obliquely outwards, by whose reaction, as the wind issues, it appears to be the inventor's design to impel and to guide the balloon.

MASON (No. 714, p. 474*) has exhibited the model of a navigable balloon, to be worked and directed by means of sails, helm, and mariner's compass. The model exhibited is upon a scale of a quarter of an inch to a foot. From what may be regarded as its after part, project laterally axles, giving a rotary motion to sails of the nature of screw-propellers.

PLUMMER (No. 716, p. 474*) has exhibited the working model of an aerial machine, furnished with wings or sails, put in motion by a clock-spring.

Calculating Machines.

There have been very many attempts to perform numerical calculations by mechanical means, or at least such parts of them as follow simple and rigid laws. Hitherto such instruments have failed to unite correctness in the results, combined with economy of time, and, for the most part, have been limited to the performance of the first two operations of arithmetic.

To make such instruments really useful, they must have the power of executing, by themselves, the successive operations for the solution of the problem imposed on them, when the simple data for this problem have been introduced, without trial, and without guess-work.

The best machine of this kind exhibited is that of Staffel (Russia, 148), which, on examination, seems to combine accuracy with economy of time, and works easily and directly. The mechanism is 18 inches in length, 9 inches in breadth, and 4 inches in height, and consists of three rows of vertical cylinders; the first contains 13, the second 7, and the third 7. Upon each of the cylinders in the first row are 10 notches, corresponding with the units 1 to 10. Within each of these cylinders is a small pulley, in connection with a lever, set in motion by a slider which, when the cylinder has been turned from either 9 to 0, or 0 to 9, sets in motion the lever, and communicates its action to wheels, which carry over the figures. The pulley connected with the cylinder, the furthest from the handle, is in connection with the hammer of a bell. The purpose of this bell is to give warning to the operator, on committing an error, and constitutes a most important addition to the machine, particularly in the operation of division.

Upon each of the cylinders in the second row 10 units are placed. These seven cylinders are so fixed upon their axes, that they can bodily be moved right and left, and fixed at any part, so that the cyphers in the two cylinders can be made to correspond. This cylinder is furnished with a spike, which lays hold of and works the third row of cylinders.

The internal communication of each of the parts is brought about by means of a connecting wheel, furnished with nine moveable pegs, which are set in motion by means of an eccentric incision in the dial.

The machine is capable of performing addition, subtraction, multiplication, division, and of extracting the square root.

The operation of addition is performed as follows:—

By simply placing one line of the numbers upon the second row of cylinders (the index pointing to addition), and turning the handle, till it stops, these numbers are transferred almost instantly to the first row of cylinders, and so on successively, till all the numbers to be added are transferred, and their sum is shown on the top row.

In performing subtraction, the first part of the operation is the same as in addition, but on placing the second line of figures on the second row of cylinders, the pointer being placed to subtraction, the handle is turned the opposite way, or against the motion of the sun, and the difference of the two numbers is shown on the upper line.

The operation of multiplication is performed by placing the multiplier and the multiplicand on the second and third rows of cylinders, and then, the index pointing to multiplication, the product will be found on the first cylinder.

The operation of division is very similar, excepting that the handle is turned as in subtraction.

These several operations were performed accurately, and with despatch.

In the performance of the square root, the following additional mechanism needs explanation. Between every division of the cylinder, in row 2, a small wheel is placed, and near it a projecting piece which acts upon a lever; when the projecting piece is near the word "rad" engraved on the cylinder, on turning the handle, the figures increase by 1. This, by other mechanism, is connected with the other two rows of cylinders. The operation of the square root is performed directly, without any guessing at numbers; but it is, comparatively, rather a long process.

Upon the whole it must be considered that Mr. Staffel has made an instrument possessed of considerable powers, and that great praise is due to him. The double motion of the handle as well as the warning bell are important improvements.

Mr. Staffel also exhibits a small mechanical machine for the performance of the addition and subtraction of fractions, whose denominators are 10, 12, and 15. By enlarging the machine, this number would be increased, and the power of the instrument extended. The operations were performed with quickness, and with accurate results. A Prize Medal was voted to Mr. Staffel.

