the idea of mechanic force, in practice, is always the same, and is proportional to the *space* through which any *moving force* is exerted, or to the *square* of the velocity of a body in which such force is accumulated.

Mémoire sur les Quantités imaginaires. Par M. Buée. *Communicated by* William Morgan, *Esq. F.R.S.* Read June 20, 1805. [*Phil. Trans.* 1806, *p.* 23.]

Chemical Experiments on Guaiacum. By Mr. William Brande. *Communicated by* Charles Hatchett, *Esq. F.R.S.* Read December 19, 1805. [*Phil. Trans.* 1806, *p.* 89.]

No one of the resins, Mr. Brande observes, possesses so many curious properties as that called Guaiacum; and he thinks it remarkable, that although many of the alterations it undergoes, when heated with different solvents, have been mentioned by various authors, it has not excited a more particular attention.

After noticing its more obvious properties, of which we shall only repeat, that when pulverized, it is of a gray colour, but gradually becomes greenish by exposure to the air, he proceeds to examine the action of various solvents upon it.

The first solvent tried by Mr. Brande was water; about 9 per cent. of extractive matter was taken up, and the solution appeared also to contain a small portion of lime. Alcohol, which was next tried, dissolved nearly the whole of the guaiacum, leaving only about 5 per cent. of extraneous matter. The effects of water, of various acids, and of alkalies, upon this solution, are then noticed. Water forms a milky fluid, which passes the filter. Muriatic acid throws down an ash-coloured precipitate. Liquid oxymuriatic acid forms a precipitate of a pale blue colour. Sulphuric acid forms one of a pale green. Acetic acid does not form any precipitate; nor does nitric acid until after the expiration of some hours, unless water be added, in which case a precipitate may be sooner obtained. This precipitate is of a green or a blue colour; whereas that which forms spontaneously is brown. Alkalies do not form any precipitate when added to the solution of guaiacum in alcohol.

Guaiacum is less soluble in sulphuric ether than in alcohol, but the properties of the two solutions are nearly similar.

Muriatic acid dissolves only a small portion of guaiacum. Sulphuric acid forms with that substance a deep red liquid, which, when fresh prepared, deposits a lilac-coloured precipitate on the addition of water. The effects of nitric acid on guaiacum are minutely examined, of which we shall only mention, that this acid, when its specific gravity was 1·39, completely dissolved guaiacum, which solution, after standing some hours, deposited a quantity of crystallized oxalic acid; but when the nitric acid was diluted, a slight effervescence took place, and a part only of the resin was dissolved, the remainder being converted into a brown substance, which was similar

to the brown precipitate obtained, by nitric acid, from the solution of guaiacum in alcohol, and possessed the properties of a resin in greater perfection than guaiacum itself. If successive portions of nitric acid be added to the above-mentioned residuum, or if a large quantity of that acid is employed so as to form a complete solution, a product may be obtained, by evaporation, which is equally soluble in water and in alcohol; both which solutions have an astringent bitter taste.

Guaiacum is soluble in the pure and in the carbonated alkalies. The precipitates formed from these solutions, by dilute sulphuric acid and by muriatic acid, were of a flesh colour, and approached to the nature of extract; being less acted upon by sulphuric ether, but more soluble in boiling water than guaiacum.

Mr. Brande now proceeds to the analysis, by distillation, of the substance here treated of. By this method he obtained, from 100 grains, the following products:—

Acidulated water..........................	5·5
Thick brown oil, becoming turbid on cooling	24·5
Thin empyreumatic oil	30·0
Coal remaining in the retort	30·5
Mixed gases, chiefly carbonic acid and carbonated hydrogen..............................	9·0
	99·5

The coal, on incineration, yielded four grains of lime, but no alkali could be discovered.

From the foregoing experiments it appears, that although guaiacum possesses many of the properties common to resins, it differs from them in the following circumstances.

1. By affording a portion of vegetable extract.

2. By the alterations which take place in it when submitted to the action of bodies which readily communicate oxygen, such as nitric and oxymuriatic acids, and by the rapidity with which it is dissolved in the former.

3. By being capable of being converted into a more perfect resin, in which it resembles the green resin that constitutes the colouring matter of leaves.

4. By yielding oxalic acid.

5. By the quantity of charcoal and lime obtained from it by distillation.

These circumstances, the author says, shows that guaiacum differs not only from the substances denominated resins, but also that it differs from those which are called balsams, gum-resins, gums, and extracts; and he thinks we may, for the present, consider guaiacum as composed of a resin, modified by the vegetable extractive principle, so that it may perhaps, without impropriety, be defined by the term Extracto-resin.

In a postscript Mr. Brande observes, that the action of oxygen on some other resinous bodies is very remarkable. By digesting mastic

in alcohol, a partial solution is formed, leaving an elastic substance, which is said to possess the properties of caoutchouc, but which becomes hard by exposure to the air.

The author has remarked, that the portion of mastic dissolved in the alcohol may be precipitated from it by water, and that this precipitate possesses the properties of a pure resin; but when a stream of oxymuriatic acid gas was passed through the solution, a tough elastic substance was thrown down, which became brittle when dry: this precipitate was soluble in boiling alcohol, but separated from it as the solution became cool. Its properties, therefore, approached in some measure to those of the original insoluble part.

On the Direction of the Radicle and Germen during the Vegetation of Seeds. By Thomas Andrew Knight, *Esq. F.R.S. In a Letter to the Right Hon. Sir* Joseph Banks, *K.B. P.R.S.* Read January 9, 1806. [*Phil. Trans.* 1806, *p.* 99.]

It is, Mr. Knight observes, very well known, that in whatever position a seed is placed to germinate, its radicle always makes an effort to descend towards the centre of the earth, whilst the elongated germen takes a precisely opposite direction: and it has been proved by Du Hamel, that if a seed, during its germination, be frequently inverted, the points, both of the radicle and germen, will return to their first direction. These opposite effects have, by some naturalists, been attributed to gravitation; and Mr. Knight conceived, that if they really proceeded from that cause, those effects would take place only whilst the seed remained at rest, in the same position with respect to the attraction of the earth, and that the operation of gravitation would be suspended by a constant and rapid change of position in the germinating seed, and might be counteracted by the agency of centrifugal force. In order to determine how far the above opinion was well founded, he made the following experiments:—

Having a strong rill of water passing through his garden, he contrived, by its means, to give motion, vertically, to a wheel of eleven inches diameter. Round the circumference of this wheel, several seeds of the garden-bean, which had been previously soaked in water, were bound in such a manner that their radicles were made to point in every direction. The wheel made rather more than 150 revolutions in a minute.

In a few days the seeds began to germinate, and Mr. Knight had the pleasure to see that the radicles, in whatever direction they were protruded, turned their points outwards from the circumference of the wheel, and in their subsequent growth receded still further from it. The germens, on the contrary, took the opposite direction; and in a few days their points met at the centre of the wheel. Three of these plants were suffered to remain on the wheel; their stems soon extended beyond its centre, but their points returned, and met again at the centre.