TABLE 3.—*List of tornadoes reported in Kansas, 1889–1896.*

From report by Prof. A. J. Henry, *in* "Report of the Chief of the Weather Bureau 1895–96."]

County.	Date.	Hour.	Loss.	
			Lives.	Property.
	1889.			
Pratt	May 6	6 p. m.		
Stafford	May 6	7:30 p. m.		
Rice	May 6	8:15 p. m.	† 3	† $8,000
Washington	May 6	11:20 p. m.	0	4,000
McPherson	May 28	2 p. m.	0	2,500
Chase	May 28	4 p. m.	1	8,000
Chautauqua	June 8	2 p. m.	0	6,000
	1890.			
Wilson	May 9	4 p. m.	2	Unknown.
	1891.			
Decatur	May 20	12:30 a. m.	0	7,500
	1892.			
Kiowa	Mar. 31	8:30 p. m.	0	15,000
Rice	Mar. 31	5:30 p. m.		
Saline	Mar. 31	6:30 p. m.		
Clay	Mar. 31	8 p. m.	† 2	† 12,000
Sumner	Mar. 31	8 p. m.		
Sumner	Mar. 31	9 p. m.		
Butler	Mar. 31	9:30 p. m.		
Butler	Mar. 31	10 p. m.	† 17	† 18,000
Marion	Mar. 31	10 p. m.		
Chase	Mar. 31	11 p. m.		
Pottawatomie	Mar. 31	Midnight	† 11	† 25,000
Montgomery	Apr. 3	2:30 p. m.	1	(*)
Greenwood	May 13	6:50 p. m.	0	1,500
Harper and Sumner	May 27	6:30 to 9 p. m.	16	300,000
	1893.			
Linn	Apr. 11	5:30 p. m.	0	100,000
Brown	Apr. 11	4:05 p. m.	1	5,000
Osage	Apr. 12	4:30 p. m.	1	12,000
Miami	Apr. 12	7:30 p. m.	0	500
Anderson	Apr. 28	5:30 p. m.	1	1,000
Jefferson	June 21	6:30 p. m.	10	2,000
Cowley	June 21	8 p. m.	0	25,000
Pawnee	Aug. 10			1,000
Logan	Aug. 12	2 p. m.	2	1,500
	1894.			
Jewell	May 2	5:45 p. m.	0	4,000
Chase	June 25	5 p. m.	0	5,000
	1895.			
Crawford	Apr. 15	7 p. m.	1	10,000
Harvey	May 1	4:30 p. m.	8	70,000
Lyon	June 17	5:30 p. m.		15,000
Coffey	Sept. 8	3 p. m.		25,000
	1896. §			
Cloud, Clay, and Washington	Apr. 20	9 to 9:30 p. m.	8	15,000
Rice	May 11	6 p. m.	0	(*)
McPherson	May 15	4 a. m.	1	1,000
Washington, Marshall, Nemaha, and Brown.	May 17	4:30 to 8:30 p. m.	† 25	† 300,000
Cowley	May 19	4 p. m.	0	3,000
Lyon	May 20	8 p. m.	0	500
Shawnee	May 20	5 p. m.	0	2,500
Cowley	May 20	11 a. m.	0	200

† This includes totals for storms immediately preceding for which no total is given.
* Damage very small.
§ To June 30 only.

TABLE 4.—*List of tornadoes reported in Kansas, 1914 and 1915.*

[From "Monthly Reports of Climatological Data of Kansas."]

County.	Date.	Hour.	Loss.	
			Lives.	Property (estimated).
	1914.			
Rice	Mar. 28	5:30 p. m.	0	$85,000
Sumner	Apr. 17	5:30 p. m.	2	100,000
Butler	June 1		0	(*)
Smith	June 2	6:15 p. m.	0	(*)
Bourbon	Aug. 19	3 p. m.	0	(*)
Wilson, Neosho, and Greenwood #	Oct. 9	5:30 to 6:30 p. m.		
Montgomery and Labette	Oct. 9	7:30 p. m.		
Cherokee	Oct. 9	8 p. m.	†10	†50,000
	1915.			
Wichita	June 3	6 p. m.	1	40,000
Kiowa	June 11	6:30 p. m.	0	60,000
Pottawatomie	June 17	4 p. m.	5	5,000
Coffey	June 17	5 p. m.	0	40,000
Bourbon	June 17	9 p. m.	0	50,000
Grant	June 23	3 p. m.	0	(*)
Crawford	June 30		0	2,000
Barton	Nov. 10	7:07 p. m.	11	1,000,000
Pratt	Nov. 10	8:30 p. m.	0	15,000
Sumner and Sedgwick	Nov. 10	10 p. m.	3	50,000

* Damage very small.
\# Three tornadoes in succession in practically the same path.
† This includes totals for storms immediately preceding for which no total is given.

