ON THE DOCTRINE OF DISCONTINUITY OF FLUID MOTION, IN CONNECTION WITH THE RESISTANCE AGAINST A SOLID MOVING THROUGH A FLUID.[1]

IV.

§ 25. ANOTHER decisive demonstration that the doctrine of discontinuity is very far from an approximation to the truth, is afforded, in an exceedingly interesting and instructive manner, by Dines' observations of the pressures on the two sides of a disk held at right angles to a relative wind of 60 statute miles per hour (88 ft. per sec.), produced by carrying it round at the end of the revolving arm of his machine. The observations were described in a communication to the Royal Meteorological Society in May 1890. In his paper of June of the same year, in the Royal Society Proceedings already referred to, he states the results, which are, that at the middle of the front side an augmentation of pressure, and at the middle of the rear side a diminution of pressure, measured respectively by 1·82 *i* and ·89 *i* of water, were found. These correspond to heads of air, of density 1/800 of that of water, equal respectively to $121\frac{1}{3}$ and $59\frac{1}{3}$ feet. The former is in almost exact accordance with rigorous mathematical theory for an inviscid incompressible fluid; which gives $88^2/64{\cdot}4$, or $122\frac{1}{2}$ feet for the depth corresponding to the pressure at the water-shed point or points, of a solid of any shape moving through it at the rate of 88 feet per second. The latter shows that there is a "suction" at the centre of the rear side very nearly equal to half the augmentation of pressure on the front; instead of there being neither suction nor augmented pressure as taught in the doctrine of discontinuity!

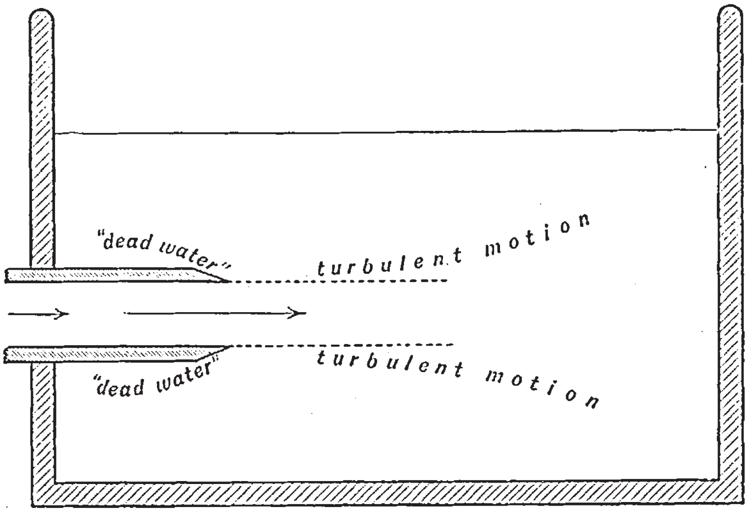

FIG. 2.

§ 26. The accompanying diagrams (2, 3, 4, 5) represent several illustrations of the doctrine of discontinuity in the motion of an inviscid fluid, less attractive to writers on mathematical hydrokinetics than that represented in Fig. 1, (whether as it stands, or varied to suit oblique incidence), because each is instantly soluble without mathematical analysis, and they do not, like it in the two-dimensional case, constitute illustrations of the beautiful mathematical method for finding surfaces of constant fluid velocity in prolongation of given surfaces along which the velocity is not constant, originated by Helmholtz,[1] developed in a mathematically most interesting manner by Kirchoff,[2] and validly applied to the theory of the "vena contracta" by Rayleigh.[3]

§ 27. A cylindric jet (not necessarily of circular cross-section) issuing from a tube with *sharp edge*, into a *very large* volume of fluid of the same density as that of the jet, is represented in Fig. 2. This case was carefully considered by Helmholtz,[4] both for the ideal inviscid incompressible fluid and for real water or real air. He gave good reason for believing that, with real water or real air, and at distances from the mouth as great as several times the diameter of the tube (or the least diameter, if it is not of circular cross section) the surrounding fluid is nearly at rest, and the jet is but little disturbed from the kind of motion it had in passing out of the tube: and therefore that the efflux is nearly the same as, other circumstances the same, it would be if the atmosphere into which the jet is discharged were inertia-less. This conclusion, which is of great importance in practical hydraulics, has been confirmed by careful experiments made eight years ago in the physical laboratory of the University of Glasgow by two young officers of the American Navy, Mr. Capps and the late Mr. Hewes. I believe it has been tested and confirmed by other experimenters.

