[174r] [(mostly) in AAL's hand]
Theorem. Page 199.
If N be a function of x and y, giving $\frac{dN}{dx} = p + q\frac{dy}{dx}$
then the equation $\frac{du}{dx.dy} = V.\frac{dN}{dx.dy}$ is incongruous &
self-contradictory, except upon the assumption
that u is , as to x and y , a function of N ;
or contains x and y only thro' N.

Let $N = \psi(x, y)$ give $y = \chi(N, x)$, and
suppose , if possible , that the substitution of
this value of y in u gives $u = \beta(N, x)$, x
not disappearing with y . Then x and y
varying

$$\frac{du}{dx.dy} = \frac{d\beta}{dN}.\frac{dN}{dx} + \frac{d\beta}{dN}.\frac{dN}{dy} + \frac{d\beta}{dx}$$

[in above line, $\frac{du}{dx.dy}$ is crossed through in pencil, and '1' written above;
'$= \frac{du}{dx} + \frac{du}{dy}$' added in pencil at end of line — in ADM's hand?]

$$= \frac{d\beta}{dN} \cdot \left(\frac{dN}{dx} + \frac{dN}{dy}\right) + \frac{d\beta}{dx} = \frac{d\beta}{dN} \cdot \frac{dN}{dx.dy} + \frac{d\beta}{dx} =$$

$$= V.\frac{dN}{dx.dy}$$, which equation being
universal , is true on the supposition that x
does not vary , or that $\frac{d\beta}{dx} = 0$. This gives $\frac{d\beta}{dN} = V$;

$$\text{or } \frac{du}{dx.dy} = V\frac{dN}{dx.dy} + \frac{d\beta}{dx} = V\frac{dN}{dx.dy}$$

because $\frac{d\beta}{dN}$ and V being independent of the variations
&c, &c. Hence $\frac{d\beta}{dx} = 0$ always ; or β does not
contain x directly, &c.

I think the above is correct. I cannot see
[174v] the use (page 200) of introducing t in
the proof <u>there</u> given . Is it possible that
I have committed an error in my original
understanding of the <u>ennunciation</u> [*sic*] of the Theorem;
& that the du ['of the equation' crossed out] and the dN
of the equation $du = V.dN$, do not mean
the du and dN derived from differentiating
<u>with respect to the quantities x and y,</u>
<u>already</u> introduced ; but with respect
to ['some' crossed out] <u>other</u> given quantity?__

I suspect so .

[the following appears underneath in pencil — still in Ada's hand]

$$u = \beta(N, x)$$

$$\frac{du}{dx} = \frac{d\beta}{dN} \quad \frac{dN}{dx} + \frac{d\beta}{dx}$$

$$\frac{d^n u}{dx.dy} =$$