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FEDERAL STANDARD

CLASSIFICATION, IDENTIFICATION, AND TESTING OF FEATHER FILLING MATERIAL

This standard was approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies

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FED. STD. NO. 148a
Section 1
December 10, 1964

FEDERAL STANDARD

CLASSIFICATION, IDENTIFICATION, AND TESTING OF FEATHER FILLING MATERIAL

Authority. *This standard is issued pursuant to the Federal Property and Administration Services Act of 1949, as amended, and its application to the purchase of commodities referred to herein is mandatory on all Federal agencies.*

SECTION 1
SCOPE AND CONTENTS

1. SCOPE

1.1 This standard defines, illustrates, and determines by standard procedure, the attributes of feather filling materials.

2. CONTENTS

2.1 The contents of this standard are as follows:

Section

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SECTION 2
CLASSIFICATION AND DEFINITIONS

2. CLASSIFICATION; FEATHER FILLING MATERIALS

2.1 Waterfowl feather filling materials.

2.1.1 *Waterfowl feathers.*

2.1.1.1 *Waterfowl down.*

2.1.2 *Landfowl feather filling materials.*

2.1.2.1 *Landfowl feathers.*

2.2 Definitions and illustrations of attributes of waterfowl feather filling materials.

2.2.1 *Waterfowl feathers.* The plumage or outgrowth forming the contour and external covering of a goose or duck, or any mixture thereof, consisting of quills and barbs; and which has not been processed in any manner other than by washing, dusting, and sterilizing (see figs. 1, 6, 7, 10, 13, 14, 15).

2.2.1.1 *Quill.* The major stem of a feather consisting of the quill shaft and the quill point (see fig. 1).

2.2.1.1.1 *Quill shaft.* The portion of the quill from which the barbs emanate (see fig. 1).

2.2.1.1.2 *Quill point.* The basal portion of the quill immediately proximal to the barb structure (see figs. 1, 11).

2.2.1.2 *Barb.* A primary branch emanating from the quill shaft of feathers, plus its barbules, being coarse in structure and appearance when compared with down barbs (see figs. 2, 3, 11).

2.2.1.2.1 *Vane.* Smooth, relatively solid collection of barbs emanating from the quill shaft (see D, fig. 1).

2.2.1.2.2 *Barbule.* A branch of the barb plus its nodes and/or prong (see figs. 3, 4, 11).

2.2.1.2.2.1 *Node.* A protuberance or swelling appearing on barbules (see figs. 4, 5).

2.2.1.2.2.2 *Prong.* Short spiny outgrowths emanating from barbules (see fig. 5).

2.2.1.2.2.3 *Internode.* The portion of the barbule between the distal end of one node and the basal end of another (see figs. 4, 5).

2.2.2 *Small waterfowl feathers.* Whole waterfowl feathers, other than quill feathers, crushed or damaged feathers, which are less than two and one-half inches in length (see fig. 6).

2.2.3 *Quill feathers.* Wing and tail feathers commonly known and referred to as quills (see fig. 7).

2.2.4 *Nestling feathers (pin feathers).* A feather not fully developed, having no distinguishable quill, but with relatively short coarse barbs emanating from a sheath (see figs. 8, 10).

2.2.4.1 *Sheath.* A covering at the basal end of nestling feathers which holds together the feather-like structure emanating from it (see figs. 8, 10).

2.2.5 *Damaged feathers.* Waterfowl feathers which are materially broken, damaged by insects or otherwise injured (see fig 9).

2.2.6 *Plumule.* Downy waterfowl plumage with underdeveloped soft and flaccid quill; with barbs indistinguishable from those of down (see fig. 10).

2.2.7 *Feather fiber.* The barb of feathers which have been completely separated from the quill shaft and any aftershaft, and which are not joined or attached to each other (see fig. 12).

2.2.8 *Down.* The plumage or outgrowth forming the undercoating of waterfowl, consisting of the light fluffy filaments (barbs) growing from one quill point, but without any quill shaft (see figs. 10, 11).

2.2.8.1 *Down barbs.* Soft filamentous structure emanating from the quill point of the down (see figs. 2, 11).

2.2.8.2 *Down fiber.* The detached barbs from down and plumules or detached barbs from the basal end of feather quill shafts which are indistinguishable from the barbs of down plumes (see fig. 12).

2.2.9 *Non-waterfowl feathers.* The feathers of any kind of fowl other than goose or duck.

2.2.10 *Non-waterfowl feather fiber.* The barbs of feathers other than goose or duck which have been completely separated from the quill shaft and any aftershaft, and which are not joined or attached to each other.

2.2.11 *Residual matter.* Residual matter is defined as quill pith, feather fragments, trash, and foreign matter (see fig. 12).

2.2.12 *Secondhand feather filling material.* Material which has previously been used in any product or used for any purpose.

2.3 Definitions and illustrations of attributes of landfowl feather filling materials.

2.3.1 *Landfowl feathers.* The plumage or outgrowth forming the contour and external covering of any breed of domesticated chicken consisting of quill and barbs which have not been processed in any manner other than by washing, dusting, and sterilizing (see figs. 16, 17, 18, 19, 20, 23, 24).

2.3.1.1 *Quill.* The major stem of a feather consisting of the quill shaft and quill point (see figs. 1, 16, 17).

2.3.1.1.1 *Quill shaft.* The portion of the quill from which the barbs emanate (see figs. 1, 16, 17).

2.3.1.1.2 *Quill point.* The basal portion of the quill immediately proximal to the barb structure (see figs. 1, 17).

2.3.1.2 *Barb.* A primary branch emanating from the quill shaft, plus its barbules, being relatively coarse in structure and appearance. In landfowl feathers the barbs as they immediately emanate from the quill shaft often exhibit a ladder-like effect. This ladder-like structure is more common to fluff barb type landfowl feathers (see figs. 2, 16, 17).

2.3.1.2.1 *Vane.* Smooth relatively solid collection of barbs emanating from the quill shaft and located principally on the distal end of the quill shaft (see fig. 17).

2.3.1.2.2 *Fluff barbs.* Relatively soft, fluffy collection of barbs emanating from the basal end of the quill shaft (see fig. 16).

2.3.1.2.3 *Barbule.* A branch of the barb plus its nodes and/or prongs (see fig. 4).

2.3.1.2.3.1 *Node.* A protuberance or swelling appearing on barbules (see fig. 4).

2.3.1.2.3.2 *Prong.* Short spiny outgrowths emanating from barbules.

2.3.1.2.3.3 *Internode.* The portion of the barbule between the distal end of one node and the basal end of another (see fig. 4).

2.3.2 *Small landfowl feathers.* Whole landfowl feathers other than quill feathers, crushed or damaged feathers which are less than 2 inches in length (see fig. 19).

2.3.3 *Quill feathers.* Wing and tail feathers commonly known and referred to as quills (see fig. 20).

2.3.4 *Nestling feather (pin feather).* A feather not fully developed, having no distinguishable quill, but with short coarse barbs emanating from a sheath (see figs. 8, 18).

2.3.4.1 *Sheath.* A covering at the basal end of nestling feathers which hold together the feather-like structure emanating from it (see figs. 8, 18).

2.3.5 *Aftershaft.* A small feather growing from the base of the quill shaft typical of landfowl feathers (see fig. 16).

2.3.6 *Damaged feathers.* Landfowl feathers other than stripped or crushed, which are materially broken, damaged by insects, or otherwise injured (see fig. 22).

2.3.7 *Stripped feathers.* The barbs of feathers stripped from the quill shaft but not separated into feather fiber.

2.3.8 *Feather fiber.* The barbs of feathers which have been completely separated from the quill shaft and any aftershaft and which are not joined or attached to each other (see fig. 22).

2.3.9 *Crushed feathers.* Landfowl feathers which have been processed by a crushing, chopping or curling machine which has changed the original form of the feathers without removing the quill (see fig. 21).

2.3.10 *Residual matter.* Residual matter is defined as quill pith, feather fragments, trash, and foreign matter (see fig. 22).

2.3.11 *Turkey feathers.* Feathers from any breed of domesticated turkey (see fig. 23).

2.3.12 *Secondhand filling material.* Material which has previously been used in any product or used for any purpose.

2.4 Definitions of attributes applicable to both classifications of feather filling materials.

2.4.1 *Percentage composition.* The percentage composition of any mixture of feather filling materials, as specified in material specifica-

tions, is the percentage of conditioned weight of the segregated component in relation to the total conditioned weight of the test specimen.

2.4.2 *Filling power.* Filling power is a measure of the capacity of a unit weight of feather filling material to fill a given volume at a low pressure and is related to the space filling capacity, fluffability, resiliency, and ability of the material to maintain a large volume under low pressure.

