The cogency of the evidence is admitted by every one who takes the trouble to compare a few signatures together, and to try making a few himself. I have taken thousands now in the course of the last twenty years, and (bar smudges and accidents, which are rarely bad enough to be fatal) I am prepared to answer for the identity of every person whose "sign-manual" I can now produce if I am confronted with him.

As an instance of the value of the thing, I might suggest that if Roger Tichborne had given his "sign-manual" on entering the Army on any register, the whole Orton case would have been knocked on the head in ten minutes by requiring Orton to make his sign-manual alongside it for comparison.

I send this specimen to you because I believe that identification is by no means the unnecessary thing in jails which one might presume it should be. I don't think I need dilate on that point. Here is the means of verifying the identity of every man in jail with the man sentenced by the court, at any moment, day or night. Call the number up and make him sign. If it is he, it is he; if not, he is exposed on the spot. Is No. 1302 really dead, and is that his corpse or a sham one? The corpse has two fingers that will answer the question at once. Is this man brought into jail the real Simon Pure sentenced by the magistrate? The sign-manual on the back of the magistrate's warrant is there to testify, &c.

For uses in other departments and transactions, especially among illiterate people, it is available with such ease that I quite think its general use would be a substantial contribution towards public morality. Now that it is pretty well known here, I do not believe the man lives who would dare to attempt personation before the registrar here. The *mukhtears*[1] all know the potency of the evidence too well.

Will you kindly give the matter a little patient attention, and then let me ask whether you would let me try it in other jails?

The impressions will, I doubt not, explain themselves to you without more words. I will say that perhaps in a small proportion of the cases that might come to question the study of the seals by an expert might be advisable, but that in most cases any man of judgment giving his attention to it cannot fail to pronounce right. I have never seen any two signatures about which I remained in doubt after sufficient care.

Kindly keep the specimens carefully.

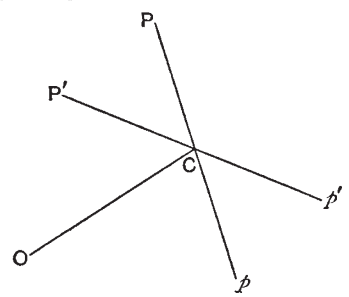
Yours sincerely,

W. HERSCHEL.

Boltzmann's Minimum Function.

MR. CULVERWELL, in his letter to NATURE of October 25, questions the existence of Boltzmann's minimum function, and asks will somebody tell us what the H-theorem really proves?

As I have made use of the theorem on several occasions, I may be permitted to say a word in its defence. I will endeavour to answer Mr. Culverwell's question what the theorem proves for the simple case of equal elastic spheres. If I can do that, it will probably not be difficult to generalise the result.



Let then V, or OC in the figure, denote the velocity of the common centre of gravity of two elastic spheres, each having diameter c. Let R be their half relative velocity. If we describe a spherical surface with radius R about centre C, and if Pp be any diameter of it, the actual velocities of two spheres are OP and Op.

Let the number per unit of volume of spheres whose velocities are represented by lines drawn from O to points within the element of surface dS at P be denoted by FdS. Let $f d$S denote the corresponding number for the element dS at p. Then F$f d$S is the number of pairs whose relative velocity R falls within the cone described with solid angle dS about PCp as axis. Let P'Cp' be any other diameter, and let F'dS', $f'd$S' be the corresponding number of spheres with velocities OP' and Op'.

[1] Attorneys.

If a pair of spheres collide the relative velocity assumes, as the result of collision, a new position only, and what that position shall be depends on the coordinates of the collision, *i.e.* the point in which a line parallel to the relative velocity through the centre of one sphere cuts a circular area of radius c, drawn through the centre of the other sphere at right angles to that line. If the collision coordinates be taken at random, then the following condition holds, viz.:—For any given direction of R before collision, all directions after collision are equally probable. Call that condition A.

