

Notes by Alexander Graham Bell, October 26, 1901

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Copy for Mrs. Bell 1901, October 26 Saturday At B.B.

It is my experience that my periods of activity leave few records behind them, and certainly the last two weeks have constituted a period of great activity for me, with very little to show for it in the way of dictated notes. I can only now recall general impressions of what I have been about, reasons, &c.

The clear realization of a the point that a kite of cellular construction can be indefinitely increased in size, without increasing its flying weight, has been the key to everything done during the past two or three weeks. I want to make a giant kite that will take up a considerable weight — a man for instance — I am convinced that a structure consisting of cells, constituting equilateral triangles, can be built of any desired size or form. One chief question in my mind has been what is the best material. Pine, which we have been using is not suitable. The wood, although the lightest we can obtain here, is extremely fragil, and a moment's consideration shows that a giant kite, made of pine sticks, though it might be very strong as a whole, would be so weak that no sticks could support the weight of the entire kite, so that something would be sure to smash everytime it comes down.

A good deal of my time has been occupied in weighing material of different sorts, and in measuring their strength, and also in looking at materials suitable for wing surfaces. Some of the results are noted in Home Notes, under date Oct. 18 1901, pp. 89 to 93. Am very much struck with the light weight 438 of the celluloid films used in a Kodak. The cotton cloth we now use weighs about 150 gms. per sq. M. We calculate that the celluloid film weighs only 76 gms. per sq. M. We have been unable, however, to try this for wing surfaces, as the celluloid we have in the laboratory is too heavy, weighing 350 gms. per

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sq. M. I will here note a few of the substances examined with reference to wing surfaces:

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SURFACE MATERIALS. Celluloid (Kodak Film).....

SURFACE MATERIALS.

Weight per Square Meter

Celluloid (Kodak Film) 76 gms.

White Cotton (used for our kite surfaces) 152 gms.

Red Cotton (used for our kite surfaces) 144 gms.

“ “ “ “ 160 gms.

Celluloid film (heavy) 350 gms.

Oil cloth (table cover material) 543 gms.

Aluminum (sheet) 1,051 gms.

Brass foil 1,307 gms.

Sheet copper 1,729 gms.

Tin plate 2,517 gms.

“ “ 2,862 gms.

Various materials suitable to be used in place of pine sticks in making framework were weighed, and calculations made to reduce the weight to that of a uniform length of 1 Meter.

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The following table shows a few of the materials tested:—

FRAME MATERIALS.

Weight per meter length

Steel (Fine piano wire used for high notes) 1 gm.

About 0.05 cm. diameter)

Aluminum wire (about 0.15 cm. diam.) 2 gms.

Brass wire (about 0.1 cm. diam. springy) 3 gms.

Iron wire (about 0.05 cm. diam. used for fastning the corks of bottles) 3 gms.

Iron wire (stove-pipe wire) (About 0.15 cm. diam.) 5 gms.

Brass wire (about 0.1 cm. diam. medium hard) 5 gms.

Steel (piano wire) (about 0.15 cm. diam. stout and strong) 8 gms.

Pine stick (about 0.5 cm. diam. sq. cross section; a 50 cm. length broke with weight of 815 gms. suspended from center) 10 gms.

Spruce stick (about 0.5 cm. diam. — square cross section. Broke with weight of 2,315 gms. suspended from center of a stick 50 cm. long) 12 gms.

Pine stick used in kites 100 × 0.5 × 0.5 cm. 11 gms.

Pine sticks used in kite (calculation made from 39 sticks, each 50 × 0.5 × 0.5 cm. and weighing altogether 224 gms.) 11 gms.

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Iron wire (About 0.25 cm. diam.) 19 gms.

Pine stick (100 × 1 × 1) 40 gms.

Spruce stick (100 × 1 × 1 cm.) 44 gms.

Brass rod (About 0.25 cm. diam.) 64 gms.

Steel rod (100 × 0.5 × 0.5 sq. cross section) 187 gms.

Pine wood (100 × 3 × 3 sq. cross section) 427 gms.

Brass Pipe (100 long, about 2.5 cm. diam.) 466 gms.

Aluminum pipe (100 long, about 1.5 cm. diam.) 145 gms.

(The following weights are calculated from a Table of Specific Gravity, given in Ganot's Physics p. 107).

Yellow pine (100 × 0.5 × 0.5) 16 gms.

Oak (100 × 0.5 × 0.5) 21 gms.

Elm (100 × 0.5 × 0.5) 20 gms.

Beech (100 × 0.5 × 0.5) 22 gms.

Bronze (100 × 0.1 × 0.1) 9 gms.

German Silver (100 × 0.1 × 0.1) 8 gms.

Aluminum (100 × 0.1 × 0.1) 3 gms.

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Of all the material investigated, the most promising seams to be steel. Calculation shows that steel wires, like the stout piano wire, weighing only 8 gms. per meter length, could be used for framework of large kite.

The lightness, and yet great strength, of the fine piano wire, weighing only 1 gram per meter, suggests utilizing its tensile strength in the construction of light framework. This at once struck me on weighing the wire, Friday October 18, 1901, and I talked over various plans with George McCurdy for utilizing the tensile strength of such wire. This led him, on Sunday, October 20, 1901, to the idea shown on p. 422, and p. 423. A few days ago I think Monday, October 21, George McCurdy proceeded to test his idea by constructing an iron ring, I should think about 40 cm. diam., of wire, about 0.25 c. diam., which by itself appeared to be too slim, and wobbly, to be of any use, but when he had braced it by numerous strings forming diameters of the circle, it became quite stiff in the direction of its plane; but evidently wanted side bracing as in the center ring shown on p. 423.

On Thursday, October 24, he made a model of a kite frame formed of two rings of iron, about 40 perhaps 50 cm. diam. and about 0.25 cm. thick (that is thickness of wire) with a brass rod in the center. The whole braced by string, as 441 shown above. The resulting structure was wonderfully strong and light. Mr. MacInnis was present here when George made this, and he showed it to Miss Safford and Marian, when they returned from the Young Ladies Club, Thursday night, Oct. 24, 1901. I have asked him to preserve it as a model.

This formed of kite frame, since George McCurdy suggested it last Sunday, Oct. 20, see p. 422 has led to quite a number of ideas, which are noted in Home Notes under date October 20, pp. 100, 111, 112, 113, 114, 115, 116, 117, 118, and Notes dated Tuesday, Oct. 22, pp. 124, 125, 126, 127, 128, 129, 130 131, 132, 133. Also in Notes dated Wednesday October 23, on pp. 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151. These pages contain written conversations between George McCurdy and myself upon the subject, and the discussion gradually developed

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the conception of the globular celled kite, shown on p. 141, of Home Notes, under date Wednesday, October 23, a model of which I made of paper the same evening. Have not time to develop this further, but shall simply make in conclusion a drawing of the globular cell.