2.4.3 *Oxygen number.* The oxygen number of feather filling materials is a measure of the degree of cleanliness as determined by the amount of oxidizable water soluble and fine suspended matter which is present in a water extract of the materials.

2.4.4 *Extractable matter.* The extractable matter content of feather filling materials serves as an indication of the amount of natural finish and free foreign extractable matter present. It also serves to indicate the presence of additive finishes such as wax or oil.

2.4.5 *Brittleness.* The brittleness of feather filling materials serves as an indicator of the resiliency of the materials and their susceptability to fracture or break during use.

2.4.6 *Turbidity.* The turbidity of feather filling materials serves as a measure of the degree of cleanliness as determined by the amount of fine suspended organic and inorganic material not removed during cleaning operations.

2.5 Definitions applicable to sampling and testing.

2.5.1 *General.* For the purpose of this standard and all material specifications referred hereto, the following definitions shall apply:

2.5.1.1 *Specimen.* The fraction or the whole of a sample unit, or a representative sample of material evolved from the identical process as the product.

2.5.1.2 *Test.* The act of evaluating a given property or characteristic of a single sample unit, by taking one or more measurements according to prescribed procedure.

2.5.1.3 *Test result.* The result of one or more test determinations on a sample unit in accordance with prescribed testing procedures.

2.5.1.4 *Sample unit (for test purposes).* The total quantity of material necessary to obtain one test result for each of the properties and characteristics specified in the material specification. In feather filling materials this will usually be specified in grams of materials, randomly selected from the sample unit. Each individual test will consist of a new portion of the sample unit.

2.5.1.5 *Reproducibility of test methods.*

2.5.1.5.1 *Inherent reproducibility.* The consistency of repeated evaluation of a property of homogeneous material obtained under controlled conditions by a single operator-equipment combination, expressed as the dispersion of the individual test results about their average. This inherent reproducibility is a standard for the performance of a single operator-equipment combination.

2.5.1.5.2 *Over-all reproducibility.* The consistency of evaluations of a property of uniform material obtained under controlled conditions by different operator-equipment combinations, expressed as the dispersion of the various test results about the over-all average. This over-all reproducibility, which includes the inherent reproducibility, is a measure of the dependability of the test method.

2.5.1.6 *Acceptable quality level (AQL).* The largest allowable percentage of sample unit in any lot whose test results fall outside the specification limits.

SECTION 3
INDEX OF TEST METHODS

SECTION 4
SAMPLING AND NUMBER OF SPECIMENS

4. Sampling and number of specimens.

4.1 Sampling. The materials to be tested shall be sampled as required in the material specification under which it is purchased.

4.2 Number of specimens. The number of specimens to be tested for each property and each sample unit shall be as stated under "Report" in the description of the prescribed method of test for the particular property unless otherwise specified in the material specification.

SECTION 5
ATMOSPHERIC CONDITIONS FOR TESTING

5. ATMOSPHERIC CONDITIONS FOR TESTING

5.1 Humidity and temperature conditions for testing. Unless otherwise specified in the applicable test method, material specification, or procurement document, physical tests of feather filling materials shall be performed under Standard Atmospheric Conditions and performed on specimens in Moisture Equilibrium under Standard Atmospheric Conditions.

5.1.1 *Standard atmospheric conditions.* Standard atmospheric conditions for feather filling materials testing are 65 percent ±2 percent relative humidity at a temperature of 70° ±2° F. (21.1°±1.1°C.).

5.1.2 *Moisture equilibrium.* Moisture equilibrium is considered to have been reached when, after free exposure of the material to air in motion controlled at Standard Atmospheric Conditions as defined above, the change in weight in successive weighings made at intervals of 1 hour is no greater than 0.25 percent.

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SECTION 6
GENERAL NOTES

6. GENERAL NOTES

6.1 Content of methods.

6.1.1 *Principal subdivisions.* The methods are organized under the headings: Scope, Test Specimen, Number of Determinations, Apparatus, Procedure, Report.

6.1.2 *Scope.* The property to be measured or evaluated, the material to which the method is applicable, and limitations of the method are stated under "Scope."

6.1.3 *Test specimen.* The test specimen, its dimensions, the way in which it is to be taken, and its method of preparations is described.

6.1.4 *Number of determinations.* The number of test specimens required to obtain the results for a property and for a sample unit will be found under "Number of Determinations" (See 2.5.1.4 of section 2).

6.1.5 *Apparatus and reagents.* The apparatus, reagents, and other materials required to carry out the test are enumerated.

6.1.6 *Procedure.* Detailed directions for carrying out the test and for calculating the result for a specimen are given.

6.1.7 *Report.* The precision and manner of expression of the test results is given.

6.2 Numerical requirements in methods.

6.2.1 *Forms used.* Numerical requirements are given in any of three forms illustrated by the following examples: "approximately 2 grams," "2 grams," and "2.000±0.002 grams."

6.2.1.1 "*Approximately 2 grams.*" This form of expression implies that the weight (length) is not critical and may vary within reason. The permissible variation is usually detected by obvious practical considerations and the nearest readily obtained approximation to the weight or dimensions may be considered satisfactory.

6.2.1.2 "*2 grams.*" This form of expression implies that the weight (length) is to be as close to "2 grams" as can be measured readily on the stated material with the usual, ordinary engineering tools.

6.2.1.3 "*2.000±0.002 grams.*" This form of expression implies that the weight (length) in question must be between 1.998 and 2.002 grams.

6.3 Changes. When a Federal agency considers that a Federal standard does not provide for its essential needs, written request for adding to or otherwise changing the standard, supported by adequate justification, shall be sent to the Administration. This justification shall explain wherein the standard does not provide for essential needs. The request shall be sent in duplicate to the General Services Administration, Federal Supply Service, Standardization Division, Washington, D.C., 20407. The administration will determine the appropriate action to be taken and will notify the agency.

6.4 Conflict with referenced specifications. Where the requirements specified in this standard conflict with any requirement in a referenced specification, the requirements of the standard shall apply. Nature of conflict between the standard and the referenced specification shall be submitted, in duplicate, to General Services Administration, Federal Supply Service, Standardization Division, Washington, D.C., 20407.

Activities outside the Federal Government may obtain copies of Federal Specifications, Standards, and Handbooks as outlined under General Information in the Index of Federal Specifications and Standards and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402.

Single copies of this specification and other product specifications required by activities outside the Federal Government for bidding purposes are available without charge at the General Services Administration Regional Offices in Boston, New York, Washington, D.C., Atlanta, Chicago, Kansas City, Mo., Dallas, Denver, San Francisco, Los Angeles, and Seattle, Wash.

Federal Government activities may obtain copies of Federal Specifications, Standards, and Handbooks and the Index of Federal Specifications and Standards from established distribution points in their agencies.

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SECTION 7
TEMPERATURE CONVERSION TABLES

Centigrade to Fahrenheit Scales

$$\frac{9}{5}\,°C. + 32 = °F.$$

°C.	°F.	°C.	°F.	°C.	°F.	°C.	°F.	°C.	°F.
−20	−4.0	21	69.8	61	141.8	101	213.8	141	285.8
−19	−2.2	22	71.6	62	143.6	102	215.6	142	287.6
−18	−0.4	23	73.4	63	145.4	103	217.4	143	289.4
−17	1.4	24	75.2	64	147.2	104	219.2	144	291.2
−16	3.2	25	77.	65	149.	105	221.	145	293.
−15	5.	26	78.8	66	150.8	106	222.8	146	294.8
−14	6.8	27	80.6	67	152.6	107	224.6	147	296.6
−13	8.6	28	82.4	68	154.4	108	226.4	148	298.4
−12	10.4	29	84.2	69	156.2	109	228.2	149	300.2
−11	12.2	30	86.	70	158.	110	230.	150	302.
−10	14.	31	87.8	71	159.8	111	231.8	151	303.8
− 9	15.8	32	89.6	72	161.6	112	233.6	152	305.6
− 8	17.6	33	91.4	73	163.4	113	235.4	153	307.4
− 7	19.4	34	93.2	74	165.2	114	237.2	154	309.2
− 6	21.2	35	95.	75	167.	115	239.	155	311.
− 5	23.	36	96.8	76	168.8	116	240.8	156	312.8
− 4	24.8	37	98.6	77	170.6	117	242.6	157	314.6
− 3	26.6	38	100.4	78	172.4	118	244.4	158	316.4
− 2	28.4	39	102.2	79	174.2	119	246.2	159	318.2
− 1	30.2	40	104.	80	176.	120	248.	160	320.
0	32.	41	105.8	81	177.8	121	249.8	161	321.8
1	33.8	42	107.6	82	179.6	122	251.6	162	323.6
2	35.6	43	109.4	83	181.4	123	253.4	163	325.4
3	37.4	44	111.2	84	183.2	124	255.2	164	327.2
4	39.2	45	113.	85	185.	125	257.	165	329.
5	41.	46	114.8	86	186.8	126	258.8	166	330.8
6	42.8	47	116.6	87	188.6	127	260.6	167	332.6
7	44.6	48	118.4	88	190.4	128	262.4	168	334.4
8	46.4	49	120.2	89	192.2	129	264.2	169	336.2
9	48.2	50	122.	90	194.	130	266.	170	338.
10	50.	51	123.8	91	195.8	131	267.8	171	339.8
11	51.8	52	125.6	92	197.6	132	269.6	172	341.6
12	53.6	53	127.4	93	199.4	133	271.4	173	343.4
13	55.4	54	129.2	94	201.2	134	273.2	174	345.2
14	57.2	55	131.	95	203.	135	275.	175	347.
15	59.	56	132.8	96	204.8	136	276.8	176	348.8
16	60.8	57	134.6	97	206.6	137	278.6	177	350.6
17	62.6	58	136.4	98	208.4	138	280.4	178	352.4
18	64.4	59	138.2	99	210.2	139	282.2	179	354.2
19	66.2	60	140.	100	212.	140	284.	180	356.
20	68.								