Now assume condition A to be fulfilled, and consider all collisions which take place between pairs of the V R spheres.

The number which after the collisions belong to the class F$f d$S will be on the above assumption $\frac{d\mathrm{S}}{4\pi}\int\int \mathrm{F}' f' d\mathrm{S}'$.

But before the collisions it is F$f d$S. Therefore, as the result of collisions it is increased by $d\mathrm{S}\left(\frac{\int\int \mathrm{F}' f' d\mathrm{S}'}{4\pi} - \mathrm{F}f\right)$. That is by $\frac{d\mathrm{S}}{4\pi}\int\int(\mathrm{F}'f' - \mathrm{F}f)d\mathrm{S}'$, F$f$ being treated in the integration as constant.

Therefore

$$\frac{d\mathrm{F}}{dt} = \frac{df}{dt} = \frac{\pi c^2 \mathrm{R}}{4\pi}\int\int(\mathrm{F}'f' - \mathrm{F}f)d\mathrm{S}'$$

and if

$$\mathrm{H} = \int\int f(\log f - 1)d\mathrm{S},$$

$$\begin{aligned}\frac{d\mathrm{H}}{dt} &= \frac{\pi c^2 \mathrm{R}}{4\pi}\int\int d\mathrm{S}\int\int(\mathrm{F}'f' - \mathrm{F}f)\log(\mathrm{F}f)d\mathrm{S}' \\ &= \frac{\pi c^2 \mathrm{R}}{4\pi}\int\int\int\int d\mathrm{S}d\mathrm{S}'(\mathrm{F}'f' - \mathrm{F}f)\log(\mathrm{F}f) \\ &= \frac{\pi c^2 \mathrm{R}}{4\pi}\int\int\int\int d\mathrm{S}d\mathrm{S}'(\mathrm{F}f - \mathrm{F}'f')\log \mathrm{F}'f' \text{ by symmetry} \\ &= \tfrac{1}{2}\frac{\pi c^2 \mathrm{R}}{4\pi}\int\int(\mathrm{F}'f' - \mathrm{F}f)\log\frac{\mathrm{F}f}{\mathrm{F}'f'}d\mathrm{S}d\mathrm{S}',\end{aligned}$$

which is necessarily negative if not zero. The above is true for all values of V and R, and therefore for the whole system.

Thus we have proved that if condition A be satisfied, then if all directions of the relative velocity for given V are not now equally likely, the effect of collisions is to make H diminish.

The objection that I understand to be made is that if you reverse all the velocities after collisions, the system will retrace its course with H increasing—which is supposed to be contrary to the thing proved.

The objection is wrong because in your reverse motion condition A is not fulfilled. The proof (is not wrong but) ceases to be applicable by failure of the condition on which it is based.

Somebody may perhaps say that by this explanation I save the mathematics only by sacrificing the importance of the theorem, because I must (it will be said) admit that there are, after all, as many cases in which H increases as in which it diminishes. I think the answer to this would be that any actual material system receives disturbances from without, the effect of which, coming at haphazard, is to produce that very distribution of coordinates which is required to make H diminish. So there is a general tendency for H to diminish, although it may conceivably increase in particular cases. Just as in matters political, change for the better is possible, but the tendency is for all change to be from bad to worse.

S. H. BURBURY.

1 New Square, Lincoln's Inn, November 12.

The Kinetic Theory of Gases.

I CANNOT quite agree in Mr. Bryan's remembrance of what took place in the discussion of the Thermodynamics Report at Oxford. As far as I recollect, Prof. Boltzmann's reply was not in special reference to such a point as the specific heats of gases, but was in answer to a very vigorous, if somewhat general, onslaught of Prof Fitzgerald, who simply stated that it appeared evident from the spectra of gases and other considerations, that the energy could not be equally divided among all the degrees of freedom of the coordinates, and said what he wanted to know from Prof. Boltzmann was *when the theory*