Letter from Alexander Graham Bell to Wilbur M. Phelps, January 10, 1901, with transcript

COPY FOR MISS MARIAN H. GRAHAM BELL. Volta Bureau, January 10, 1901. Dear Dr. Phelps:—

My Secretary Miss Safford has made a copy of our joint notes in my note book for your information, which I send herewith. She feels a little uncertain as to her ability to copy the diagrams successfully, but I have told her to go ahead and do the best she can, for even if she does not understand them YOU WILL.

With kind regards, Your sincerely, (SIGNED) Alexander Graham Bell. Dr. Wilbur M. Phelps, Dumfries, Virginia.

p. 128. (Note-Book) “Home Notes”.

Copy for Miss Marian H. Bell.

1901, Jan. 5. Saturday. At V. B.

Dr. Phelps has the floor.

If body temperature will not cause enough evaporation frictional heat could be used.

A.G.B. In utilizing differences of temperature what we want is to get as great a difference of temperature as possible. One way is to seek to increase the temperature at the warmer side — and here frictional heat comes in as an aid — but it would be equally advantageous to diminish the temperature at the other end and probably more easy to do it.

In liquifying gasses — the cold produced by the evaporation of the liquid is utilized to lower the temperature of a portion of the uncondensed gas. The gas is cooled to a certain point under great compression — then some of the compressed cooled gas is allowed suddenly to expand and in expanding a greater amount of cold is produced, which is utilized to cool the compressed gas still more — so that a portion of the gas is greatly cooled by the expansion of the rest.

W.M.P. In using a bicycle pump, the heat produced by friction is sufficient to burn the hand.

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A.G.B.

Use bicycle pump to draw vapor from over body of salt water (the evaporation lowers temperature of salt water) and condense vapor in closed vessel — say test-tube (compression heats the test-tube and contained vapor). In order to produce condensation — test-tube should be cooled. Cool it by putting it in the salt water from which the vapor was originally drawn.

p.129.

W.M.P. The cooling cannot be done in original salt water because the temperature of the salt water is maintained by the supply of heat from the body or other source.

A.G.B.

A.G.B. Let aqueous vapor be highly compressed in tube (a) by action of bicycle pump. Let there be a fine orifice (b) in end of tube — so that some of the compressed vapor escapes by orifice (b) — and traverses interior of tube (c), surrounding tube (a). The sudden expansion of the escaped vapor 3 will cool it — and as this cooled vapor passes over surface of tube (a) in escaping, it cools tube (a) — and this cools condensed gas in (a) —

so that the condensed gas arrives at orifice (b) at lower temperature than before — so that when it escapes it is cooler to begin with before it expands. Expansion cools it still more — then tube (a) is cooled still more, &c., &c., there is therefore a continuous progressive lowering of the temperature of the condensed gas in (a) until condensation takes place in (a). Any liquid water formed could be caught in a closed vessel (d). Something in this.

W.M.P.

p.130.

The advantage of using frictional heat rather than vital heat, is that starving persons or "cast-aways" need all the vital heat they have, and at the same time need exercise to maintain vital heat, thus with a frictional apparatus it is not necessary to have a cold surface next to the body, and the exercise of turning a frictional apparatus will be of real benefit to the person.

A.G.B.

Here we are developing means for increasing the heat at one end, and increasing the cold at the other — conditions favorable to increased quantity of water condensed.

4

W.M.P. Centrifigal machine, shows that rapid revolutions, of a body can be obtained with expenditure of little force (used in urinary work).

W.M.P.

A.G.B.

Here we have a means of heating a cylinder containing salt water — by the friction of an outer cylinder revolving in contact with it. — The inner surface of the outer cylinder rubbing against the outer surface of the inner cylinder (which is fixed and contains the salt water).

On p. 129 we have a means of cooling the condensed water vapor by the expansion of a portion which is allowed to escape.

p. 131.

Now we want to combine these instrumentalities with a pump which shall exhaust the air or vapor over the salt water — and compress the vapor in the condensing apparatus, and the same handle which works the frictional heater is to work the pump. I will ask Dr. Phelps to make a drawing of 5 a combined apparatus with pump.

W.M.P.

(Signed). W.M.Phelps, 1-5-'01.

(Signed) Alexander Graham Bell,Jan.5, 1901.

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1901, Jan. 6. Sun. At V.B.

p. 132.

W.M.P.

Have each retort covered with asbestos.

A.G.B.

Have sliding valves opened mechanically by action of piston rod — and not dependent upon differences of gaseous pressure.

Large capacity advisable in condenser — so that escape of air or vapor through fine orifice may not rapidly reduce the pressure inside condenser.

Capacity of pump should be large, and two chambers advisable, one on each side of piston — vapor being condensed on one side and rarified on other. By means of sliding valves communication could be established at the proper times with the proper receivers (evaporator or condenser). These might be connected alternately with the interior of each chamber.

A.G.B.

W.M.P. This is fine.

7

1901, Jan. 9 Wednesday. At V.B.

p. 133.

W.M.P. Pump supply Company — 12th Street, bet. E and F., on west side of street.

8

A.G.B.

Think it will pay to think a little over the arrangement to produce frictional heat. Arrangement shown on p. 130 involves two pretty large surfaces in contact with one another.

p. 134.

Might it not be better to have only a small surface in frictional contact. Given a certain amount of muscular power — would not the intensity of the heat produced be in inverse proportion to the surfaces in contact: — Large surfaces slightly warmed — where shall surfaces would be greatly heated. Inclined to think that frictional contact should be small. Then, again with large surfaces the resistance to motion would be so much greater than with small surfaces — that the rotatory motion produced with the same exertion of muscular power would be less — and what we want in order to produce heating effect is rapid rotation — not slow.

