LITERATURE.


A machine, according to Reuleaux’s definition, is "a term adopted to describe a mechanism so arranged that by their means the mechanical forces may be compelled to do work accomplished by certain definite motions. . . ." From this statement the study of Machinery is divided into several parts, each large and important enough for separate treatment. The arrangements for bringing natural forces to act on machinery are not considered in this treatise, but are treated by the theory of prime-movers; the given forces of the machine and its parts are the subject of the mechanics. A necessary requirement of machinery is based upon the study of the strength of materials; the combination of these parts-utterly different dimensions having been previously fixed—that they may have certain determine motions, forms what is called the "Geometry of Machines," and which Reuleaux treated in the work before us under the name "Kinematics of Machinery." This work is not a textbook of machine design, like its author’s well-known Geometrie der Gegenstande, but treats design only as it is determined by the theory in the machine. The subject is treated theoretically, but with a recognition of the claims of practice such as Englishmen do to make it useful; and the German scientific professor, "The right application of theoretical laws, he says, "demands certain steps, and the practical value of a mechanism, in this respect, is a mere knowledge of its theory, if his work is to be what is called practical. . . . This art of making practical designs can be but very partially communicated by teaching, it can be only made quite clear by example. The scientific abstraction only serves to show the possibilities of the machine; it affords no means whatever of judging between practical and unpractical, . . . The attitude of theory and practice is, therefore, no agreement with the thought that must be one of mutual respect." (p. 54.) Such a confession of faith affords excellent promise that the work will be of the highest usefulness in this country, where the old idea of "mechanical instinct" which, whatever our shortcomings, is seldom wanting in English engineering.

It would occupy too much space were we to give here even an outline of Reuleaux’s method of treating this subject. The reader can consult the novel and highly original work in its entirety. But we shall point out a few of its leading features. One of the points that strikes the reader will be the thoroughgoing attempt to base the treatment of a mechanism as a "converting" one motion into another. Reuleaux analyses mechanisms into their "elements," that is the geometric forms (pins and axes, screws and nuts, etc.) which primarily determine the motion of each of their members or "links," and classifies them according to the arrangement of these elements, sub-dividing them according to the particular kind of the mechanism which is fixed, or made stationary. In this way he certainly obtains some results which are very useful in practical industrial work. But the driving mechanism of the direct-acting and the oscillating engines contain exactly the same elements around which the only difference between them is in the link which is fixed; the universal joint is shown to be essentially identical with the universal joint of a coach. And for "converting circular into rectilinear" motion is shown to be equally a mechanism for converting rectilinear into circular motion, or for converting swinging into circular, and a host of other "conversances." The whole combination, or "kinematical chain," it is shown in each case to be nothing more than being merely in the link which is fixed. Having

Once determined what constitutes the essence of a pair of elements in a mechanism, it becomes comparatively easy to trace them out and recognize them in all sorts of machines. This, of course, a part of the matter which directly concerns the engineer, and it is one to which Reuleaux devotes a great deal of care. He conceives one of the mechanisms whose abstract forms he makes a special object of study of which he does not mention anything in his book, and we find it applied to spare no trouble in hunting through English, French, and German books and technical periodicals for illustrative instances. But what is the practical utility of his method? "Kinetische Analyse" to actual machines? He examines in detail a long series of engines (chiefly steam), and he states how, after his analysis, he finds them to be repleteions of a very few simple kinematical combinations in extraordinarily different constructive forms. The application of this is very interesting, and in many cases shows unexpected light on complex and unintelligible combinations.

Another point of interest is Reuleaux’s treatment of the action of fluids (liquid or gaseous) in machines. "In examining machinery," the translator says, "we consider the motions of each body as a whole, ignoring altogether its molecular condition, or, more strictly speaking, assuming that its molecular constitution and molecular stability is not disturbed during the motion. This pre-supposition is made tacitly in the case of rigid bodies, but it is not independent of the application of external force. It is made also in the case of ropes, belts, etc.; for when these are made to move in machines that they are kept in tension by some force external to themselves; in any other case their motions would be quite independent of forces. . . . The only way to make the action of certain forces independent of any other assumption than this; but the external force must be a pressure instead of a pull, and must be applied in directions other than that in which motion takes place." Reuleaux points out that engines have continually acted upon this view of the problem of air, the medium of locomotion of water, or, by a rod or a rope, just as might be most convenient. Fluids, however, have never before been "treated as a simple compound of pure mechanism." Why, he explicitly excluded them from the subject. Engineers have long ago recognized this fact, and we have said, what theory refused to recognize; but even those most familiar with the subject will probably be surprised at the completeness of the analysis that Reuleaux is able to point out between machines having only rigid organs and those working with fluids. The comparison, for instance, between a steam and a pump (p. 125) is very striking.

In order to utilize his kinematic analysis, Professor Reuleaux worked out a "kinematical notation," which is fully explained in his book, and of which he makes continual use. In it he employs the very simple means of lines and arrows as we have been able to test it, is of great assistance in acquir ing the real (kinematic) constitution of complex apparatus. There are many cases in which it will doubtless prove of considerable practical value in machine design, by enabling the designer to take in at a glance the nature of mechanisms which it is extremely difficult to see through on the drawing-board, and thus to arrive directly at improvements and simplifications which otherwise would only be reached in a roundabout way after many trials.

Professor Reuleaux is not content with analyzing machines, but in his concluding chapter gives a somewhat elaborate sketch of a synthetic method of arriving at the design of a machine when invention should be to a great extent a scientific process, conducted along fixed lines to arrive at a reliable result as in a mathematical or chemical investigation, where still, of course, individual capacity or genius shall influence the result as before. Without entering upon this subject, we should have been unable to point this out as a feature of the method which is fixed; the universal joint is shown to be essentially identical with the universal joint of a coach. And for "converting circular into rectilinear" motion is shown to be equally a mechanism for converting rectilinear into circular motion, or for converting swinging into circular, and a host of other "conversances." The whole combination, or "kinematical chain," it is shown in each case to be nothing more than being merely in the link which is fixed. Having

* Some account of it will be found in a lecture given by Professor Kennedy, at South Kensington, in May, which we have had in type for some time, and shall publish shortly.