THOMAS DE COLMAR (France, No. 390, p. 1196) exhibits the next best calculating machine in the Exhibition, and has combined the two essentials of economy of time and accuracy of results. It is adapted for the performance of the four first rules of arithmetic; and indirectly the square-root may be extracted by the knowledge of $a^2+2ab+b^2$, the results being inferred; but this is not the legitimate use of the instrument.*

The instrument is adapted for the multiplication of numbers whose product is expressed by less than 16 figures; and consists of two rows of cylinders, the one containing 16, and the second 8; the former are moveable, the operation at each step being changed tenfold.

The principle of the instrument is, that multiplication is in reality the continual addition of itself as many times as there are units in the multiplier, and division that of continued subtraction of the divisor.

On trying the machine, the number 1 was almost instantaneously taken from 10,000, giving the difference, 9,999, accurately; the performance of this operation is generally a severe test to these machines.

The number 5,321 was multiplied by 3,256 in less time than was required to perform the calculation, in the manner following:—The number 5,321 was placed on one series of cylinders, and the number 6 was placed on one of the cylinders of the second row, and on the handle being turned (in one direction always) the number 31,926 appeared; the upper row was moved through one division, the handle again turned, and so on, till in a very short time, the number 17,325,176 appeared.

The several operations to which the instrument was subjected were performed quickly and accurately.

A Prize Medal was voted to M. Thomas De Colmar.

WERTHEIMER (No. 387, p. 451) exhibits several calculating machines, adapted for the performance of addition and subtraction of numbers and moneys, of this and of other countries.

Each machine consists of a box, with a metal plate divided into nine indexes, with semicircular notches, under which are placed a succession of holes. Round the indexes, numbers are engraved, and the semicircular notches are furnished with teeth, and a pointer to insert between the notches, for the purpose of bringing the notch opposite any particular figure, from right to left. This operation is dangerous, for the notch is liable to slip and not go home.

The instruments are ingenious, but they are much wanting in the essentials of such machines, viz., economy of time and unerring accuracy. The Jury, however, voted Honourable Mention to them.

* For a description of this ingenious and useful machine, see the report of M. Benoit, "Au nom du Comité des Arts Mécaniques, Société d'Encouragement."

SCHILT (Switzerland, No. 59, p. 1270) exhibits a simple calculating machine, but which can perform the first operation of arithmetic only. Honourable Mention was voted to Mr. Schilt.

ROOKER (No. 340, p. 448) has exhibited a sliding scale of involution, the invention of Dr. Roget. The instrument consists of one fixed and one moveable scale, like a sliding rule. On the slide a line is logometrically divided, the divisions of one half being from 1 to 10, and repeated on the second half in the same order.

The fixed scale is graduated in such manner, that each of its own divisions is set against its respective logarithm on the slider, and, consequently, all the numbers on the slider will be situated immediately under those numbers in the fixed scale, of which they are the logarithms. Thus, 3 on the fixed scale will stand under 100 on the rule, and so on.

The instrument is adapted to perform the operations of involution and evolution. The principle of the instrument is contained in the equation—

$$\text{Log. log. } a^x - \text{log. log. } a = \text{log. } x.$$

rom the first member of which a disappears. Two differences of the second logarithms of the power and of the root being equal to the first logarithms of the index, it is evident, that if a scale of second logarithms be engraved on one line, and a first on a line sliding along it, the indexes being read off on the latter, the power will be so on the former.*

LALANNE (France, No. 1690) exhibits a calculating rule, constructed upon new principles, consisting of a graphic table formed entirely of right lines, with which all calculations, usually performed by the sliding rule, can be performed to within 1-200th of the true result. The Jury awarded Honourable Mention to this Exhibitor.

Instruments for the use of the Blind.

HUGHES (No. 401, p. 452) has exhibited a portable typograph or writing machine for the blind.

This is a beautiful mechanical contrivance (by no means difficult in use) by which a blind person is enabled to print legibly, with ease and rapidity. It is also applicable to printing uniform labels for Museums, &c. (for description see "Illustrated Catalogue"). The following is the manner of using it. The paper intended to be written upon is placed within a portfolio, one side of which is made of semi-carbonized paper, which, being durable and inexpensive, serves for ink. Having done this with the first finger of the right hand, any required letter, figure, or point of the index circle is brought to the right side of the lever, the thumb being inserted in the end of which, presses it downwards. This pressure will give the impression of a corresponding type letter acting upon the back of the transfer paper. The next operation is to lift the lever to its utmost height, which motion makes the space required for the next letter, and so on to the end of a word. A repetition of the movement will also make the space between the words.