§ 28. The very simplest application of the doctrine of discontinuity to the theory of the resistance of fluids to

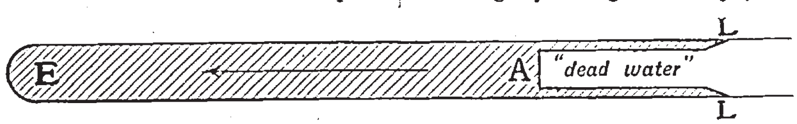

FIG. 3.

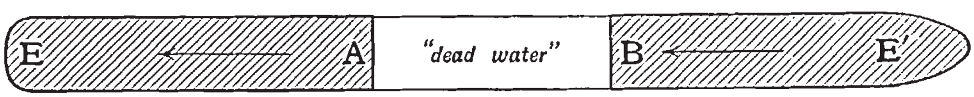

FIG. 4.

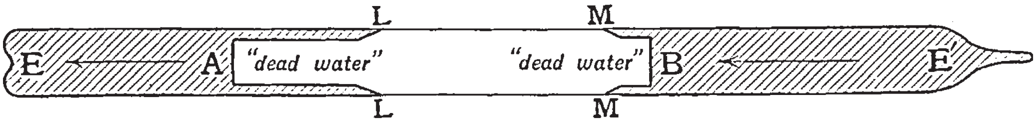

FIG. 5.

1 Continued from page 575.

1 "Wissenschaftliche Abhandlungen," vol. i. pp. 153-156.
2 "Vorlesungen über Mathematische Physik," vol. xxi.
3 "Notes on Hydrodynamics," *Phil. Mag.* 1876, second half-year.
4 "Wiss. Abh.," vol. i. pp. 152-153.

solids moving through them, is represented in Fig. 3, and the result is no resistance at all! Surely this case, requiring no calculation, might have been a warning of the extreme wrongness of the doctrine in connection with resistance of fluids against solids moving through them. The nullity of the resistance in the case represented by Fig. 3 according to the assumption of a wake of "dead water" having the same pressure, Π, as the distant and near water flowing uniformly in parallel lines, follows immediately from an easily proved theorem which I stated in the combined meeting of Sections A and G in Oxford last August, to the effect that the longitudinal component of the pressure on each of the ends, E, E′, in Figs. 3, 4, 5, whatever their shapes, and whether "bow" or "stern" provided only that it ends tangentially in a cylindric "mid-body" long in comparison with the greatest transverse diameter of the solid, is equal to ΠA, where A is the area of the cross-section of the cylindric part of the solid.

§ 29. Figs. 4 and 5 represent two varieties of a case wholly free from the inconceivable endlessness of Fig. 1, and carefully chosen as thoroughly defensible by holders of the doctrine of discontinuity if it has any defensibility at all. I venture to leave it with them for their consideration.

KELVIN.

PARACELSUS.[1]

"THEOPHRASTUS VON HOHENHEIM was adjudged by most eminent physicians to be a man of genius, indeed of superlative genius. . . . By others, who refused to follow him, he was thought to be less deserving than the cooks, the bellows-blowers, and the charcoal-burners." Thus spoke Lukas Gernler, Rector of the University of Basel, in 1660. Häser, in his "History of Medicine," says: "Probably no physician has grasped his life's task with a purer enthusiasm, or devoted himself more faithfully to it, or more fully maintained the moral worthiness of his calling, than did the reformer of Einsiedeln." And of this same reformer, Zimmermann, who was physician to Frederick the Great, wrote: "He lived like a pig, looked like a drover, found his greatest enjoyment in the company of the most dissolute and lowest rabble, and throughout his glorious life he was generally drunk."

As with these, so with others who have tried to form an estimate of the character of Paracelsus. Some praise him inordinately; others as inordinately abuse him. It is only men of power and character who are thus extolled and thus abused. You may neglect an ordinary man; you must either praise much, or anathematise more, a great man.

