to the northwest, a situation that gives rise to cold northerly and northeasterly winds in central Europe. . . . While the immediate causes of these interruptions of temperature has thus been made clear, it is not yet certain whether or to what extent such interruptions, with their attendant barometric conditions tend to recur from year to year on certain dates, such as the days of the ice saints. Irregularities in a curve showing the mean annual march of temperature as deduced from a record of 50 or 100 years may be due to excessive departures in particular years rather than to a real tendency to recurrence on particular dates, and, on the other hand, a tendency to recurrence might not manifest itself in the mean curve, especially, if as some students have surmised the phenomenon is one that undergoes periodic fluctuations.

Bearing on this question is a mathematical discussion by Professor C. F. Marvin, entitled, "Normal temperatures (daily): are irregularities in the annual march of temperature persistent?"[7] Average annual temperature curves based on the averages of the means of each week over a period of years, may be well-covered mathematically in a curve of one or two harmonics. The residuals, which in a given period are much the same over a large part of the eastern United States, are mostly due to some extreme departures occurring in a single year of the record: which throws doubt on the existence of recurrent irregularities.

Professor Marvin's mathematical analysis of only 15-year averages shows that it is possible to get a surprisingly accurate, smoothed, normal annual temperature curve from a short record.

NOTES

The *Monthly Weather Review*[8] contains so much material that these occasional notes in SCIENCE have by no means covered even a majority of the 150 contributions, not to mention hundreds of abstracts and other items of meteorological interest, published during the past year. For a brief summary and mention of many of the important contributions published during 1919, and the reader is referred to the American Year Book; and for the articles and notes themselves, to the *Monthly Weather Review* files maintained at all Weather Bureau stations, and at a few hundred college, university and public libraries.

Hereafter, these notes on meteorology and climatology for SCIENCE will be continued by Mr. C. LeRoy Meisinger, assistant editor of the *Monthly Weather Review*.

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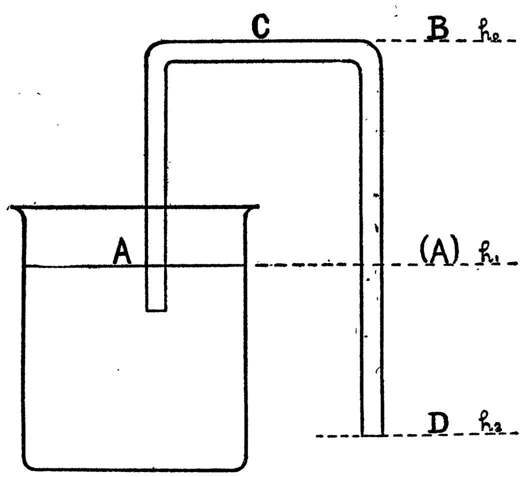
SPECIAL ARTICLES

THE SIPHON IN TEXT-BOOKS

THE treatments commonly accorded to the siphon in text-books of physics of college grade may be classified in three groups. I have attempted to reduce the characteristic features of each group to a typical or standard form. There is no intention to quote and italics are strictly mine. Reference is made to the diagram, which will serve in common for the three methods of treatment.



I. The pressure at A is the resultant of an *upward* pressure equal to the atmospheric pressure and a *downward* pressure due to the column of liquid AB. The pressure at D is the resultant of an *upward* pressure equal to the atmospheric pressure and a *downward* pressure due to the column of liquid DB. As DB is greater than AB, the resultant pressure

[7] *Ibid.*, pp. 544–555, 4 plates, fig.

[8] Government Printing Office, Washington, D. C., printed for the Weather Bureau.

upward at A is greater than that at D. The liquid *must therefore flow* from A to D.

It is evident from this discussion that a siphon can not operate if AB is greater than the barometric height for the liquid in question.

II. If we consider the pressures *acting at C* we will find that the pressure *toward D* is the atmospheric pressure minus the pressure represented by a column of liquid AB, while the pressure *toward A* is the pressure of the atmosphere less the pressure represented by the column of liquid DB. The resultant pressure is therefore *toward D, determining a flow* in that direction.

It is evident from this discussion that a siphon can not operate if AB is greater than the barometric height for the liquid in question.

III. The end D being closed, and the siphon filled, the pressure at D will exceed atmospheric pressure by an amount represented by the column of liquid DA, since all points at the level of A are now at atmospheric pressure. Upon opening D this excess pressure causes the flow, and the atmospheric pressure at A keeps the tube filled.

It is evident from this discussion that a siphon can not operate if AB is greater than the barometric height for the liquid in question.

The refrain with which each treatment concludes is a noteworthy element of uniformity, to be considered below. Special features of criticism are as follows.

I. Pressure at a point within a body of fluid is not upward or downward, to left or to right, north, east, south or west. It is without direction.

The pressure at A, whether inside the tube or outside, and whether the siphon be flowing or not flowing, is never greater than the pressure at D.

The flow of a liquid between two points does not necessarily take place from high to low pressure. See the discussion below, based on Bernoulli's principle, of this particular case.

II. As above stated, pressure in a body of fluid is without direction. The pressure at C is neither toward A nor toward D, and certainly does not have unequal components in these two directions.

