiveness—first, shunted; second, not shunted. Now, if a series of sounds of different intensities (e. g., the sound of the same whistle differently deadened by coverings) be compared with these two standards, the ratio of the two intensities thus estimated for each sound should be the same for all the sounds, and if calculation according to the theoretical law above stated for short distances should show such a constancy of ratio, it would afford strong evidence that the theoretical law is correct. The tables of results obtained verified the law of intensity at short distances and showed that the commonly accepted law of inverse squares at short distances is quite inapplicable.

Having thus verified the theoretical law for short distances, the use of the telephone receiver as a standard for estimating the intensity at great distances from the source becomes possible.

Tables of results summarizing the observations obtained at great distances showed that the values of m required to reconcile the observed variations of intensity at each increase of distance with the theoretical law at great distances increased uniformly; and hence it is evident that the theoretical law can not be quite correct. In fact, there must be another cause of decay of intensity not taken account of in the theoretical discussion; and this other cause, whatever it is, produces results not in accord with an exponential law of variation. What this other cause is, the author does not undertake to say.

The Intensity of Telephonic Sounds. By A. Wilmer Duff.

[Abstract.]

If a sound of constant intensity act on a telephone transmitter, the intensity of the sound given off from the receiver will depend upon the total resistance, inductive and non-inductive, of the circuit. If the circuit include a resistance box and the total resistance be varied in a known way, the relative changes of current affecting the receiver can be calculated. If, now, the receiver be held at varying distances from the ear, so that the sound emitted by it seems to the ear as loud as the sound heard directly from the distant source that acts upon the transmitter, then the variations in intensity of the sound given off by the receiver can also be estimated. (See preceding article.)

By this method it was found that the intensity of sound emitted by the receiver varied roughly as the three-halves power of the current traversing the circuit.

The Distance to Which Small Disturbances Agitate a Liquid.

By A. Wilmer Duff.

[Abstract.]

In the course of an unfinished piece of work on a new method for determining the viscosity of water, the following somewhat curious result was obtained:

If a sphere of one centimeter radius hang from an arm of a balance by a long fine wire, and be immersed in a vessel of water, it may be caused to perform vertical vibrations of any desired extent and rapidity by suitably weighting the pans of the balance. The nearness of the sides of the vessel will be found to greatly affect the rate at which the vibrations die down. Even when the sides of the vessel are very distant, they have an appreciable effect. When the vessel is a large-sized carboy, the effect of the sides is still quite appreciable. That is to say, if a sphere of one centimeter radius perform one vibration for every fifteen seconds through a range of one centimeter in a mass of water, the effect on the water at a distance of a foot from the sphere is quite appreciable and measurable, the water being agitated to that distance instead of merely flowing round the slowly moving sphere to fill up the space it vacates.

It may be added that the method referred to for measuring the viscosity of water is not intended as a practical method for finding the viscosity of different liquids, but merely as a means of contributing to the settlement of the dispute regarding the discordant values of the viscosity of water obtained by the several other methods that have been employed.

The Evaporation of Water Covered by a Film of Oil.

By A. Wilmer Duff.

[Abstract.]

A vessel of water covered by a film of paraffin oil 4 mm. thick and placed in a box artificially kept dry, lost 4 gms. of water in two months, while in another case in which the film of oil was only 1 mm. thick the loss in two months was 11 gms. After considerable difficulty it was proven that this loss was not at all due to a passage of the water through

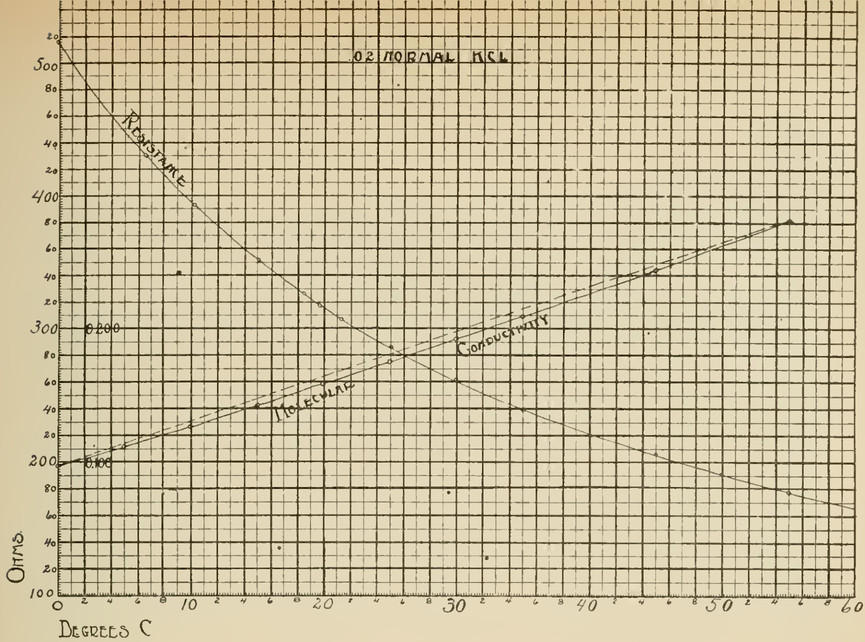
the oil film, but to the water creeping out between the oil and the glass. This may be tested by placing two similar glass vessels on the pans of a sensitive balance, pouring some water in one and covering it with a layer of oil, and pouring in the other oil only to the same depth. After counterbalancing and closing the balance case very tightly to prevent air currents, the arms may be kept counterbalanced by suitable riders, and it will be found that the evaporation of the water takes place with sufficient rapidity to be measured in a short time. But if the water be contained in a watch-glass placed in the bottom of the glass vessel and entirely covered and surrounded by oil, no evaporation will be discovered.