Total number of tornadoes in the 10 years 1889–1896 and 1914–15, 64; number of lives lost, 143; property loss, $2,427,200.

REFORESTATION AND OCCULT CONDENSATION.[1]

By PAUL DESCOMBES, Honorary Director of State Manufactures.

[Dated: July 28, 1914, Bordeaux, France.]

The tree has always been considered the great regulator of waters, although science has yet to translate this beneficent action into precise formulæ. There are periods when one sees entire regions laid waste by deforestation, as Algiers where the aqueducts and the hot springs of ancient cities contrast with the dried-up beds of wadies which watered them in former times, and it is only a few years since man began to penetrate the mystery which envelops the hydrologic rôle of the forest.

From the very first investigations have supported an increase of rains by reforestation, and M. Daubrée summarized them in 1910 in his report to the Commission on Floods, as follows:

The condensing action of forests has been confirmed experimentally at l'Ecole de Nancy. From a series of observations made in 1867–1899 it follows that the average quantities of rain falling in a forest and outside a forest are in the ratio of 100 to 76. Prof. Ebermayer in Germany and Blanford in India have found that the depth of rainfall has been, on the average, 12 per cent greater in a forest than on an open field.

The action of forests upon rain should not be relegated to the infinitely small meteorological data, as Cézanne says. One is justified in asserting that the presence of forests augments pluviosity, to be sure in variable measure, according to the air currents, topography, and from other causes.[2]

This increase of the annual amount of rain water, whether it be a quarter or an eighth, is far from corresponding to the amplitude of the phenomenon which transforms regions previously watered but from which the tree has disappeared, into waterless deserts, and a new way opened up to investigations when attention was drawn to the importance of atmospheric condensations not measurable by the raingage.

The majority of the works on forestry emphasize the influence of the forests upon the rainfall régime and the regulation of run-off. The trees have yet another hydrologic rôle which it is proper to put in evidence—they provoke an abundant condensation of meteoric water without rain.

In foggy weather everyone has seen numerous drops fall from the trees resulting from the condensation of the fog.

In the clearest air, also, abundant condensation is produced on the trees; dew during the night, hoarfrost and needles of all forms during days of frost.

All waters resulting from these condensations without rain reach the ground softly and successively, under the most favorable conditions for their absorption by the soil and the nourishing of springs. They are of great interest in alpine economy because they always contain ammonia even at the highest elevations and thus supply nitrogen assimilable by vegetation. In the equatorial regions, even far removed from the sea and permanent water bodies, the dew continues to form during the dry season and is abundant enough to support vegetation and to furnish water to certain animals.[3]

These diverse varieties of condensation without rain occur also on the bare soil, but their intensity is found to be considerably augmented in the forests by the expanse and high radiative power of the foliage surface.

The determinations which one might make in cold regions or at great altitudes would present a very real interest in making known the importance of these condensations without rain and the relations which they might bear to the quantity of water evaporated by the vegetation.[4]

[1] *Descombes, Paul.* Le réboisement et les condensations occultes. C.-r. Assoc. franc p. l'avancem. des sci., 43me sess. Le Havre, 1914. Notes et Mém. Paris, 1915. pp. 337–341 *Translated by* H. Lyman and C. Abbe, jr., for the MONTHLY WEATHER REVIEW.

[2] *Daubrée, L.* Rapports et documents de la Commission des Inondations. Imprimerie Nationale, Paris, 1910, p. 506.

[3] Reported by *Henri Polier*, Captaine de l'Infanterie coloniale.

[4] *Descombes, Paul.* Sur un mode de l'action hydrologique des fôrets. Soc. des. sci. phys. et nat., Bordeaux, 17 mars 1904.

French experiments in this line have not yet been possible, for the service of agricultural meteorology has been established only a few months in France and the decree prepared two years ago [1912] looking toward the organization of a scientific forest service has not yet been signed. Still, some recent results make it possible to estimate the importance of condensation without rain.

It is known in effect that the Swiss meteorologists, particularly Prof. Forel, have reported an unlooked-for circumstance which is often manifest at great altitudes, viz, the annual stream discharges exceed the amount of rain or snow falling in the valley and measured instrumentally;[5] furthermore, the same has been observed in France on the plateau of Langres, at the reservoir of the Mouche which serves to feed the canal between the Marne and the Meuse. These supplemental waters arising from condensations without rain, one may conclude that in certain drainage basins the quantity of water originating from occult condensations exceeds that lost by evaporation, and since, according to M. Daubrée, the amount of evaporation from a drainage basin is more than half of that which falls as rain,[6] these occult condensations exceed in certain cases one-half of the rain received by the valley.

