3. While the iodide of silver commences its contraction at 142° C., and finishes it at 145°·5 C., the alloy commences to contract 18° C. lower (viz., at 124° C.) and finishes 6°·5 C. lower (viz., at 139° F.).

4. The chlorobromiodides of silver ("Proc. Roy. Soc.," vol. 25, p. 292) also began to contract on heating (an effect which, of course, we must attribute solely to the presence of iodide of silver), at 124° C., but they finished at 133° C.

5. The harsh sounds emitted by the alloy during cooling, and the tremors simultaneously propagated through the mass, prove that violent molecular agitation is going on at such time as the iodide of silver is passing from the amorphous plastic condition to the brittle crystalline condition, within the mass of the iodide of lead.

6. The fusing point of the alloy is 125° C. lower than that of the iodide of silver, which constitutes one-third of its weight, while it is only 19° C. higher than that of the iodide of lead, which constitutes two-thirds of its weight.

7. If the lowering of the fusing point (also markedly apparent in the case of the chlorobromiodides of silver) is due to the fact that similar particles of matter attract each other more powerfully than dissimilar, and hence when the particles of two bodies are mutually diffused, the attraction becomes less, and the molecular motion is consequently more readily assimilated, the same cause may serve to explain the commencement of the phase of contraction on heating the alloy at a temperature of 18° C. lower than the substance to which it owes this property.

The lead silver iodide alloy is finally compared with a chlorobromiodide of silver, which latter, although it contains 8 per cent. more of iodide of silver than the lead silver iodide alloy, undergoes a contraction on heating, which is more than twenty times less, although in both cases we must regard the effect as solely due to the iodide of silver.

II. "Permanent Molecular Torsion of Conducting Wires produced by the Passage of an Electric Current." By Professor D. E. Hughes, F.R.S. Received March 17, 1881.

In a paper on "Molecular Electro-Magnetic Induction," presented to the Royal Society March 7, 1881 (p. 524), I gave a description of the induction currents produced by the torsion of an iron wire, and the method by which they are rendered evident. The electro-magnetic induction balance there described is so remarkably sensitive to the slightest internal strain in anywise submitted to it, that I at once perceived that the instrument could not only determine any mechanical strain such as torsion or longitudinal stress, but that it might indicate the nature and cause of internal strains. Upon putting the

question to it, does the passage of electricity through a wire produce a change in its structure? the answer came, it does, and that to a very considerable extent; for an iron wire adjusted to perfect zero, and which would remain free from any strain for days, becomes instantaneously changed by the first passage of a current from a single cell of Daniell's battery; the wire has now a permanent twist in a direction coinciding with that of the current, which can be brought again to zero by mechanically untwisting the wire, or undoing that which the passage of electricity has caused. Before describing the new phenomenon, I will state that the only modification required in the apparatus, is a switch or key by means of which the telephone upon the wire circuit is thrown out of this circuit, and the current from a separate battery of two bichromate cells passed through the wire alone, at the same time, care being taken that no current passes through the coil, but that its circuit should remain open during the passage of the electric current through the wire under observation; an extra switch on this circuit provides for this. The reason for not allowing two currents to react upon each other, is to avoid errors of observation which may be due to this cause alone. When, however, we take an observation, the battery is upon the coil and the telephone upon the wire alone; an experiment thus consists of two operations. First, all external communications interrupted, and an electric current passed through the wire; and, second, the electric current taken off the wire, and all ordinary communications restored. As this is done rapidly by means of the switches, very quick observations can be made, or if desired the effects of both currents can be observed at the same instant.

Now, if I place upon the stress bridge a soft iron wire $\frac{1}{2}$ millim. diameter, 25 centims. long, I find, if no previous strain existed in the wire, a perfect zero, and I can make it so either by turning it slightly backwards or forwards, or by heating the wire to a red heat. If I now give a torsion to this wire, I find that its maximum value is with 40° torsion, and that this torsion represents or produces electric currents whose value in sonometric degrees is 50; each degree of torsion up to 40 produces a regular increase, so that once knowing the value of any wire, we can predict from any sonometric readings the value in torsion, or the amount of torsion in the opposite direction it would require to produce a perfect zero.

If now I place this wire at zero, and thus knowing that it is entirely free from strain, I pass an electric current through it, I find that this wire is no longer free from strain, that it now gives out induction currents of the value of 40, and although there is no longer any battery current passing through this wire that the strain is permanent, the outside coil neither increasing or diminishing; the internal strain it has received by the passage of an electric current through the wire,

upon giving a torsion to the wire in one direction, I find the inductive force increase from 40 to 90, but in the other direction it is brought to zero, and the amount of torsion some 35° required to bring the wire again to zero represents exactly the twist or strain that had been produced instantaneously by the passage of an electric current. If I repeat the experiment, but reverse the battery current sent through the wire, I find an opposite twist of exactly the same value as previously, and that it now requires an opposite torsion to again bring the wire to zero. It is not necessary, however, to put on an equal opposite torsion on wire to bring the currents to zero, for, as I have shown in my late paper, the sonometer not only allows us to measure the force and indicate its direction, but allows us to oppose an equal electric current of opposite name, thus producing an electrical zero in place of the mechanical one produced by torsion.

Evidently here there has been a sudden change in the structure of the wire, and it is a twist which we can both measure and reproduce. The question at once becomes, has a molar twist been given to the wire such as would be detected by the arm or free end of the wire, or a molecular change leaving no trace upon its external form of what has passed?

