A number of the factors which enter into the efficiency of an air lift must of necessity be determined by experiment on the particular well in question; but some of them admit of generally applicable determinations being made. Among these is the best form of footpiece, as the connection between the air pipe and the eduction pipe is called. There are a number of forms of footpieces on the market, for some of which extravagant claims of efficiency are made; but as wide variations in the efficiency are due to slight changes in the proportions of other parts of the system or the method of operation, such claims are to be looked on askance, unless they are backed up by adequate guarantees. Tests have shown that the effect of a change in footpiece may be to increase the efficiency as much as 50 per cent. when the head is high, with a much smaller increase when the head is low.

The efficiency of even a well-designed air lift is low, varying from 20 per cent. for a lift of 600 feet to 45 per cent. for a lift of 50 feet; and is greatly influenced by the ratio of the submergence of the air pipe to the lift, the best ratio being about 2. This is clearly shown by a test of a well at Hattiesburg, Mississippi. In this test the speed of the air compressor was adjusted so as to keep the rate of flow of water constant, while the length

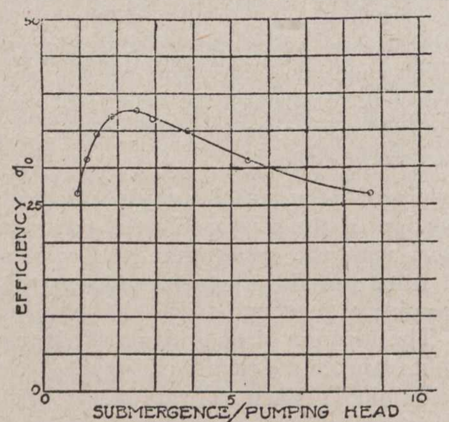

Fig. 2.

of the air pipe was varied. The data are given in the following table and shown in Fig. 2.

Total depth of well	453.5 feet.
Inside diameter of casing	9⅝ inches.
Inside diameter of air pipe........	2½ inches.
Inside diameter of eduction pipe...	9⅝ inches.
Static lift (l)	4.0 feet.

Effect of Submergence on Efficiency Pumping Head.

Submergence.	Efficiency.	Submergence.	Efficiency. Per cent.
8.70	26.5	1.86	36.8
5.46	31.0	1.45	34.5
3.86	35.0	1.19	31.0
2.91	36.6	0.96	26.5
2.25	37.7	....	....

Flow, about 1,100 gallons per minute; pumping head, about 37 feet.

These results show that the maximum efficiency is secured when the submergence is 2.5 times the lift, and that the efficiency falls off more rapidly for a reduction in the submergence than for an increase. It is a good plan, therefore, to have the submergence more than that calculated for the best efficiency rather than less. This allows for the usual occurrence, *viz.*, that the pumping lift increases as more wells are sunk or during a dry season.

Previous to this test the length of the air pipe in this well had been varied with a view to finding out the best flow at which to operate the well. The important data are given below and plotted in Fig. 3:—

Length of Air Pipe. Feet.	Flow. Gal. per min.	Pumping Head. Feet.	Efficiency. Per cent.	Duty. Gal. per h.p. hr.
224	1,495	47.5	32.6	1,630
208	1,459	45.8	31.5	1,640
184	1,419	44.3	31.1	1,670
162	1,359	39.4	30.0	1,790
142	1,299	37.7	30.6	1,920
124	1,219	37.5	32.8	2,070
105	1,106	37.1	36.7	2,340
86	1,008	32.5	33.4	2,450
79	904	29.3	31.3	2,530
67	802	26.0	30.5	2,750
43	690	21.2	29.8	3,240

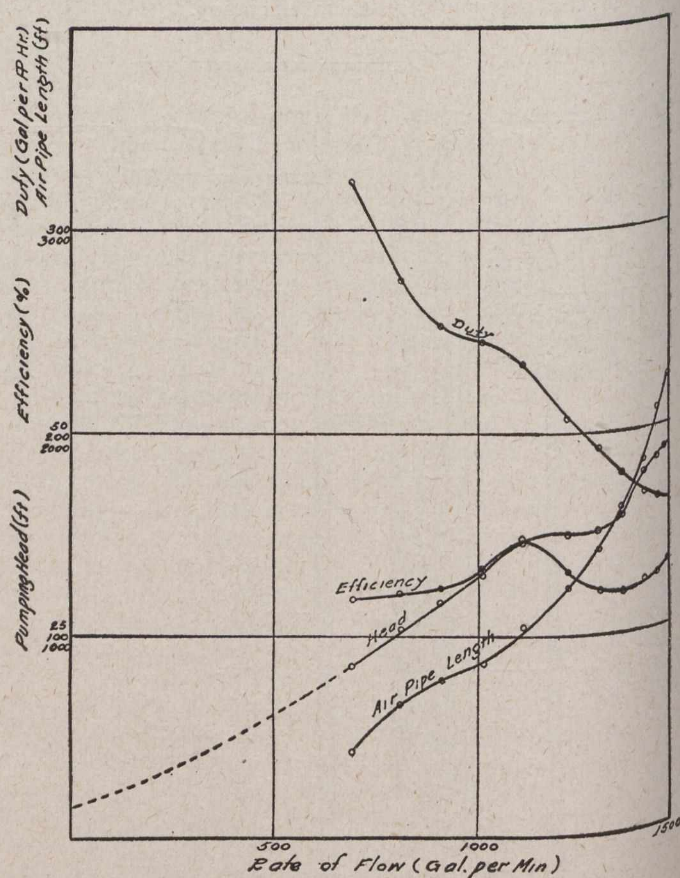

Fig. 3.

The air supply was apparently adjusted so as to get the best efficiency for each submergence.

This test shows an anomalous variation of the relation of pumping head to rate of flow, which is probably due to the coming into action of a second water-bearing stratum, there being two cut by the well, when the level of the water had dropped 33 feet on account of the operation of the lift.

The writer believes that pump duty, water pumped per unit of energy supply, should be made the criterion of operation rather than mechanical efficiency. He has, therefore, calculated the last column.

This shows that the duty of the lift increases as the rate of pumping is decreased, which is due primarily to the decrease in the pumping head. The variation will be small for a free-flowing well, or one in which the drop