A mere rod, — or axis — could be made to spin round more rapidly and easily than a cylinder around a vessel containing salt water.

A.GB.

9

A.G.B.

If the rotating rod should be in the salt water, and the point of intense heat at the bottom, the water there would rise to the surface and be replaced by cooler water until the whole mass of water should be heated. Now Dr. Phelps may have the floor.

W.M.P.

The apparatus on p. 130 represents the first crude ideas that came to us upon this subject, and no doubt Dr. Bell's plan would give us much better results. However, we will determine this point by experimentation.

p. 135. Will first take an ice cream freezer and fasten a sheet of tin around it and place water in the outer wood covering, and note result on a thermometer.

Will then place a piece of iron in a glass preserving jar and produce friction on that with a steel pin turned by a small wheel — wheel from my electric machine. — Have jar full of water — compare amount with that in ice cream freezer and note results. Or, better still, will run a rod of steel down the center of ice cream freezer to take the place of the ice cream can.

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A.G.B.

A small quantity of water can more quickly and easily be heated than a large quantity. In the Herreschoff engine a mere drop of water falling upon a red hot surface is instantly flashed into super-heated steam. Would it not be more easy by means of frictional heat to evaporate your water drop by drop! Only sufficient quantity being used to prevent formation of solid incrustation of salt. A metallic reservoir should be avoided and the material of which it is composed should be non-metallic and a non-conductor of heat — so that all the heat generated by friction should be transferred to the water, and none be wasted in heating the cylinder or reservoir containing the water.

W.M.P.

p. 136. It seems to me that the deposit of salt instead of hindering the working of such a plan would be an advantage, by causing more friction, and that the revolving pin would throw out the surplus of deposit. The salt water could be made to drop into a small pan at the point of the pin.

W.M.P.

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A.G.B.

Oil reservoir of student lamp allows oil to escape in very small quantities to lamp. Apply to salt water. Water bottles for birds on same principle.

A.G.B.

A.G.B.

Another point: — The rotating pin should not be metallic — as this would conduct away from the place of intense heat, a considerable portion of heat which might better be transferred to water. All the parts in frictional contact — non-metallic and composed of non-conducting material.

W.M.P.

p. 137. My apparatus, does away with the objection, of having to open the salt water compartment — to replenish, which if necessary would allow steam to escape, and air to enter the 12 evaporator.

However, it seems, that some plan, will have to be developed whereby the suction from the pump, will not cause the water to flow too rapidly from the water compartment. This could be done by regulating the lumen (?) of the feeder so that the pressure used would just draw a few drops of water from the water compartment.

A.G.B.

But, if we can produce intense heat by friction what is the need of a pump at all. We need nothing more than heat to produce fresh water — of course with condenser.

Suppose we can heat a DROP of salt water so as to vaporize it quickly — the steam produced can easily be condensed into water. If we have intense heat — if only with a drop — all our complicated apparatus designed for operations at low temperatures — becomes unnecessary.

Think it will pay to consider this matter of frictional heat by itself without reference to other parts of apparatus.

p. 138. As the matter lies in my mind just now, the most important question to be considered is: —

Can we, by a moderate exertion of muscular power, produce intense heat at a point; and can that source of heat be employed to raise the temperature of a small quantity of water

— say a drop or two — up to any considerable degree — 13 say 100° C. the boiling point of water.

If so, there is no need for pump — partial vacuum — refrigeration by escape of portion of condensed vapor, &c., &c., &c. The whole problem is simplified down to a fine point — Can we by friction produced by muscular exertion vaporize a drop of water.

W.M.P.

Would it not be a good idea to have the shaft a non-conductor of heat, and have the point of steel? Why not have a small tube with a shaft iside inside of it, which could be moved up and down by hand — as a bicycle pump — and placed in the water?

A.G.B.

We want to give the hand a mechanical advantage

A.G.B.

A.G.B. Rotating large wheel slowly will make small pin spin. Hand should have advantage of leverage.

14

A.G.B.

A.G.B.

Hand at (a), fulcrum at (c) and great pressure at (b) — hence great heating power possible at (b) or (c).

Opposite actions — one gives velocity with little pressure, other slow action with great pressure. Which is most advantageous? It is velocity versus pressure.

p. 139.

W.M.P. Why not combine the two by means of a spring or a screw on top of the pin.

W.M.P.

15

A.G.B.

Whole arrangement here would become hot. Could not that be placed in the salt water.

A.G.B.

Crude — but conveys idea.

A.G.B.

Could be placed in metallic case so as to be protected from salt water — and case become hot. If not protected — centrifugal force would throw the water off.

16

p. 140

A.G.B.

Would not balance wheel be advisable to sustain the motion by inertia.

A.G.B.

17

A.G.B.

A.G.B. No advantage in separate wheel to turn with. Would take as much power to move the axis at (a) as at (b). It is a question of velocity versus pressure. Inclined to think more important to multiply your pressure by mechanical leverage than to multiply velocity.

p. 141.

A.G.B.

A.G.B. Get bird's drinking fountain and fill it with salt water. Put alchohol lamp under as shown — and see what effect will be produced by evaporation. Query: — What will be come of the salt. Will it plug up the thing — Crystalize over the edge and syphon off the water — or will water in reservoir keep it dissolved until saturated solution forms.

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Interesting to know what would happen.

Volta Bureau, Washington, D. C., January 10, 1901.

N.B. The above notes have been copied from Dr. Bell's “Home Notes” from January 5 to January 9, 1901, pp. 128 to 141 inclusive.

B. A. Safford. Secretary.