TEMPERATURE CONVERSION TABLES (Concluded)

Fahrenheit to Centigrade Scales

$$(°F. - 32) \times \frac{5}{9} = °C.$$

°F.	°C.	°F.	°C.	°F.	°C.	°F.	°C.	°F.	°C.
0	−17.78	51	10.56	101	38.33	151	66.11	201	93.89
1	−17.22	52	11.11	102	38.89	152	66.67	202	94.44
2	−16.67	53	11.67	103	39.44	153	67.22	203	95.
3	−16.11	54	12.22	104	40.	154	67.78	204	95.56
4	−15.56	55	12.78	105	40.56	155	68.33	205	96.11
5	−15.	56	13.33	106	41.11	156	68.89	206	96.67
6	−14.44	57	13.89	107	41.67	157	69.44	207	97.22
7	−13.89	58	14.44	108	42.22	158	70.	208	97.78
8	−13.33	59	15.	109	42.78	159	70.56	209	98.33
9	−12.78	60	15.56	110	43.33	160	71.11	210	98.89
10	−12.22	61	16.11	111	43.89	161	71.67	211	99.44
11	−11.67	62	16.67	112	44.44	162	72.22	212	100.
12	−11.11	63	17.22	113	45.	163	72.78	213	100.56
13	−10.56	64	17.78	114	45.56	164	73.33	214	101.11
14	−10.	65	18.33	115	46.11	165	73.89	215	101.67
15	−9.44	66	18.89	116	46.67	166	74.44	216	102.22
16	−8.89	67	19.44	117	47.22	167	75.	217	102.78
17	−8.33	68	20.	118	47.78	168	75.56	218	103.33
18	−7.78	69	20.56	119	48.33	169	76.11	219	103.89
19	−7.22	70	21.11	120	48.89	170	76.67	220	104.44
20	−6.67	71	21.67	121	49.44	171	77.22	221	105.
21	−6.11	72	22.22	122	50.	172	77.78	222	105.56
22	−5.56	73	22.78	123	50.56	173	78.33	223	106.11
23	−5.	74	23.33	124	51.11	174	78.89	224	106.67
24	−4.44	75	23.89	125	51.67	175	79.44	225	107.22
25	−3.89	76	24.44	126	52.22	176	80.	226	107.78
26	−3.33	77	25.	127	52.78	177	80.56	227	108.33
27	−2.78	78	25.56	128	53.33	178	81.11	228	108.89
28	−2.22	79	26.11	129	53.89	179	81.67	229	109.44
29	−1.67	80	26.67	130	54.44	180	82.22	230	110.
30	−1.11	81	27.22	131	55.	181	82.78	231	110.56
31	−0.56	82	27.78	132	55.56	182	83.33	232	111.11
32	0.	83	28.33	133	56.11	183	83.89	233	111.67
33	0.56	84	28.89	134	56.67	184	84.44	234	112.22
34	1.11	85	29.44	135	57.22	185	85.	235	112.78
35	1.67	86	30.	136	57.78	186	85.56	236	113.33
36	2.22	87	30.56	137	58.33	187	86.11	237	113.89
37	2.78	88	31.11	138	58.89	188	86.67	238	114.44
38	3.33	89	31.67	139	59.44	189	87.22	239	115.
39	3.89	90	32.22	140	60.	190	87.78	240	115.56
40	4.44	91	32.78	141	60.56	191	88.33	241	116.11
41	5.	92	33.33	142	61.11	192	88.89	242	116.67
42	5.56	93	33.89	143	61.67	193	89.44	243	117.22
43	6.11	94	34.44	144	62.22	194	90.	244	117.78
44	6.67	95	35.	145	62.78	195	90.56	245	118.33
45	7.22	96	35.56	146	63.33	196	91.11	246	118.89
46	7.78	97	36.11	147	63.89	197	91.67	247	119.44
47	8.33	98	36.67	148	64.44	198	92.22	248	120.
48	8.89	99	37.22	149	65.	199	92.78	249	120.56
49	9.44	100	37.78	150	65.56	200	93.33	250	121.11
50	10.								

SECTION 8
TEST METHODS

FILLING POWER

1. SCOPE

1.1 This method is intended for determining the space filling capacity of feathers, feather fibers, feather products, down, and mixtures thereof and is determined as the height of a given weight of material under a predetermined load.

2. TEST SPECIMEN

2.1 The specimen shall consist of 22.68±0.05 grams of material prepared as specified in 5.1.

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the material specification, three specimens shall be tested from each sample unit.

4. APPARATUS. (See fig. 1 and fig. 2.)

4.1 **Cylinder.** The cylinder shall be a rigid phenolic bonded paper or aluminum tube 12.75 inches ±0.01 inch inside diameter, and 20 to 21 inches in length. The inner wall shall have a smooth finish. The cylinder shall be set in a vertical position and shall be open at both ends with means of supporting the base end rigidly on a horizontal surface. This horizontal surface shall be capable of being leveled. It is convenient to have the cylinder detachable from the base for facilitating specimen removal. A removable perforated cover with air-blowing unit attached thereto shall be provided for use in retaining the specimen during air fluffing.

4.2 **Piston.** The piston shall be made of rigid material and shall weigh 118.0±0.5 grams (Balsa wood with a stiff, smooth paper contact surface or expanded rubber has been found satisfactory for this purpose). The piston shall have a diameter of 12.55±0.01 inch with the edge beveled to ⅛ inch. The exact center of the piston shall be well defined for measuring purposes. A device for lowering the piston in a horizontal position shall be provided. This may be accomplished by suitably attaching strings or by other manual or mechanical means. The piston shall be uniformly centered within the cylinder so that it shall not contact the inside surface of the cylinder.

4.3 **Measuring device.** The device shall consist of a smooth thread, with small plumbs as counter-weights, one of the plumbs serving as the depth indicator. The thread shall run over two pulleys so that one plumb will drop directly on the center of the piston while the other will run along a vertically fixed centimeter scale graduated in units of 0.1 centimeter. The centimeter scale shall be mounted so that the zero position is uppermost and directly adjacent to the lowest point of the depth indicator plumb when the other plumb is touching the center of the piston at the bottom of the cylinder.

4.4 **Fluffing device.** A fluffing device (air blower assembly, see fig. 2), shall be utilized for thoroughly fluffing or loosening the specimen. The blower shall be so designed that the arms rotate at a speed of 1100±100 revolutions per minute at an air gage pressure of 50±2 pounds.

4.5 **Analytical balance.** An analytical balance capable of weighing accurately to the nearest 0.01 gram.

4.6 **Stop watch.**

4.7 **Conditioning container.**

5. PROCEDURE

5.1 **Preparation of specimen.** Approximately 85 grams of material shall be fluffed in the filling power apparatus for 2 minutes at 50±2 pounds air gage pressure. The material shall then be exposed under standard atmospheric conditions in the unpacked state in a screened container composed of a solid bottom with screened sides and top for not less than 3 days nor more than 5 days. The material shall be mixed with a rod once a day to insure complete relaxation and conditioning.