It will be found that, notwithstanding that it requires some 40° of torsion to annul the effects of a passage of an electric current, no visible movement nor any tendency of the free end to turn in the direction of the twist it has received can be observed. I believe, however, to have noticed a slight tremor or movement of half a degree, but as I could not always reproduce it, and as it is so slight compared with the 40° of internal twist, I have not taken it into account, for if the wire is firmly fastened at both ends, no molar torsion being possible, except an elastic one, which would instantly spring back to zero, the current on passing produces its full effects of twist and it is permanent. Thus, the molecules have in some extraordinary way rearranged themselves into a permanent twist, without the slightest external indication of so great a change having taken place. An equally remarkable change takes place in aid of, or against (according to direction of current) an elastic permanent strain. Thus, if I first put the wire under 40° right-handed permanent torsion, I find its value to be 50. Now, passing the positive of battery through its free end, and negative to fixed end, the induction currents rise at once in value to 90; if, now, the negative is momentarily passed through the free end and positive to fixed end the induced currents at once fall to 10, and these effects remain, for on taking off the elastic torsion the wire no longer comes to zero, but has the full twist value produced by the current.

Tempered steel gave only one or two degrees against 50 for soft iron, but supposing this might be due to its molecular rigidity, I care-

fully brought the wire to zero, and then observed the first contact only. I found, then, that the first contact gave a value of 40, but the second and following only one or two. By bringing the wire back to zero by a momentary touch with a magnet, a continued force of 40, or if constant reversals were used instead of a simple contact, there was constant proof of a similar great molecular change by the passage of a current in steel as well as iron.

I can find no trace of the reaction of the wire upon the magnetism of the earth, as in all positions the same degree of force was obtained if great care is take that the wire is absolutely free from longitudinal magnetism. There is, however, a slight reaction upon its own return wire if brought within 1 centim. distance of the wire, and this reduces the twist some 10°. The maximum effects are obtained when the return wire is not nearer than 25 centims.; thus, the action is not one produced by a reaction, but by direct action upon its internal structure.

Copper and silver wires so far show no trace of the action. I believe, however, that a similar strain takes place in all conductors, and I have obtained indirectly indications of this fact; in order, however, to verify this, would require a different method of observation from the one I have described, and I have not yet perfected the apparatus required.

It seemed probable that if I approached a strong permanent magnet to the wire, I should perceive a twist similar to that produced by the passage of a current; but no such effects were observed, but it has a most remarkable effect of instantly bringing to zero a strain produced by the current, and, no matter which pole, the effect was the same. Thus, a strain of 50°, which remains a constant, instantly disappears upon the production of longitudinal magnetism, and I have found this method of reducing an iron wire to zero of strain far more effective than any other method yet tried, such as vibrations, heat, twisting, &c.

It will be seen from this that the molecular arrangement set up by magnetism is very different from that produced by the passage of an electric current. It evidently has a structure of its own, else it would not have instantly destroyed the spiral strain left by the passage of electricity if it had not taken up a new form, as rendered evident in the longitudinal magnetism, which we could at once perceive on the wire. This question, however, belongs to a separate investigation, and I hope the apparatus will aid me later in throwing some new light upon this subject.

Another method of reducing the wire to zero, after the passage of a current, is to keep the wire in a constant state of vibration. It requires in time about one minute to bring it to zero, but if, on the contrary, I set the wire vibrating during the passage of the current,

the permanent twist becomes greater and more difficult to reduce to zero.

If a wire which has internal strains is heated to redness, these strains almost entirely disappear, and I can thus reduce by heat a strain which a current had produced, but heat, whilst allowing of greater freedom and motion of its molecules, does not prevent an internal strain being set up, for whilst heat can reduce the wire to zero, after the passage of the current, the effects are increased. If, during the time that the wire is at a red heat, the current is passed in the same time, and at the same instant we take off the current and the external heat, the wire when cold will be found to have a higher degree of strain than previously possible with the wire when cold.

We have seen that both mechanical vibrations and heat can reduce the wire to a zero, but its action is very slow, several minutes being required; but the action of electricity in producing a permanent twist is exceedingly quick. I have found that a single contact, whose duration was not more than 0·01 of a second, was equal to that of a prolonged contact of several minutes, and magnetism was equally as quick in reducing this strain to zero. And it is the more remarkable when we consider the very great mechanical force required by torsion of the wire to untwist the strain produced in an instant of time by electricity.

The results I have given are those obtained upon soft iron wires of $\frac{1}{2}$ millim., but I have experimented with different sizes up to 3 millims. diameter. The results with 1 millim. diameter were quite as evident as the $\frac{1}{2}$ millim., but on the 3 millim. wire the strain was reduced to 25° instead of 50°, owing to the extreme rapidity and low electrical resistance compared with my small battery wires. On a telegraph line, the wire of which is almost entirely of iron, there must be a very great strain set up, which, however, would remain a constant, except where reversed currents are used, and in this case a constant movement of the molecules of the wire must be the result.

I believe it to be most important that we should determine, as far as we can by experimental research, the nature of all molecular changes produced by electricity and magnetism, and in this belief I am happy in being able to bring this paper before the Royal Society.

III. "On the Tendinous Intersection of the Digastric." By G. E. Dobson, M.A., M.B. Communicated by Professor J. D. Macdonald, M.D., F.R.S. Received March 14, 1881.

The digastric muscle in man and in many other mammals consists as is well known, of an anterior and a posterior portion, united by a