$\Rightarrow$ the map φ is given by the matrix

$$\begin{bmatrix} \frac{1}{2}\left(\frac{\omega_1}{dz_1}\right)'(p), & \left(\frac{\omega_1}{dz_1}\right)(p), & \left(\frac{\omega_1}{dz_2}\right)(q) \\ \frac{1}{2}\left(\frac{\omega_2}{dz_1}\right)'(p), & \left(\frac{\omega_2}{dz_1}\right)(p), & \left(\frac{\omega_2}{dz_2}\right)(q) \\ \vdots & \vdots & \\ \frac{1}{2}\left(\frac{\omega_g}{dz_1}\right)'(p), & \left(\frac{\omega_g}{dz_1}\right)(p), & \left(\frac{\omega_g}{dz_2}\right)(q) \end{bmatrix}$$

Now the number of independent relations among the row vectors of this matrix is just the number of linearly independent holomorphic differentials vanishing up to order 2 at p and vanishing at q, that is, the dimension of $H^0(S, \Omega^1(-2p-q))$.

This explains that " Here, of course, we take the "linear span" of a point p_i with multiplicities a_i in D to be the span of p_i together with the first $a_i - 1$ derivatives of the canonical map. "

Finally, since the dimension of the linear span of d points on C is just $d-1$ less the number of independent linear relations on the points, we have the geometric version of the Riemann-Roch:

The dimension r of the complete linear system containing a divisor $D = \sum p_i$ is equal to the number of independent linear relations on the points p_i on the canonical curve,