5.2 **Determination of zero reading.** Slowly lower the piston until it rests on the bottom of the empty cylinder. Lower the plumb until it touches the top surface of the piston. The depth is read directly adjacent to the lowest point of the indicator plumb on the centimeter scale to the nearest 0.1 centimeter. This shall be repeated until two consecutive identical readings are obtained. This measurement shall be read to the nearest 0.1 centimeter and shall be considered as "the zero depth (depth of empty cylinder)" and in calculation of results is indicated as "A."

5.3 Fluffing. The test specimen (see 2.1) shall be placed in the cylinder and air blown for approximately 10 seconds at 50±2 pounds air gage pressure to thoroughly mix and fluff the specimen.

5.4 Volume measuring. Immediately after fluffing, the piston shall be slowly lowered onto the material. When there is a definite slackening of the supporting strings, a stopwatch shall be started. The plumb shall be lowered so that at the end of a 1-minute interval, it just touches the center of the top surface of the piston. The depth shall be read directly from the centimeter scale to the nearest 0.1 centimeter and shall be considered "volume depth" and in calculation of results is indicated as "B." Each specimen shall be refluffed and measured three times for depth. In event the piston is supported at an angle, the measurement shall be taken from the same point as above.

6. CALCULATION OF RESULTS

Filling capacity = B − A
Where: A = zero depth (depth of empty cylinder)
B = volume depth

7. REPORT

7.1 The report shall be based on the volume at the designated time pressure level. The distance between inside surface of the bottom of the cylinder and the bottom surface of the piston shall be reported. This shall be obtained by subtracting the zero reading obtained in 5.2 from the depth obtained in 5.4. A measure of the height of the material under the piston shall be considered its filling power.

7.2 The filling power of the sample unit shall be the average of the results obtained from the specimens tested and shall be reported to the nearest 0.1 centimeter.

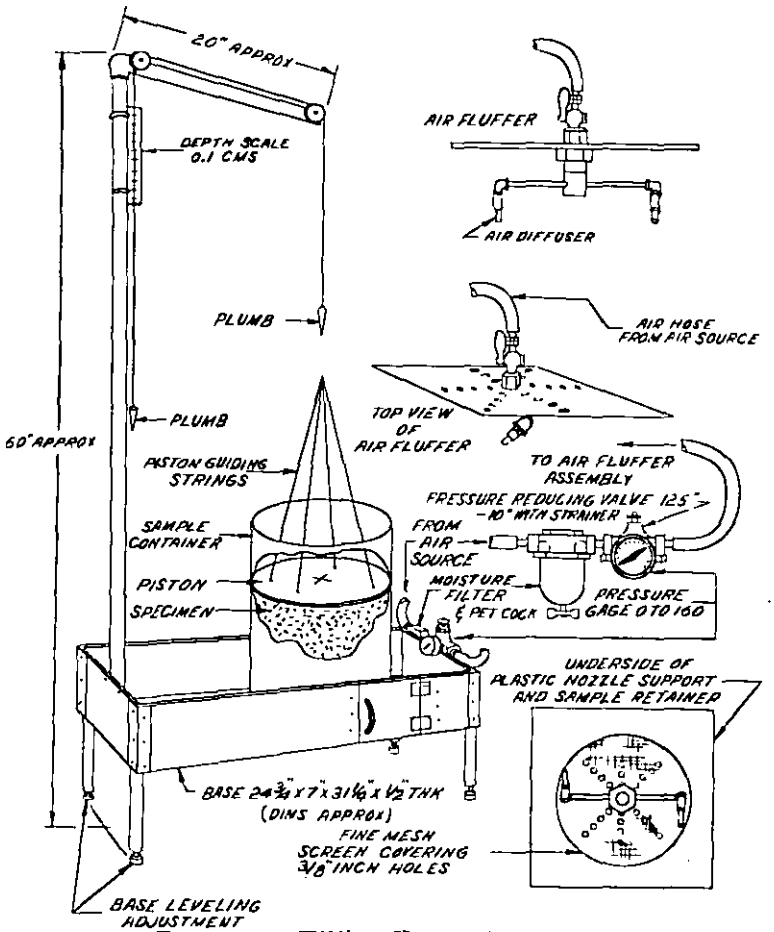

FIGURE 1.—Filling Power Apparatus.

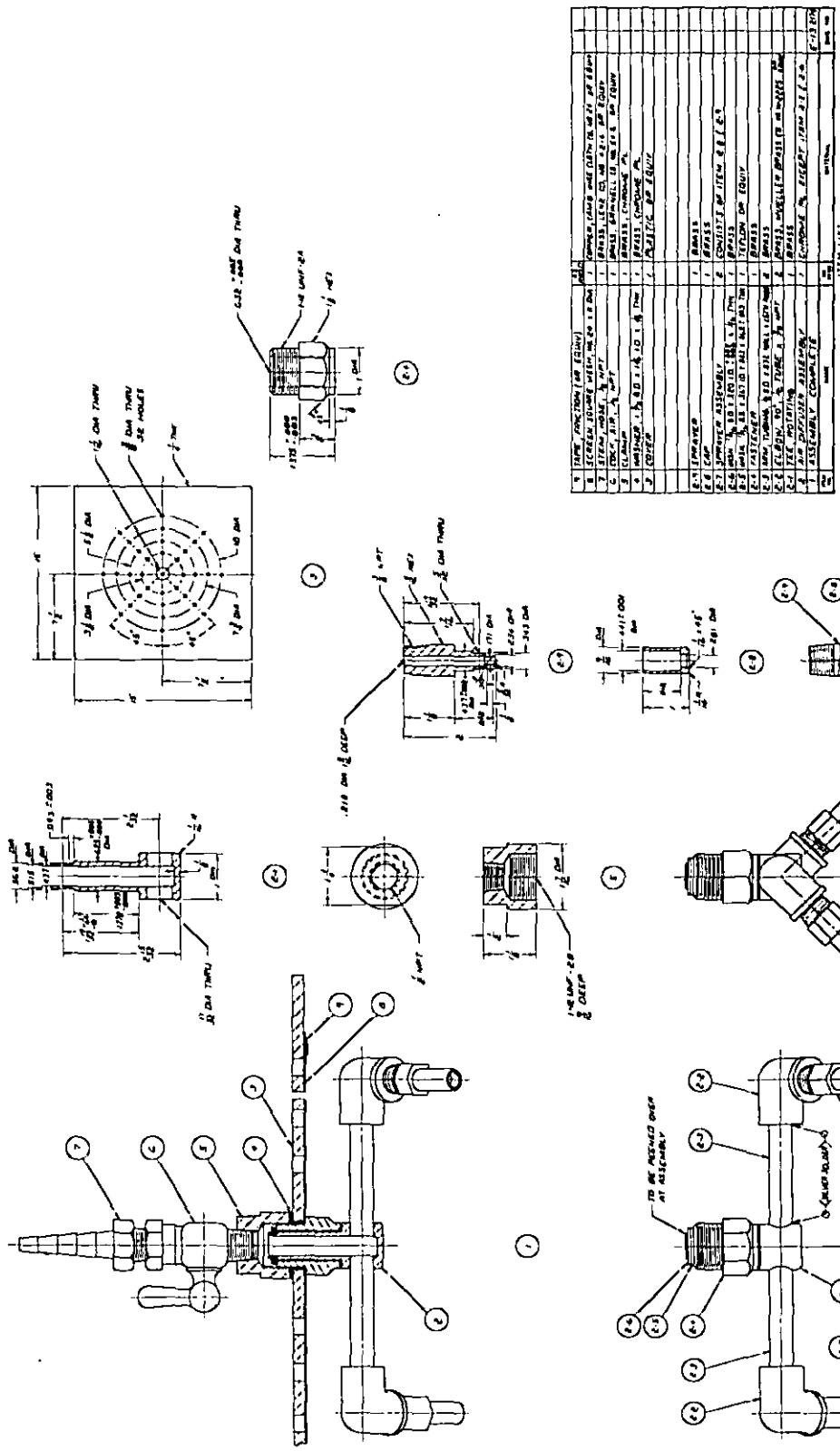

FIGURE 2.—Air Blowing Assembly and Details.

DETERMINATION OF COMPOSITION OF FEATHER FILLING MATERIALS

1. SCOPE

1.1 This method is intended for determining the composition by weight of feather filling materials.

2. TEST SPECIMEN

2.1 The specimen shall consist of 4 grams (see 4.1) of the material prepared as specified in 5.1.

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the material specification one specimen shall be tested from each sample unit.

