same or different molecules, is the algebraical sum of the powers of the individual forces.

From the parallelogram of motions it follows that—

Prop. I. The power of the resultant of a system of forces imparted to a single molecule is equal to the power of the forces. Whence—

Cor. 1. If the forces imparted to a molecule are in equilibrium, their power for any actual or hypothetical motion of the molecule is zero.

Cor. 2. If the forces imparted to a molecule are not in equilibrium, their power for any motion in the direction of the resultant is positive.

Definition.—A system of molecules is said to be passive for a given motion when for that motion the power of its internal forces is zero.

Prop. II. The power of the external forces of a system for actual or hypothetical motions for which the system is passive is equal to the power of the resultant motions of the several molecules of the system.

For (by Prop. I.) the power of the resultant forces for each (and therefore for all) of the molecules is equal to the power of the external together with that of the internal forces, but the latter, in the case of the entire system, is zero by hypothesis.

Cor. 1. If external forces be imparted to a passive system at rest in a given position such that for any hypothetical motion through that position the power of such forces is zero, the system will remain at rest.

For if motion ensued, the resultant and therefore (Prop. I.) the external forces would have positive power for such motion, which is contrary to hypothesis.

Cor. 2. If external forces be imparted to a passive system at rest, and be in equilibrium, the power of these forces for any hypothetical motion of the system through this position of rest is zero.

For as the whole system is at rest each molecule is at rest, and the resultant forces of the molecules are all of them zero, whence their power and therefore that of the external forces (Prop. I.) is zero.

It will be seen that Prop. II. is (or is equivalent to) *D'Alembert's Principle*, and its two corollaries constitute what is called the *Principle of Virtual Velocities*.

It may be urged that this merely relegates the difficulty to determining for what motions systems are passive. This really, however, presents no difficulty, for it is obvious that a system is passive generally when its internal forces neither tend to produce or destroy kinetic energy in the system; so that (1) rigid systems are passive for all motions consistent with their rigidity; (2) all systems are passive for rigid motion; (3) inelastic and theoretically perfect funicular systems are passive; and (4) inelastic and theoretically perfect fluid systems are passive, &c.

D'Alembert's principle and the principle of virtual velocities ought to form the basis of that part of kinetics which involves the idea of the transmission of force, whether the result is motion or equilibrium. D'Alembert's principle is the most general. The principle of virtual velocities is to it what Maclaurin's theorem is to Taylor's. The form in which it is given in Prop. II. above is more convenient for use than that in which it is generally stated, viz. that the resultant forces reversed balance the impressed forces.

Lagrange's proof of the principle of virtual velocities and its modifications are altogether too artificial and unsatisfactory.

Cape of Good Hope F. GUTHRIE

Recent Gales

THE gales of October 16 and December 8 varied considerably. In the former gale there were constant oscillations, from ·004 to ·010 of an inch, every 30 seconds between 1 a.m. and 2 a.m.; whilst in the December gale there were no oscillations, but a constant fall that was most rapid during squalls. The difference between the dry and wet bulb thermometers in the October gale was only a quarter of a degree, whilst in that of December it exceeded from $2\frac{1}{2}°$ to $3\frac{1}{2}°$ (or a difference of from thirteen to eighteen times as great). During the gale in October, 1·160 inches of rain fell, and in that of December 0·758 of an inch.

The lowest reading (corrected for temperature) of the barometer at 530 feet above the sea was on October 16, 28·019, and on December 8, 27·693 inches (this occurred at 8 p.m.).

The barometer reduced to sea-level was less than 28·5 inches from 11.30 a.m. of the 8th till 8.15 a.m. of the 9th (or nearly 21 hours). The October gale was W.S.W., and the December gale W.

		Hour	Barometer reduced to sea-level	Temp. °	Wet bulb °	Diff. °
Oct.	15,	4.15 p.m.	28·880	49·7	49·5	0·2
	16,	12.15 a.m.	28·811	47·8	47·6	0·2
		2.15 ,,	28·699			
		7.45 ,,	28·591	47·2	47·0	0·2
		8.30 ,,	28·668	47·7	47·5	0·2
		10.0 ,,	28·744	47·8	47·6	0·2
		2.45 p.m.	28·941	47·8	47·6	0·2
		5.0 ,,	29·042	47·8	46·8	1·0
Dec.	8,	2.20 a.m.	29·212			
		3.30 ,,	29·144			
		8.5 ,,	28·596			
		10.0 ,,	28·561	40·3	38·7	1·6
		2.0 p.m.	28·431	40·3	37·5	2·8
		3.30 ,,	28·378	37·3	34·7	2·6
		6.0 ,,	28·287			
		7.30 ,,	28·278			
		8.0 ,,	28·273	39·7	37·0	2·7
		9.0 ,,	28·286			
	9,	12.30 a.m.	28·327	37·0	33·4	3·6
		2.45 ,,	28·297			
		5.50 ,,	28·342			
		10.0 ,,	28·642	42·0	38·7	3·3
		7·0 p.m.	28·987			
	10,	10·0 a.m.	29·339	41·6	38·6	3·0

The last gale commenced at 1 a.m. on the 8th (with constant squalls of hail and rain), and was most violent from 4.45 p.m. till 8.30 p.m.

Thunder and lightning occurred from 11 a.m. till 11.30 a.m.; and from 4 p.m. till 4.40 p.m. on the 8th, and from 1.35 a.m. till 2.45 a.m. on the 9th.

Much damage was done to house-roofs. Very few trees were blown down here, for in this exposed situation trees are better prepared to resist gales. About 11 feet of the top of a large specimen of *Picea Webbiana* was destroyed. E. J. LOWE

Shirenewton Hall, Chepstow, December 11

Note on the Manipulation of Glass containing Lead

IN reading Mr. Shenstone's very useful little treatise on glass-blowing (reviewed in NATURE of the 9th inst., p. 123), I have failed to notice any mention of an expedient which I have found very useful for dealing with English flint-glass containing much lead silicate; although I greatly prefer for most purposes the readily fusible "soda-glass" used probably everywhere except in England.[1]

Of course, all ordinary flames, such as those of the Bunsen burner and the blow-pipe, consist, in part, of reducing gases which cause the separation of lead from glass introduced into them. This reduction can be prevented or remedied, as Mr. Shenstone says, by holding the glass a little in front of the visible flame; but there is in this region hardly enough heat to do all that is required in the manipulation of the glass.

If, however, oxygen instead of air is used in a Herapath blow-pipe, the resulting flame has so little reducing power, that lead-glass can be safely held well within it; and this is the flame that I always use in dealing with such glass.

It is true that oxygen is, at present, rather more expensive than air; but most, if not all, laboratories have a supply of the gas, either in a gas-holder or a bag, for the optical lantern and other purposes; and with it the manipulation of lead-glass becomes what shaving is, in certain advertisements, *said* to be—"a luxury." H. G. MADAN

Eton College

P.S.—The oxy-coal-gas blow-pipe is also extremely useful for difficultly-fusible "combustion-tubing." Bulbs of fair size can be blown, and side-junctions, &c., made in this glass, with almost the same facility as in ordinary "soda-glass."

[1] The *best* glass of this kind is that used by Geissler, Alvergniat, and others, for making their marvellous specimens of glass-work; but I doubt if glass of the same excellence, in regard to fusibility and freedom from any tendency to devitrify, is generally procurable.