If it is not yet known by precise measurements the degree to which reforestation augments these occult condensations, it suffices to compare the plumes of hoarfrost which decorate a tree after a clear winter night or the large drops which in the morning roll about on the leaves of the humble cabbage, with the extremely small quantity of dew that covers an equivalent area of denuded soil in their neighborhood in order to perceive that vegetation considerably augments these occult condensations.

Lacking the experiments in observatories or research laboratories—not a specimen of which has been so far published—a preliminary determination permits one to appreciate the degree to which vegetation may reenforce this occult condensation.

The amount of dew collected on May 2, 1913, on some carefully measured leaves amounted to 2.3 grams per square decimeter, which corresponds to 0.23 mm. of rainfall. Now, assuming that the foliage of a large tree represents but 15 stages of leaves and that the number of nights when the dew forms on them may be 200 per year, a not improbable number in a dry climate, then the water annually deposited would be the equivalent of $0.23 \times 15 \times 200 = 690$ mm. This quantity of water differs but little from the annual rainfall at a great number of stations, and we are justified in saying that "the quantity of water annually deposited on the trees by occult condensation is of the same order as that coming from rains."

The importance of this supplementary supply of meteoric water for the wooded terrain shows how the destruction of forests helps to transform it into desert soil. Deforestation, first of all, cuts down the major part of occult condensations and at the same time reduces the quantity of rain water. It is generally followed by increased pasturing of goats and sheep, whose short-sighted owners believe that more grass will be secured by cutting down the woods, and the live stock devour down to the roots the plants that they tear up while browsing in dry seasons.

When the herbaceous vegetation, increasingly rare, has disappeared in its turn, the burning sun rapidly evaporates all the surficial waters while the subterranean rivers exist only for the purpose of carrying off the waters precipitated by the steadily decreasing and intermittent rains.

This is the kind of devastation that causes such an encroachment of the desert as was recently reported by the expedition to survey the region about Lake Tchad:

> A series of dry years—says the commander, Tilho—has permitted the Sahara to advance southward at the same time that Lake Tchad diminished in extent. Thus, in July, 1908, the oasis of Beduaram to the north of Lake Tchad marked the boundary between steppe and desert; its arborescent vegetation fell off to some 10 or 12 Talhas, and the dune on the southeast was covered with the characteristic desert plants—Had and Nessi. Now in June, 1870, Nachtigal had noted in the same region the absence of Had and the existence of a thin forest (une claire forêt) composed of trees of the Soudan steppe. In 1908, at the time of our visit, the first gum acacias and a few Serrahs did not appear until we were well within the depths of the oasis N'Gourti, more than 60 kilometers south of Beduaram.[7]

The *Acacia tortilis*, the Talha, which the Lake Tchad expedition photographed near the Gouradi wells,[8] is the sole survivor of an immense forest whose history we shall never know. Besides it will never matter whether the forest was destroyed by fire or otherwise, the climatic modifications that have accompanied its disappearance show the genesis of the transformation into desert.

The manner in which the desert spreads and by which the climatic deterioration is aggravated suffice, furthermore, to indicate the countermethods for the rescue of certain desert regions from the vicious circle in which they seem to be at a standstill. "Vegetation is lacking for want of water and water is lacking for want of vegetation."

It would generally be possible to reestablish in the vicinity of wells or oases any kind of vegetation merely by suppressing pasturage, and this would result in a first hydrologic amelioration. The trees which could then be planted in the shelter of the initial vegetation would produce a further improvement in climate, and the progressive enlargement of these spots of verdure would thus reclaim considerable regions from the desert.

Furthermore, it is not necessary to go as far as the desert in order to appreciate the interest which attaches to the reenforcement by occult condensations, for it would remedy the scarcity of water under which navigation and hydraulic power suffer during the summer in the majority of our rivers.

The forestry research stations should not delay in informing us of the amount of dew deposited in various forms on trees of varied species and dimensions, and upon the importance of occult condensations during different periods of the year. These determinations which, of course, present certain difficulties, might keep us waiting a long time, as also the results of the observations made outside the laboratories, in the field itself, under various conditions of forestation, and it would be a very great lack of foresight to put off for so long a time a serious effort toward reforestation.

While working energetically toward reforestation it is well, however, not to forget the theoretical researches, and we present the following resolution:

"That studies be undertaken on the supplementary contingent of the waters which reforestation brings to the soil by reenforcing of occult condensations."

[5] Service d'études des grand forces hydrauliques, région des Alps. Paris, 1908, tome iii, p. 22.

[6] Daubrée, L., loc. cit.

[7] *Ministère des colonies*, Documents sci. de la mission Tilho. Paris, 1911, t. 2, p. 10 bis.

[8] Mission Tilho, loc. cit., p. 45.