4. APPARATUS

4.1 **Separating box.** A wooden box of the following approximate dimensions:

Base—18 inches long by 12 inches wide
Front—6 inches high
Back—12 inches high

The box shall have a glass lid hinged to the top edge of the back panel to provide a clear view of its interior and a free and secure closure during examination of the sample. It shall also have two openings, in the front panel, large enough to permit the examiner's hands to enter the box to separate and examine the particles in the sample, and shall be equipped with a light inside the box to provide sufficient illumination of its interior. The interior may be painted with a lacquer or flat black paint.

4.2 **Weighing bottles.** Tared weighing bottles or beakers with covers to be used as containers in the separating process.

4.3 **Tweezers.** Tweezers suitable for extracting and separating the components.

4.4 **Balance.** An analytical balance capable of accurately weighing to the nearest 0.001 gram.

5. PROCEDURE

5.1 **Preparation of specimen.** Approximately 28 grams of the material constituting the sample unit for testing shall be exposed in the unpacked state in a container composed of solid bottom with screened sides and top until in standard condition. The material shall be mixed with a rod over the exposure period to insure complete conditioning. The test specimen consisting of approximately 4 grams of sample shall be transferred into a weighing container of known weight and then weighed to the nearest 0.001 gram to determine its exact weight.

5.1.1 *Weighing.* All weights shall be determined to the nearest 0.001 gram.

5.2 The weighing bottle or beaker containing the specimen shall be placed on the floor of the separating box along with as many empty containers of known weight as necessary for the separation of the sample. In the event of dispute, prior to their use, all weighing bottles or beakers shall be kept under standard conditions. The lid of the separating box shall be kept closed.

5.3 Each component of the material in the sample to be analyzed shall be closely examined to determine its nature. Each particle shall be classified in accordance with the definitions in section 2 and shall be placed into the appropriate weighed container. Each container shall be properly marked.

5.4 **Evaluation.**

5.4.1 Upon completion of the separating process, the weight of the content of each weighing bottle or beaker shall be determined by substracting the tare weight of the container from the gross weight.

5.4.2 The percentage of each component shall be determined in accordance with the following formula:

$$\frac{\text{Total weight of material in component}}{\text{Total weight of specimen}} \times 100 = \text{Percent of component in sample}$$

6. REPORT

6.1 The percent of each component of the mixture shall be reported to the nearest 0.1 percent.

7. RETESTS

7.1 In the event that the sum of the weights of all components varies more than one percent from the original sample weight, the test shall be repeated and the original results discarded.

7.2 When test reports indicate failure, each separate portion of the sample shall be kept in a properly identified envelope for ready reference in the event of dispute. If test results are not questioned within three months from date of the report, these samples may be discarded.

7.2.1 If results indicate failure, a recheck shall be performed on another specimen obtained in a similar manner from the original sample.

8. ANALYTICAL REVIEW POINTS

8.1 Macroscopic examinations.

8.1.1 *Macroscopic identification of feathers.*

8.1.1.1 *General.* The definitions given in section 2 for waterfowl and landfowl feathers may, for basis of differentiation, be subdivided into two categories as follows:

Waterfowl:
- Goose
- Duck

Landfowl:
- Chicken
- Turkey

Waterfowl feathers may also be classified according to geographical origin and by the type of the bird producing them. The former designation is the one most commonly used by the industry. In general, waterfowl feathers are superior to landfowl in respect to filling power and resilience and therefore the presence of landfowl feathers in a waterfowl mixture is usually considered as a sign of adulteration.

8.1.1.2 *Distinguishing characteristics of feathers.* The following are considered as distinguishing characteristics of goose, duck, chicken, and turkey feathers:

a. Goose feathers:
   (1) A stout central stem
   (2) A strong longitudinal curl (when present)
   (3) Bulbous, ellipsodial base point
   (4) Oblong or broad outline
   (5) A tendency to have a broad top
   (6) Downy fibers at base
   (7) White or gray color. If gray, the color will be a solid steel gray, sometimes with a tip of white

b. Duck feathers:
   (1) A thin weak central stem
   (2) Slender cylindrical base point
   (3) Slight longitudinal curl if present at all
   (4) Triangular or pointed outline
   (5) Tends to narrow at top
   (6) Few downy fibers at base
   (7) White or dark color. Colored duck feathers are characterized by the variety of colors not only from feather to feather, but on the same feather. They may be brownish-black, with green or purple tint at tip, speckled white and black, speckled white and brown, white with a large red-brown spot, white or gray discolored with regularly placed black spots.

c. Chicken feathers:
   (1) A shiny, glossy surface
   (2) A feather-like appendage or aftershaft growing at the base of the central stem
   (3) An open structure of fibers along the central stem at the base of the feather directly under the after-shaft
   (4) White, white and black, white tipped with brown, brown or red color

d. Turkey feathers:
   (1) A shiny, glossy surface
   (2) A feather-like appendage or aftershaft growing at the base of the central stem
   (3) An open structure of fibers along the central shaft at the base of the feather usually extending nearer the distal end than chicken feathers and more pronounced than on chicken feathers
   (4) White, bronze, red, black in color

8.1.1.3 *Discussion of figures in section 8.*

8.1.1.3.1 A typical goose feather, illustrating some of the above characteristics is shown on figure 1. Similarly, typical chicken feathers are shown on figures 16, 17 and 23. Little difficulty would be encountered in identifying the feather on figure 16 as chicken due to the presence of the typical aftershaft and the open ladder-like structure. The feather shown on figure 17 however, resembles a duck feather in some respects. Note however, that it has the characteristic open ladder-like structure which identifies it as chicken. A variety of the various feathers is shown on figures 1, 6, 7, 10, 16, 17, 18, 19, 23, and 24. Examination of these figures will reveal many of the characteristics listed. It is to be noted, however, that in many cases the features of the various types of goose and duck feathers are similar, and therefore it is impossible to establish a firm rule to identify them by visual inspection. This is even more evident on examination of the feathers shown on figure 13 which contains 36 feathers of both goose and duck origin. Following is the identification of these feathers, reading from left to right and top to bottom, according to the type of bird and geographical origin:

Line 1:
1. Goose (Domestic)
2. Duck (China)
3. Duck (China)
4. Duck (Siam)
5. Duck (Domestic, Long Island)
6. Duck (Domestic, Long Island)
7. Goose (China)
8. Goose (China)
9. Goose (Formosa)
10. Goose (China)
11. Goose (Poland)
12. Goose (Poland)
13. Duck (Domestic, Long Island)
14. Goose (Poland)
15. Goose (Domestic)

Line 2:
1. Goose (Formosa)
2. Duck (China)
3. Duck (China)
4. Goose (Domestic)
5. Duck (China)
6. Duck (Domestic, Long Island)
7. Goose (Czechoslovakia)
8. Goose (China)
9. Duck (Domestic)

Line 3:
1. Duck (Siam)
2. Duck (Domestic, Long Island)
3. Goose (Czechoslovakia)
4. Duck (China)
5. Goose (Hungary)
6. Goose (Poland)
7. Duck (Domestic, Long Island)

Line 4:
1. Duck (Domestic)
2. Duck (Domestic)
3. Goose (Domestic)
4. Goose (Domestic)
5. Goose (Domestic)

8.1.1.3.2 *Feather size.* Feathers are also classified according to size which may vary from less than 1 inch to 14 inches in length. The "small waterfowl" feathers as on figure 6 represent goose and duck feathers taken from the wing, neck, breast, back and keel feather tracts of waterfowl of Asian, European, and domestic origin. The "small landfowl" feathers as on figure 19 represent chicken feathers taken from wing, neck, breast, back and keel feather tracts of landfowl of domestic origin. Turkey feathers are shown on figure 23. Waterfowl and landfowl quill feathers are shown on figures 7 and 20. Feathers of this type have no value as filling material and their use in filling materials should be kept to a minimum. They may be identified by the following characteristics: a stiff central shaft; a flat, two dimensional surface; a vane portion consisting of rigid barbs emerging laterally from the shaft; a shiny vane portion, particularly on the underside; little or no fluff portion at the base of the feather; and a quill point of ¼ inch or more in length.

8.1.1.3.3 *Damaged feathers.* Damage to feathers may occur in several ways, such as inefficient plucking, insect damage, deterioration, prior usage, and severe slaughtering. Some damage to feathers may occur on the fowl itself prior to slaughtering and plucking due to type of environment, diet, illness, etc. The amount of damaged feathers occurring in live

fowl, however, is usually negligible, figures 9 and 22 illustrate the most common type of damage encountered in feathers. As shown by these figures, damaged feathers are characterized by fractures and breaks to the quill shaft, absence of distal and/or basal portion of the feather itself, absence or damage to the right and/or left feather vanes, intermittent absence of vanes, and vanes entirely separated from the quill shaft.