To indicate the rate at which water can thus creep between oil and glass, it may be stated that when the glass vessel is 9 cm. in diameter and the layer of oil as much as ½ cm. thick, the evaporation takes place at the rate of nearly a milligram per hour.

A Note on Temperature Coefficient of Electrical Conductivity of Electrolytes. By Arthur Kendrick.

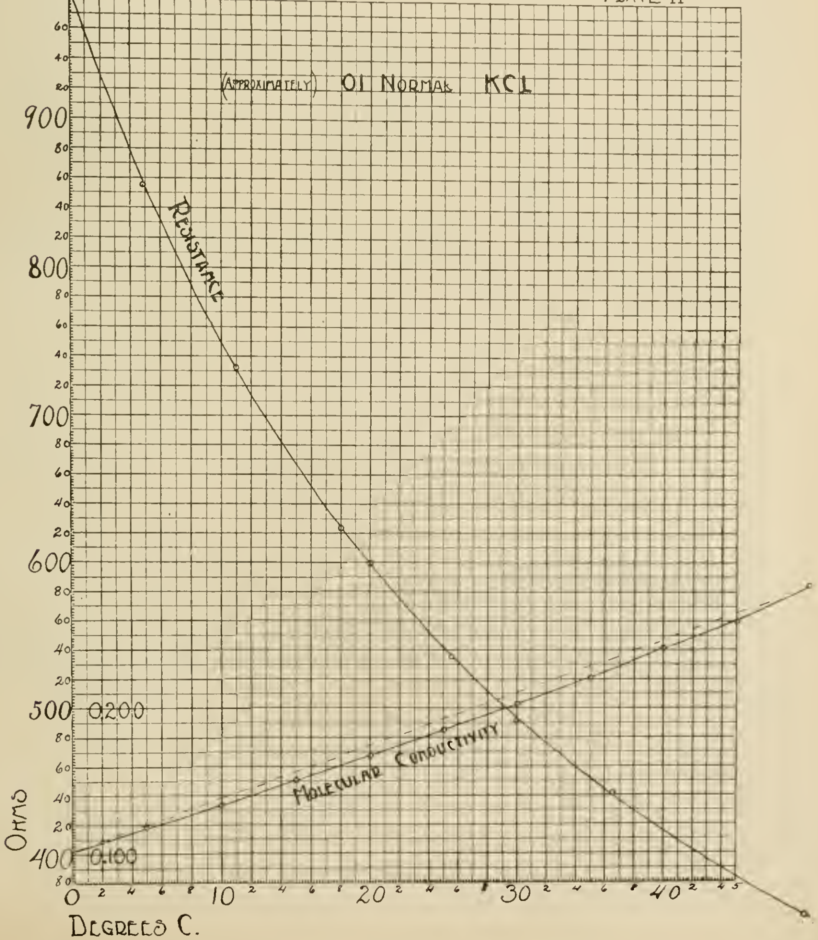
[Abstract.]

This paper was a preliminary note of work begun to determine the temperature coefficient of conductivity of various electrolytes of varying concentrations. The two plates give the curve of resistance and molecular conductivity in the case of a $\frac{2}{100}$ normal KCl aqueous solution and an approximately $\frac{1}{100}$ normal KCl aqueous solution, between 0° C and about 50°. The figures 0.100 and 0.200 mark the ordinates of the molecular conductivity curves. The resistances in each case are the actual, corrected resistances for the cell used, and the molecular conductivity is the resistance, taken from the curve divided by $\frac{2}{100}$ and $\frac{1}{100}$ respectively, the concentration values. The broken straight lines are drawn to make noticeable the curvature.



.02 NORMAL KCL
RESISTANCE
MOLECULAR
CONDUCTIVITY
0.200
0.100
OHMS
DEGREES C

PLATE II



(APPROXIMATELY) .01 NORMAL KCL
RESISTANCE
MOLECULAR CONDUCTIVITY
0.200
0.100
OHMS
DEGREES C.