Even as regards the name of the "reformer of Einsiedeln" there are divergencies of opinion. Kahlbaum, in the pamphlet cited below, says that he never called, or signed, himself by the sounding name that was given him by some of his followers, who thought to awe the common people by styling their master "Philippus Aureolus Theophrastus Paracelsus Bombastus ab Hohenheim." For himself, Theophrast von Hohenheim was sufficient. On one occasion, says Kahlbaum, he used the name Aureolus, to distinguish himself from Theophrastus a disciple of Aristotle. The father of Paracelsus was a natural son of a member of the noble family of the Bombasts of Hohenheim, and he adopted their name as his own. In accordance with a fashion of the times, the name von Hohenheim was paraphrased into the classical tongues. *Paracelsus*, which may perhaps be rendered as "belonging to a lofty place," seems to be a kind of Græco-Latin form of von Hohenheim, the family name of Theophrastus. As von Hohenheim became *Paracelsus*, so Lieber became *Erastus*, and Schütz became *Toxites*; and in modern times the Jewish Neumann emerged from the baptismal font as *Neander*.

Paracelsus was born at Einsiedeln, in the canton of Schwyz, towards the end of the year 1493. He was educated for a time by his father, then by the monks of a convent in the valley of Savon, and then in the University of Basel. After leaving the University, Paracelsus studied under Johannes Trithemius, Abbot of Sponheim, and then under Siegmund Füger, a rich nobleman at Schwaz in the Tyrol. Both Trithemius and Füger were celebrated adepts and students of occultism, and from them Paracelsus may have imbibed the doctrines which he afterwards developed. Paracelsus was a great wanderer: he visited Tübingen, Heidelberg, Ingoldstadt, Vienna, Leipzig, Cologne, Toulouse, Paris, Salerno, and many other towns; he probably also spent some time in the East, and he is said to have received the stone of wisdom from an adept at Constantinople. Wherever he went he always eagerly sought fresh knowledge.

In 1527 he delivered lectures in the University of Basel, with the sanction of the Rector. Paracelsus attempted to institute a method of testing the apothecaries of the town as to their knowledge of the business of making drugs and determining the purity of the materials they dispensed. He spoke scornfully of the decoctions, tinctures, extracts, and syrups that the apothecaries delighted to prepare, calling them all "soup-messes" (*Suppenwust*). Of course the dealers in decoctions were up in arms against the man who attacked their trade. Paracelsus also roused the physicians. He taught that they should go to nature, and not to books, for their knowledge; he rebelled against the doctrine that was then held by almost every medical man, "the truth is to be found only in the ancients." He boasted that for ten years he had not opened a single book written by a follower of Galen, and he spoke of the Galenists as men who tried to hide their folly under red cloaks; and, worst of all, he delivered his lectures in German. The physicians and apothecaries of Basel could not stand these things. Paracelsus was abused not only publicly, but also in anonymous pamphlets; it is said that one of these productions was found on a Sunday morning affixed to the door of the Minster, with the superscription, "The Shade of Galen to Theophrastus, better called Kakophrastus." Of the attacks made on him Paracelsus exclaimed, "These vile ribaldries would raise the ire of a turtle-dove." Matters came to a head when a Canon of St. Clara, who had been cured by three laudanum pills, refused to pay Paracelsus the 100 florins he had promised, and sent six florins instead. Paracelsus sued the Canon for the money, but the court dismissed his suit. In his indignation Paracelsus seems to have put himself into the wrong; hearing that the magistrates had resolved to arrest him, on the advice of his friends he fled from Basel in 1528. After wandering about over a great part of Europe, Paracelsus found a resting-place at Salzburg, under the protection of the Archbishop Ernest. But he did not live long to enjoy the repose that had come at last. He died on September 24, 1541, after a short illness, in his forty-eighth year.

It is not possible to form a just estimate either of the character or the work of Paracelsus. The evidence is not sufficient, nor sufficiently trustworthy. Nevertheless we can draw some kind of picture of the man, and we are able to trace, in a hesitating way, the effects of his labours and his teaching on the progress of science. The pamphlet by Kahlbaum is concerned with dates, and the outward paraphernalia of the life of Theophrastus. Kopp gives a short account of the work of Paracelsus in

[1] "Theophrastus Paracelsus: ein Vortrag gehalten zu Ehren Theophrasts von Hohenheim, am 17 Dezember 1893, im Bernoullianum zu Basel." Von Georg W. A. Kahlbaum. 70 pp. (Bruno Schwabe, Basel, 1894.)