8.1.2 *Macroscopic identification of down, plumules and nestling feathers.*

8.1.2.1 *Down.* Down occurs in nature as an undercoating of waterfowl growing next to the skin below the feathers and will average about 20 percent of the total covering of a mature bird. While down does occur on landfowl, the amount is negligible. A typical down cluster, enlarged, is shown on figure 11. Down is characterized by having a large number of slender filaments or barbs growing in all directions from a single quill point. In general, it is much superior to feathers as a filling material. Down will vary greatly in size and use value. The three main factors contributing to these are: (1) age of fowl at time of plucking; (2) area of origin; and (3) specie. Any attempt to differentiate between goose and duck down by macroscopic means, such as color or size, may result in serious errors. Positive identification can only be made by microscopic methods. See figure 10 for other examples of down.

8.1.2.2 *Plumules.* Plumules or half downs, as they are sometimes known, resemble down in many respects. They can be distinguished from down by their underdeveloped soft and flaccid quill. For all practical purposes, plumules are very close to down as a filling material and are usually so considered. Due to their light weight, which makes them very difficult to separate from down, plumules will be found in all stocks containing down. Samples of plumules are also shown on figure 10.

8.1.2.3 *Nestling feathers.* Nestling feathers (pin feathers) resemble neither down, plumules, or feathers. They are underdeveloped feathers found mostly in stocks obtained from birds which are not fully matured or in moult and are found in both waterfowl and landfowl. An enlarged view of a nestling feather showing the characteristic sheath and relatively coarse barbs is shown on figure 8. Due to their short, coarse barbs, which extend in one plane, they have very poor filling power. Macroscopic appearance of nestling feathers is similar regardless of the type of fowl. See figures 10 and 18 for other examples of nestling feathers.

8.1.3 *Feather and down fiber.* All feather filling mixtures will be found to contain loose barbs or fibers. Feather fibers may be recognized by their relatively coarse, stiff, structure. The presence of excessive feather fiber may be due to excessively severe processing, deterioration, prior usage or deliberate adulteration. This latter is particularly indicated by the presence of excessive quantities of chicken feather fibers. It is possible to crush white chicken feathers, recover the light fluffy fibers and use them to adulterate down stocks. Chicken feather fibers may be identified by the usual macroscopic and microscopic means. Examples of loose feather and down fibers are shown on figures 12 and 22.

8.1.4 *Residual matter.* In making an analysis of feather filling materials, small amounts of extraneous matter or residue are always found. This may consist of epidermis, quill pith, quill fragments, quill chaff, sand, dirt, trash, etc. The presence of excessive amounts of these materials, shown on figures 12 and 22, is an indication of improper or poor processing.

8.2 **Microscopic examinations.**

8.2.1 *General.* As previously shown, feathers can often be identified by their contour, curvature, quill point, quill shaft, color, etc. Down may similarly be identified. Quite often however, these characteristics are similar, making it difficult, if not impossible, to make a positive identification in this manner. For absolute identification, microscopic methods must be employed.

8.2.2 Feathers consist of an array of barbs growing out from a quill shaft. Down plumes also consist of a series of long filaments (barbs) growing from a central quill point. Individual barbs, as shown on figure 2 have side branches or barbules. This structure is shown on figure 3, which is an enlarged view of a portion of a single barb. It will be noted that the barbules

have protuberances on them which resemble prongs and nodular structures. These structures are shown in detail on figures 4 and 5. The nodular structures are known as nodes and the distance between them is called the internode. It is these barbules, nodes, and internodes which serve as a means of identification.

8.2.3 *Classifications.*

8.2.3.1 *Duck.* In duck down and feather barbs, figures 4 and 5, the proximal barbules, those near the base of the barb, have from one to six nodes (depending partly on the species of duck) near the distal end of the barbules. These nodes are always relatively large in all but the most immature downs and feathers, and the internode is always short. On barbules nearest the base of the barb, their terminal ends may be somewhat filamentous, ending more abruptly or bluntly farther out on the barb. There are frequently several prongs beyond the last node. In the more distal barbules, the nodes are usually absent, but the prongs are present, their internode corresponding with that between the nodes. The prongs appear only distally on the barbules, as is characteristic with nodes on duck down barbules.

8.2.3.2 *Goose.* On barbules from goose down and feathers (see figs. 4 and 5) the nodes are much smaller. The nodes nearest the base of the barbule are often less than half way from the base to the tip of the barbule, and the internodes are usually one and one-half to two times, or more, the length of the internodes on duck down barbules. The distal end of the barbules beyond the last node is extremely long and filamentous, especially on those barbules near the base of the quill shaft, becoming shorter farther out toward the tip. As is the case with duck down barbules, those situated more distally on the barb have prongs only whose internode corresponds in length with that between the nodes. In very immature down and feathers, even the basal barbule will have prongs in place of nodes. The location on the barbule and the distance between the prongs will approximate that of nodes.

8.2.3.3 *Chicken and turkey.* In chicken and turkey plumage, the barbules emanating from the barb have a series of evenly spaced light swellings or protrusions which give the barbule the appearance of a bamboo stalk (see fig. 4). The protrusions start well down on the barbule, almost to where the barbule joins the barb, and will usually extend out to the distal end of the barbule, the last two or three protrusions being in the form of prongs. Microscopically there is a very slight difference in the nodule structure between the chicken and turkey barbule, and for all practical purposes the chicken and turkey barbule are considered as identical.

8.2.3.4 *Summary.* The basic characteristics noted above have been found to be consistent in both down and feathers, regardless of the age or sex of the bird. There are slight differences, for instance, in the length of the internode of duck down barbules, even on the same barbule. But the maximum length of the internode of duck down barbules rarely closely approaches the minimum length of the internode of goose down barbules. Furthermore, the nodes on duck down barbules are always situated more distally on the barbule, regardless of the length of the barbule, whereas the nodes on the barbules of goose down may begin only one-third, approximately, of the distance from the basal end of the barbule to its tip. Figures 4 and 5 illustrate the above points.

8.2.4 *Selection of materials.* Caution should be exercised especially to persons applying these methods for the first time. In commercial stocks, especially if mixed, loose barbs from the down of one source may become entangled in the down from another source, and a hasty conclusion may be in error for this reason. Either the entire down plume or feather should be studied, or a single barb which is definitely known to have been attached to the object under observation, should be removed and examined. The removal of barbs is very valuable, especially in the case of feathers, as the quill shaft does not permit mounting to get a flat mount, hence getting a reasonable consistent focal plane. In feathers, it is also important to get a barb near the base of the quill. In all cases, care is to be exercised.

8.3 Secondhand feathers and down.

8.3.1 *Remarks.* Federal specifications prohibit the use of secondhand feathers and down and it is necessary, therefore, that the analyst be able to detect the presence of secondhand material in feather filling material mixtures.

8.3.2 *Feathers.* The following are some of the characteristics of secondhand feathers:

a. Central stem is yellow.
b. Large percentage of feathers are broken.
c. Feathers are frequently broken at both ends, showing only central portion.
d. Feathers are bent or the stem is cracked.
e. Feathers have a lateral curl.
f. Stems are brittle or weak.

Secondhand feathers may contain relatively large percentages of bent and broken feathers and feather fragments. Fragments from secondhand feathers are similar to those from damaged feathers. Other characteristics, such as yellowness of the quill shaft, may be used to differentiate between these.

8.3.3 *Down.* The following are some of the characteristics of secondhand down:

a. Weak, brittle, lacks resilience.
b. Clusters disintegrate into fibers easily.
c. Large portion of down fiber is present.
d. Large portion of broken bits of feather fiber entangled in down.

In addition to the above, secondhand down may be matted, rolled or felted, lack luster, and the barbs may be broken. If the stock suspected as being secondhand is shaken out on a black surface and the down carefully brushed to one side, a number of very fine coarse feather barbs are apparent.

8.3.4 *General discussion and microscopic identification of secondhand materials.* It is evident that identification of secondhand material cannot always be made by macroscopic examination alone, although it is frequently sufficient to indicate at least the possible presence of secondhand material and to suggest the advisability of further study.

8.3.4.1 The appearance of feathers and down which have been used will vary with the amount of use and treatment which they have sustained. The degree of variation, from observations made on known used control samples of secondhand feathers or down, varies from undetectable to complete deterioration of the stock. Even in feather or down stocks which are known to be 100 percent secondhand, there will be numerous feathers and down plumes which will show no indications of being secondhand, either visually or microscopically.

