The increase of the pressure of the air inside the boiler is therefore almost entirely due to the increase of temperature of this air raised from t to t^1 by the effect of heat, Q, developed by the detonation. If w be the weight of air in air-boiler, and c the specific heat, with constant volume, then $wc\,(t'-t) = Q$. Moreover, P and P′ being the pressure expressed in metres of air before the detonation, $T = t + 273$, the absolute temperature of the air before explosion; P its pressure in metres of water, then $\frac{P'-P}{P} = \frac{t'-t}{T}$ whence $P'-P = \frac{P}{T} \times \frac{Q}{wc}$ Again $P = 10\cdot33 \times \frac{H}{760}$ and $w = 10\cdot71 \times 1\cdot293 \times 1\cdot293 \times \frac{273}{T} \times \frac{H}{760}$ whence taking $c = 0\cdot168$, $P'-P = 0\cdot0171Q$, and $Q = 58\cdot4\,(P'-P)$, in which H is the height of the barometer in millemetres of mercury, 10·171 cubic metres is the capacity of the boiler, and 1·293 kilogrammes is the weight of one cubic metre of air at normal temperature and pressure.

Experimental Result for Dynamite.—Almost completely detonated unconfined.—Take the case of dynamite: A cartridge (curve N, fig. 9) of 772gr. of dynamite at 75 per cent. Vonges, detonating unconfined, develops a pressure P - P = 0·33; hence Q = 48·5, and for 100 grammes (1,543gr.) Q=97.

The heat produced by the complete decomposition of dynamite may be reckoned at 1,110 calories, or 55·5 calories for 50 grammes, the temperature of the detonation of dynamite being equal to 5,252° Fahr., and the specific heat of the earth being 0·19. If this quantity of heat is immediately restored to the air in the boiler the quantity of heat, Q, would not be more for 10 grammes than 97·2 calories. The figures differ so little from that observed experimentally, that it may be assumed that the detonation of unconfined dynamite causes its complete decomposition.

Experimental Results of Various Explosives.—If similar calculations are made for other explosives, the results contained in the annexed table are obtained. This table shows that dynamite, as previously mentioned, detonates almost perfectly unconfined. Military gun-cotton, = (0·81 cubic inch) approaches very nearly to complete detonation under same conditions. In mining-cotton, even for certain mixtures, low in nitrogen of cotton of 0·68 and nitrate of ammonia, and for mixtures of dynamite and of sal-ammoniac, the amount of heat disengaged on detonation is greater than the theoretical quantity. With most of the explosives the amount of heat disengaged on detonation is less than the theoretical quantity. It should be concluded from this that these explosives only detonate imperfectly when unconfined. The imperfect detonation is doubtless due to the fact that the reactions assumed in theory, and which are actually produced in a closer vessel, as will be shown further on, have not time to be produced when the explosive is not confined in the infinitely short time during which the gases are kept in contact. Not only are the reactions very incomplete, but they become altogether different reactions from those expected. Mr. Berthelot has laid great stress on this possible variation in the nature of decompositions and reactions, more especially in the case of nitrate of ammonia. Moreover, one imagines that the phenomena would be still more marked with dual explosives, in which it is assumed—(1) That the detonation of one of the two substances entail that of the other; (2) That gases produced by the simultaneous detonation react on each other. These two hypotheses may both fail without the second.

Nature of Explosive.	Weight of Cartridge.	Weight of Fulminate in Detonator.	Pressure (P′ − P) observed in Inches of Water.	Q. Deducted for 1,543gr.	Q. Theoretical for 1,543gr.
	Gr.	Gr.	In.	Units of Heat.	Units of Heat.
Dynamite (75 per cent.)	771·6	23·15	32·68	385·1	385·9
Military cotton (=0·81 cubic inch) ...	771·6	23·15	28·35	349·4	402·9
Mining-cotton (=0·71 cubic inch)	771·6	23·15	58·27	682·8	408·9
Blasting-gelatine (Paulilles)	617·3	23·15	22·05	318·4	609·3
" "	771·6	23·15	27·17	319·9	
Bellite	771·6	23·15	9·84	115·9	397·8 (1)
" (Paulilles)	771·6	23·15	11·02	129·8	
" "	771·6	46·30	13·39	158·0	
Pyroxyline-powder (Moulin Blanc) ...	771·6	23·15	17·52	202·5	325·5 (2)
" " ...	771·6	23·15	20·47	241·4	
" " ...	771·6	23·15	23·62	277·9	
" " ...	1,003·1	23·15	24·02	217·2	
Cotton, 58; nitrate of barium, 42 ...	771·6	23·15	27·56	325·5	321·6 (3)
" (=0·68), 20; ammonia nitrate, 80 ...	771·6	23·15	5·91	69·5	317·6
" " 25; " 75 ...	771·6	46·30	16·14	190·6	361·3
" " 35; " 65 ...	771·6	23·15	16·93	198·5	404·9
" " 60; " 40 ...	463·0	23·15	13·78	270·4	381·1
" " 80; " 20 ...	463·0	23·15	24·80	488·3	325·5
" " 90; " 10 ...	463·0	23·15	37·01	726·5	301·7
Dynamite, 20; ammonia-nitrate, 80 ...	771·6	23·15	8·86	104·8	198·5
" 67; " 33 ...	771·6	23·15	17·52	206·4	210·4 (4)
" 50; sal ammoniac 60 ...	771·6	23·15	16·54	195·3	39·7 (5)
" 60; " 40 ...	771·6	23·15	17·32	204·4	138·9
" 67; " 33 ...	771·6	23·15	20·87	246·1	194·5

(1) Calculated assuming 17·5 per cent. dinitro-benzol and 8·25 per cent. nitrate of ammonia.
(2) Decomposed to $Ba\,CO_3$.
(3) Decomposed to $Ba\,CO_3$.
(4) Quantity of heat calculated, assuming complete combustion of the nitro-glycerine and simple dehydration of the alum.
(5) These quantities of heat are calculated on the supposition of the decomposition of the sal ammoniac into $HCl_2 + N + 3H$, and the complete combustion of the nitro-glycerine.