Having finished a line of writing, the index circle is pushed back to the left side of its frame, and the thumb-screw turned for the desired distance between the lines; one whole turn of this screw giving four lines to the inch.

The typograph is about the size of a quarto book, and does not occupy a surface of more than 12 inches square. Its inventor has done good service, having the merit of exhibiting the best machine for the same purpose, it being the most simple in its operations of any in the Exhibition. The Prize Medal was awarded to Mr. Hughes.

TOLLPUTT (No. 382, p. 451) exhibits a machine for facilitating the writing of the blind.

FOUCAULT (France, No. 220A, p. 1187) has exhibited a printing-machine for the blind. It consists of a fan composed of 26 rods, terminated at the upper extremity with the letters of the alphabet arranged successively, together with other rods terminated with the various ciphers and symbols required in printing; the lower extremity of these rods is furnished with a corresponding letter, &c., to the one above, but in smaller type. On pressing the larger character at the upper extremity, the smaller letter beneath is proportionably depressed, which causes it to leave its printed impression on a paper previously prepared. By a little contrivance the paper is made to move onwards, in proportion to the successive pressures from above. The exhibitor of this machine, himself blind, has the merit of being its inventor, and he was awarded the Prize Medal.

THOMPSON (United States, No. 26, p. 1434) has exhibited an invention for teaching the blind to draw and write. This device is simple, and intended to afford a means to the blind of acquiring knowledge of various kinds.

The writing tablet is covered with white leather, a material well suited to the purpose intended, as it yields to the pressure of the style without retaining the impression.

The style may be made of any hard material capable of receiving and retaining a rounded smooth point. The paper should be of a strong and rather firm texture, but at no visit of the Jury was any explanation given, and they are unable to speak further of this invention.

GALL (No. 687A, p. 471*) has exhibited a triangular alphabet for the blind. This is an improvement on the Parisian, Austrian, and other circular alphabets, and it is probable that adult blind persons may by its means be easily taught to read. A volume containing the Epistle to the Ephesians, in the same characters, was exhibited, and Gall's apparatus for the writing of the blind, by means of which they can correspond with each other by post, as described in the "Illustrated Catalogue."

MARCHESI (Austria, No. 139, p. 1049,) exhibits a circular printing machine, by which the blind can print readily with three different kinds of type. On examination by the Jury it elicited much commendation, and a Prize Medal was awarded to M. Marchesi.

Miscellaneous.

DUNIN (No. 210, pp. 433, 434) has exhibited a piece of mechanism designed to illustrate the different proportions of the human figure. This beautiful piece of mechanism resembles in outward appearance a well-formed human figure, standing erect. It is capable of both considerable expansion and contraction in all its parts. The internal mechanism is completely concealed, the figure externally being composed of a number of thin slips of steel and copper, which overlap each other in proportion to the amount of expansion or contraction exercised. The motion these slips are made to possess is communicated to them by thin metal slides to which they are attached within the figure, the slides being furnished with projecting pins at their extremities. These pins are inserted into curved grooves, cut in circular steel plates, the curvature of the grooves being so arranged, that when the steel plates are put in revolution by a train of wheels and screws, the slides belonging to the several parts of the figure are expanded or contracted in correct proportion. The external slips of metal are disposed as much as possible in the direction of the fibres of the muscles in the living subject, in which direction the two motions of contraction and expansion are severally performed. Where in nature the fibres of the pectoral muscle converge towards the shoulder, in the figure there is much compound internal mechanism, and very ingenious external arrangement; the contraction of the chest, the back, the shoulder, and the fore-arm, are performed either simultaneously, with great accuracy and just proportion, or each part can be separately adjusted if required. These adjustments, the most compound and difficult to be overcome, Count Dunin, by a new and most ingenious combination of mechanism, has successfully achieved. The dimensions of the figure are subjected to their respective variations by the establishment of a connection between several parts of the internal mechanism and a winding key, by means of circular-headed projections, which being turned to the right or left, gently and gradually effect the contraction or expansion of the adjacent parts of the figure. The motions we have just described, are performed by the introduction of the winding key into several

* See "Philosophical Transactions" for the year 1815.