8.3.4.2 For a closer examination of materials suspected as being secondhand, it is necessary to use the microscope. This is not often necessary for feathers, although it can be used as a valuable adjunct to the macroscopical study. Previous usage of down is usually indicated microscopically by the amount of textile (colored and natural) fibers present in the down plume. Experience and comparison with known controls of both new and used down plumes show that in new plumes, the presence of textile fibers is from nil to occasional; whereas in used plumes, the textile fiber content is from five to fifteen fibers per plume, and at times, even exceeds this figure.

8.3.4.3 The amount of broken barbs on feathers and down present are also additional indications of secondhand material. Again, experience and comparison with known control samples of both new and used stocks show that in new stocks, broken feather and down barbs rarely exceed five per plume and often there will only be one or two per plume. In secondhand stocks, the amount of broken barbs is usually from 5 to 40, and at times, even exceeds this amount. The presence of large amount of chicken feather barbs in down plumes, in stocks, which upon analysis have been found to contain no chicken feathers or chicken feather fiber, indicates that the down plumes have been previously used in stocks containing chicken feathers or that the down has been adulterated.

8.3.4.4 It is to be emphasized that the macroscopical examination is not sufficient for the detection of all secondhand stocks, since used material frequently had not been damaged to the point where it can be detected by visual means. New material may be damaged in processing so that the presence of broken barbs or damaged material must not in itself be taken as proof that the materials have been used previously. Such evidences are only indications and must be supplemented by further testing.

DETERMINATION OF BRITTLENESS OF FEATHERS

1. SCOPE

1.1 This method is intended for determining the brittleness of landfowl and waterfowl feathers.

2. TEST SPECIMEN

2.1 The test specimen shall consist of 50 feathers prepared as specified in 5.1.

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in material specification, one specimen (50 feathers) shall be tested from each sample unit.

4. APPARATUS

4.1 None required for this method.

5. PROCEDURE

5.1 **Preparation of specimen.** Approximately 28 grams of the material constituting a sample unit for testing shall be exposed in the unpacked state in a container composed of solid bottom with screened sides and top for not less than 3 days nor more than 5 days. The material shall be mixed with a rod over the exposure period to insure complete relaxation and conditioning. The test specimen consisting of 50 feathers randomly selected from the conditioned sample shall be chosen.

5.2 Each individual feather shall be tested by bringing the ends together in the direction of maximum curvature. Fracture of the quill shall be evidence of failure.

6. REPORT

6.1 The brittleness of the sample unit shall be reported as "pass" or "fail."

6.2 Unless otherwise specified, no more than 4 of the 50 feathers composing the specimen shall exhibit evidence of failure.

DETERMINATION OF OXYGEN NUMBER (TITRATION METHOD)

1. SCOPE

1.1 This method is intended for determining the oxygen number of feathers, feather products, down, and mixtures thereof by means of a titration process.

2. TEST SPECIMEN

2.1 The specimen shall consist of 10.0±0.1 grams of material prepared as specified in 5.1.

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the material specification, two specimens shall be tested from each sample unit.

4. APPARATUS AND REAGENTS

4.1 Apparatus.

4.1.1 *Tumbler jar.* The tumbler jar and apparatus shall be as specified in method 5500 of Federal Specification CCC–T–191, except that the jar shall be all glass or stainless steel.

4.1.2 *74 micron (standard No. 200) sieve.*

4.1.3 *Analytical balance.*

4.1.4 *Micro-burettes (2) (divided into 0.02-ml divisions).*

4.1.5 *Porcelain casserole.*

4.1.6 *Stopwatch or other suitable equivalent, and timer.*

4.1.7 *Beaker, 2,000 milliliters.*

4.2 **Reagents.**

4.2.1 *Distilled water.*

4.2.2 *6N sulfuric acid.*

4.2.3 *Potassium permanganate.*

5. PROCEDURE

5.1 **Preparation of specimen.** Approximately 28 grams of the material shall be exposed in the unpacked state in a container composed of solid bottom with screened sides and top until in standard condition. The material shall be mixed with a rod over the exposure period to insure complete relaxation and conditioning. The test specimen consisting of 10.0±0.1 grams shall be taken from the conditioned material.

5.2 The specimen shall be placed in a tumble jar with 1 liter of distilled water, sealed and tumbled at room temperature for 60–65 minutes. The resulting suspension shall be filtered through a 74 micron (Standard No. 200 sieve) into a beaker. Do not squeeze excess water from stock into beaker.

5.3 A 100-ml. aliquot of the above filtrate shall be transferred to a porcelain casserole, neutralized and made acid with the addition of 1 to 2 milliliters excess of 6*N* sulfuric acid. The solution shall be titrated with standard 0.1*N* potassium permanganate, by means of a burette divided into 0.02-ml. divisions, adding approximately 0.02 ml. at a time until a pink color persists for 60 seconds. This small amount is not sufficient to make a full drop and shall be collected on a glass stirring rod and then added to the solution. Calculate oxygen number to the number of grams of oxygen per 100,000 grams of the sample as follows: The number of milliliters of 0.1*N* K MnO_4 determined shall be multiplied by a constant (80). The product from the multiplication shall be considered "the initial oxygen number of the feather material" and in calculation of results is indicated as "A."

5.3.1 *Blank determination distilled water.* A blank determination shall be made on distilled water to determine the oxygen number of the water. This shall be done by following the exact procedure stated above excluding the feather material. The value determined shall be considered "the blank determination of the distilled water" and in the calculations of results is indicated as "B."

6. CALCULATION OF RESULTS

6.1 The true oxygen number of the feather material shall be calculated from the following formula:

True oxygen number of feather material = A − B

Where:

A = Initial oxygen number of the feather material

B = Blank determination of the distilled water

7. REPORT

7.1 The true oxygen number of the sample unit shall be the average of the true values obtained from the specimens tested and shall be reported to the nearest whole number.

DETERMINATION OF SOLVENT SOLUBLE MATTER

1. SCOPE

1.1 This method is intended for determining the amount of solvent soluble matter present in feather filling materials.

2. TEST SPECIMEN

2.1 The test specimen shall consist of 3.0±0.5 grams of material prepared as specified in 5.1.

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the material specification, two specimens shall be tested from each sample unit.

4. APPARATUS AND REAGENTS

4.1 **Apparatus.**

4.1.1 *Soxhlet extractor.*

4.1.2 *Extraction thimble (Whatman single thickness) (33 mm.×80 mm.).*

4.1.3 *Water bath.*

4.1.4 *Analytical balance.*

4.1.5 *Oven.*

4.2 **Reagent.**

4.2.1 *Chloroform or carbon tetrachloride U.S.P.*

5. PROCEDURE

5.1 **Preparation of test specimen.** Approximately 28 grams of material constituting a sample unit for testing shall be exposed in the unpacked state in a screened container, composed of a solid bottom with screened sides and top until it is in standard condition.

5.1.1 *Weighing.* All weighings shall be determined to the nearest 0.001 gram.

5.2 The test specimen shall be placed in a fat-free extraction thimble (Whatman single thickness) and covered with a mat of fiberglass to prevent escape of specimen.

5.3 Thimble with specimen shall be extracted in a Soxhlet extractor, using carbon tetrachloride or chloroform for a minimum of 20 cycles.

5.4 The extract shall then be evaporated on a water bath, dried to constant weight in an oven 100°–105°C., cooled and weighed. The weight of the extract is the solvent soluble matter.

6. CALCULATION OF RESULTS

6.1 If DDT is present on the material the DDT content shall be determined by method 6 and the amount of solvent soluble matter present determined by the following formula:

$$\text{Percent solvent soluble matter} = \left(\frac{\text{(Wt of dried extract}}{W} \times 100\right) - \text{(DDT content percent)}$$

6.2 When DDT is not present on the material the percent solvent soluble matter shall be determined by the following formula:

$$\text{Percent solvent soluble matter} = \frac{\text{Wt of dried extract}}{W} \times 100$$

Where:

W is the conditioned weight of the specimen in grams.

7. REPORT

7.1 The solvent soluble matter of the sample unit shall be the average of the results obtained from the specimen tested and shall be reported to the nearest 0.1 percent.

DETERMINATION OF DDT (DICHLORO-DIPHENYL-TRICHLOROETHANE) CONTENT

1. SCOPE

1.1 This method is intended for the determination of the DDT content on feather filling materials.

2. TEST SPECIMEN

2.1 The test specimen shall consist of 10.0±0.5 grams of material prepared as specified in 5.1.

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the material specification, two specimens shall be tested from each sample unit.

