STEAM.

Τηε articles Steam and Steam-enginein the third edition of the present work were originally written by Dr Robison, and were long the standards of reference upon these subjects. The rapid progress of science and *of* the mechanical arts during the present century, has now rendered it necessary to substitute for these articles those maturer results of recent research, to the attainment of which the original papers were themselves the means of very materially conducing. The value of these original researches was further enhanced by passing through the hands of the man of all others the most capable of appreciating their value, and the best qualified to increase it by his contributions. It was the early friend and companion of Professor Robison, Mr Watt himself, who, towards the close of his life, and notwithstanding the laborious nature of the undertaking, agreed to revise those articles for republication, so as to present them to the public with somewhat of that greater completeness which it is to be presumed their author would himself have conferred upon them, had he lived to see the investigations which he had begun, carried forward and completed. Mr Watt was, however, prevented by the weakness of increasing years from doing more than adding notes to these articles, and they were accordingly printed in that form; but they contain a most interesting chapter of the history of inventive genius, for they give us, in Watt’s own words, the history of the progress and consummation of his own noble inventions, and display the efforts of genius working its way through the obscurities of imperfect knowledge to the discovery of pure truth and the achievement of the most exquisite combinations.

While, therefore, it was impossible to retain the articles themselves, it was highly desirable that all that had rendered them valuable should be retained, and more especially such portions as serve to record the state of the mechanics and physics of steam at that time, and the pro gress of the invention ; and these, together with the notes of Mr Watt, it has been thought better to give in the precise words of the original, than to transpose them into language which could neither be more clear nor more appropriate than that with which their authors had invested them. Such portions of the articIes on steam and the steam-engine, as have been in this manner retained, are distinguished by an appropriate mark. Paragraphs from the pen of Dr Robison have a star \* placed at their commencement ; those of Mr Watt, in like manner, have a cross. To all that was interesting and valuable in the original articles, an attempt has been made to superadd whatever subsequent labour and research may have brought to light. These remarks apply to the articles Steam and Steam-engine. Steam Navigation is entirely new.

SECTION I.—CONSIDERATIONS OP A GENERAL NATURE

REGARDING THE PROPERTIES, PHENOMENA AND APPI.ICATIONS OF STEAM.

1. \* Steam is the name given in ourlanguage to the visible, moist vapour which arises from all bodies which contain juices easily expelled from them by heats not sufficient for their combustion. Thus we say, the steam of boiling water, of malt, of a tan-bed. It is distinguished from smoke by its not having been produced by combus tion, by not containing any soot, and by its being conden­

sible by cold into water, oil, inflammabIe spirits, or liquids composed of these.

2. \* We see it rise in great abundance from bodies when they are heated, forming a white cloud, which diffuses itself and disappears at no very great distance from the body from which it was produced. In this case the surrouuding air is found loaded with the water or moisture which seems to have produced it, and the steam seems to be completely soluble in air, composing, while thus united, a transparent elastic fluid.

3. \* But, in order to its appearance in the form of an *opaque white* cloud, the mixture with or dissemination in air seems necessary. If a teakettle boils violently, so that the steam is formed at the spout in great abundance, it may be observed, that the visible cloud is not formed at the very mouth of the spout, but at a small distance before it, and that the vapour is perfectly invisible at its first emission. This is rendered still more evident by fitting to the spout of the teakettle a glass pipe of any length, and of as large a diameter as we please. The steam is produced as copiously as without this pipe, but the vapour is transparent and colourless throughout the whole of the pipe. Nay, if this pipe communicate with a glass vessel terminating in another pipe, and if the vessel be kept sufficiently hot, the steam will be as abundantly produced at the mouth of this second pipe as before, and the vessel will remain quite transparent. The visibility, therefore, of the matter which constitutes the steam is an accidental circumstance, and appears to require its dissemination in the air ; and we know that one perfectly transparent body, when minutely divided and diffused among the parts of another transparent body, but not dissolved in it, makes a mass which is visible. Thus oil beaten up with water makes a *white opaque* mass.

4. If the column of steam which ascends from a boiler that is suddenly opened, be observed in a clear dry day, when the sun is shining, the column of vapour, gradually widening as it rises, will be observed to be of a very brilliant silvery white, and will cast a strong dark shadow upon the objects which it intercepts from the direct rays of the sun : but, if the observer be placed in this shadow, the sun will appear to him to be of a strong tawny, or fiery red colour, or, if the column be very dense, the sun will be invisible. These appearances closely resemble some phenomena of the clouds, which we know are corn posed of watery vapour, and which sometimes appear of a fleecy white, again of a fiery red or a burnished gold colour, or again of a dappled grey, down through every degree of darkness, until the vapour become so dense and opaque as altogether to obscure the light of the sun by a thick black cloud. These appearances have been satisfactorily accounted for. Steam, in its attenuated state, is a transparent, invisible, colourless gas. When disseminated through the air, in excessive quantities, small globuIes are formed, of a film of water, enclosing light vapour. These globules, floating thickly in the air, form an aggregation of minute films of fluid, capable of reflecting and trans­mitting light. When we are so placed that the light may be reflected to us, and when the cloud is so thick as to reflect it completely, we have the same brilliant white which results from the comminution of glass, rosin, ice, and other transparent media ; and, nt the same time, an observer, placed on the opposite side of the cloud, sees it as a dense black opaque mass, because the light being totally