III. Except the concluding refrain, this treatment correctly represents the facts, and shows at least why the siphon ought to start flowing. Curiously enough, Bernoulli's principle and the law of diminution of potential energy having been known for a long time, little attempt is made to show what happens, and why, when the siphon is actually working, the discussions being chiefly hydrostatic.

If we assume that the siphon gives an example of steady frictionless irrotational flow of an incompressible fluid, an assumption probably justified as a first approximation, we can apply Bernoulli's principle.

Then, for any given stream tube

$$p + hdg + \tfrac{1}{2}dv^2 = \text{constant},$$

in which p represents fluid pressure, h height above any assigned zero level, g acceleration of gravity, d density of the fluid, and v the speed with which it is moving.

Considering now the siphon when in steady flow, and assuming the reservoir indefinitely large, we find that the stream lines begin at the free surface, widely spread, the liquid flowing here at a speed approaching zero; converge into the orifice of the short limb, with much increased speed; traverse the entire length of the tube, supposed of uniform cross section, without change in speed, and that the stream emerges finally at this speed.

At the surface A *outside the tube* the pressure is atmospheric. Inside the tube it is less than atmospheric, for the stream has gained speed at the same level. As the stream ascends, at uniform speed, the pressure diminishes continuously, the least pressure being reached at the highest point. Descending, at constant speed, the pressure increases until at the lower orifice D the pressure is once more atmospheric, and the stream emerges in pressure equilibrium with the air surrounding it.

Taking a stream tube beginning at surface A outside the tube, and ending at D we have

$$p_1 = p_2 = P \text{ (atmospheric pressure)},$$

$$v_1 \doteq 0,\ v_2 = V \text{ (constant speed through tube)},$$

and applying Bernoulli's principle

$$P + h_1 dg = P + h_2 dg + \tfrac{1}{2} dV^2,$$

whence

$$V^2 = 2g(h_1 - h_2) = 2g\overline{DA},$$

which expresses a simple interchange of potential and kinetic energy, corresponding strictly with the facts upon the assumption that the operation is frictionless.

It will be easy to express the reduced pressure at the level A, inside the tube, by comparing two points at level A, one outside, the other inside

We have, outside

$$p_1 = P \quad v_1 \doteq 0,$$

inside

$$h_1' = h_1 \quad v_1' = V,$$

and thus

$$p_1' + h_1' dg + \tfrac{1}{2} dV^2 = P + h_1 dg,$$

$$p_1' = P - \tfrac{1}{2} dV^2,$$

but

$$\tfrac{1}{2} dV^2 = dg(h_1 - h_2);$$

therefore

$$p_1' = P - dg(h_1 - h_2).$$

We can now discuss the invariable refrain or *coda* found in all the type treatments. It appears to be based upon the assumption that a liquid can not exist with a negative pressure, or as sometimes expressed, under tension. This is hardly true; there is considerable experimental evidence to the contrary. Let us make this assumption, however, and limit the working height of the siphon to that which makes the pressure zero at the highest point.

Comparing points C (at level B) and D we have

At C

$$p_0 = 0,\ v_0 = V.$$

At D

$$p_2 = P,\ v_2 = V.$$

$$h_0 d\,g + \tfrac{1}{2} dV^2 = P + h_2 dg + \tfrac{1}{2} dV^2;$$

whence

$$(h_0 - h_2) dg = P.$$

Now $h_0 - h_2$ is the difference in level between D and B, which is thus shown to equal the barometric height for the given liquid, in the assumed limiting case. The ordinary statement asserts that AB equals the barometric height in the limiting case, the loss of pressure at A inside the tube being overlooked, and the concept being hydrostatic rather than hydrokinetic.

This discussion is not original in substance; see some good treatises on hydrodynamics.

HAROLD C. BARKER

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION E—GEOLOGY AND GEOGRAPHY

THE seventy-second meeting of Section E (Geology and Geography) of the American Association for the Advancement of Science was held in the Soldan High School building in St. Louis, Mo., on December 30 and 31. In the absence of Professor Charles Kenneth Leith, the vice-president elect of Section E, Dr. David White, chief geologist of the U. S. Geological Survey, was voted chairman for the St. Louis meeting, and presided.

The address of the retiring vice-president, Dr. David White, upon the subject, "Geology as Taught in the United States," was given on the morning of December 31 in the main auditorium, before a joint session of the Association of American Geographers, the American Meteorological Society, and Section E. This address will be printed in full in SCIENCE.

The vice-president of Section E for the coming year will be elected by the executive committee at its meeting in April. Dr. Nevin M. Fenneman, of the University of Cincinnati, was elected member of the council.

The program which was so full that each session overran the allotted time, comprised the following papers:

The origin of glauconite: W. A. TARR. Glauconite is a hydrous silicate of iron and potash. The composition is variable, but the amount of potash rarely exceeds 8 per cent. The mineral is amorphous, and is usually some shade of green. It occurs as rounded grains and irregular areas in dolomites, limestones, conglomerates, marls, sandstones and shales. It is found in the Cambrian formations of Missouri, Oklahoma, Texas, South Dakota and Wyoming, and in the Cretaceous and Eocene formations along the Atlantic and Gulf coasts. Geographically and geologically, glauconite is associated with granites, usually being deposited