4. APPARATUS AND REAGENT

4.1 **Apparatus.**

4.1.1 *Soxhlet extractor.*
4.1.2 *Analytical balance.*
4.1.3 *Steam or water bath.*
4.1.4 *Water-cooled reflux condenser.*
4.1.5 *No. 52 Whatman filter paper.*
4.1.6 *500-ml. Erlenmeyer flask.*

4.2 **Reagents.**

4.2.1 *Petroleum ether U.S.P.*
4.2.2 *99 Percent isopropyl alcohol.*
4.2.3 *50 Percent isopropyl alcohol.*
4.2.4 *Metallic sodium.*
4.2.5 *Distilled water.*
4.2.6 *Phenolphthalein solution.*
4.2.7 *Nitric acid.*
4.2.8 *0.1N silver nitrate.*
4.2.9 *Ferric ammonium sulfate indicator.*
4.2.10 *0.1N potassium thiocyanate solution.*
4.2.11 *Nitrobenzene.*

5. PROCEDURE

5.1 **Preparation of specimen.** Approximately 28 grams of the material constituting a sample unit for testing shall be exposed in the unpacked state in a container composed of solid bottom with screened sides and top until in standard condition. The material shall be mixed with a rod over the exposure period to insure complete relaxation and conditioning. The test specimen consisting of 10.0±0.5 grams of material shall be selected.

5.1.1 *Weighings.* All weighings shall be determined to the nearest 0.001 gram.

5.2 The test specimen shall be placed in a Soxhlet apparatus with petroleum ether or any suitable benzene type solvent and extracted for two hours. Transfer the flask to a steam or water bath and evaporate almost all the solvent: *Do not evaporate to dryness*, since the DDT may decompose. Add 25 ml. of 99 percent isopropyl alcohol and 2.5 grams of metallic sodium cut into small pieces and swirl the flask in order to mix its contents. Connect to a water-cooled reflux condenser and boil gently for a minimum of one-half hour. Shake the flask occasionally. Decompose the excess sodium by cautiously adding 10 milliliters of 50 percent isopropyl alcohol through the condenser at a rate of 1 to 2 drops per second. Boil for an additional 10 minutes and then add 60 milliliters of distilled water.

5.3 Cool to room temperature, add 2 to 3 drops of phenolphthalein solution, neutralize by adding nitric acid (1 to 1), and add 10 milliliters of the diluted acid in excess. Add dropwise, with stirring of the solution, a measured excess (25 ml.) of 0.1*N* $AgNO_3$ solution. Coagulate the precipitate by heating on a steam or water bath for approximately one half hour. Cool to room temperature and filter through a No. 52 Whatman filter paper and wash thoroughly with distilled water, receiving the filtrate in a 500-ml. Erlenmeyer flask.

5.4 Add 5 milliliters of ferric ammonium sulfate indicator and 5 drops of nitrobenzene, titrate the excess $AgNO_3$ consumed by the specimen with standardized 0.1*N* potassium thiocyanate (KCNS).

6. CALCULATION OF RESULTS

6.1 The percent of DDT present in the material shall be calculated using the following

formula and the result altered as required by the blank determination in accordance with 6.2.

Percent DDT (dichloro-diphenyl-trichloroethane)

$$=\frac{[\text{ml}\times \text{N}(AgNO_3)]-[\text{ml}\times \text{N}(KCNS)]\times 7.094}{\text{Weight of specimen (grams)}}$$

6.2 A blank determination for the chemicals used shall be made following the exact procedure given above excluding the feather material and limiting the excess 0.1*N* $AgNO_3$ solution to 5 milliliters in order to obtain a chloride correction value. The blank value shall be subtracted from the DDT determination to obtain the exact value of DDT present.

7. REPORT

7.1 The DDT content of the sample unit shall be the average of the results obtained from the specimens tested and shall be reported to the nearest 0.1 percent.

DETERMINATION OF MOISTURE CONTENT OF FEATHER FILLING MATERIALS

1. SCOPE

1.1 This method is intended for the determination of the moisture content of feather filling materials in standard condition or in the "as received" state.

2. TEST SPECIMEN

2.1 The specimen shall consist of 5 grams of feather filling material prepared as specified in 5.1.

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the material specification, two specimens shall be tested from each sample unit.

4. APPARATUS

4.1 **Glass weighing bottle.** Approximately 100 milliliter capacity fitted with a ground glass cover or an aluminum weighing can of the same capacity with a tight-fitting cover.

4.2 **Circulating air oven.** Thermostatically controlled capable of maintaining temperature at 105° to 110°C. (221° to 230°F.).

4.3 **Analytical balance.**

4.4 **Desiccator.**

4.5 **Desiccating agent such as calcium chloride, calcium sulfate, etc.**

4.6 **Tongs.**

5. PROCEDURE

5.1 **Preparation of specimen.**

5.1.1 *Moisture content of material as received.* When the moisture content is required of the material as received, the specimen shall be delivered to the testing laboratory in a sealed, moistureproof receptacle of the smallest possible volume. The maximum weight of the receptacle and the specimen shall be approximately 100 grams. The sealed receptacle with the specimens shall be weighed as received, the specimen removed, and the receptacle reweighed. The difference between the weight of the unopened receptacle and of the receptacle alone shall be the submitted "original weight of the specimen" and shall be recorded as "O."

5.1.2 *Moisture content of the "conditioned material."* When the moisture content of conditioned material is required, the specimen shall be in standard condition as defined in section 2 and weighed.

5.1.3 *Weighing.* All weighings shall be determined to the nearest 0.001 gram.

5.2 The glass weighing bottle and cover, or the aluminum weighing can and cover, shall be dried at 105° to 110°C. (221° to 230°F.) to constant weight. The container and cover shall be placed separately in the oven. After drying for 1 hour, the container and cover shall be transferred, using clean tongs, to a desiccator and allowed to cool to room temperature over a desiccating agent. The container and cover shall then be weighed.

5.3 The heating, cooling, and weighing cycle shall be repeated until the weight is constant within ±0.001 gram. This is the "weight of the weighing container." The container shall be kept in a desiccator when not in use.

5.4 The uncovered container, with specimen, shall be placed in the oven for not less than 1.5 hours at a temperature of 105° to 110°C. (221° to 230°F.). The container shall be covered and quickly transferred to a desiccator. After cooling to room temperature, the container and specimen shall be weighed. The specimen and container shall be returned to the oven and the drying, cooling, and weighing cycle repeated until the weight is constant within ±0.001 gram. The weight of the container, 4.3, shall be subtracted from this weight to obtain the "dry weight of the specimen" recorded as "D."

6. CALCULATION OF RESULTS

6.1 The moisture content shall be calculated as follows:

$$\text{Moisture content of specimen, percent} = \frac{O-D}{O} \times 100$$

Where:

O=original weight of specimen
D=dry weight of specimen

7. REPORT

7.1 The moisture content of the sample unit shall be the average of the results obtained from the specimens tested and shall be reported to the nearest 0.1 percent.

DETERMINATION OF ACIDITY (pH) OF FEATHER FILLING MATERIALS

1. SCOPE

1.1 This method is intended for determining the pH of a water extract of feather filling materials.

2. TEST SPECIMEN

2.1 The specimen shall be 1.00±0.01 gram of material prepared as specified in 5.1.

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the material specification, two specimens shall be tested from each sample unit.

4. APPARATUS AND REAGENTS

4.1 Apparatus.

4.1.1 *Analytical balance.*

4.1.2 *Scissors.*

4.1.3 *Potentiometric pH apparatus with glass and calomel electrodes.*

4.1.4 *Glass-stoppered Erlenmeyer flask, 250-milliliter capacity.*

4.1.5 *Beaker, 100 milliliter.*

4.1.6 *Water distillation apparatus.*

4.2 Reagents.

4.2.1 *Distilled water.* Distilled water shall be boiled for 30 minutes to remove carbon dioxide. The boiled water shall be placed in a flask, stoppered, and cooled to room temperature. The pH of the carbon-dioxide-free distilled water shall be between 6.2 and 7.0 at 25°C.

4.2.2 *Potassium acid phthalate, 0.05 molal solution, pH 4.0 at 25°C.*

4.2.3 *Sodium borate, 0.01 molal solution, pH 9.18 at 25°C.*

5. PROCEDURE

5.1 Preparation of specimen. Approximately 15 grams of the material constituting a sample unit for testing shall be cut into 1/16 inch pieces. The cut material shall then be placed in a suitable container and conditioned. A test specimen of 1.00±0.01 gram shall be selected from the conditioned cut sample.

5.2 The weighed specimen of cut material shall be placed in a 250-ml. Erlenmeyer flask with 5 milliliters of distilled water. The material shall be macerated with a glass rod (flattened at the end) until all material is wet and 65 milliliters of distilled water added. The flask shall be stoppered and allowed to stand for 3 hours at room temperature, with occasional shaking. Without removing the material, the temperature of the water shall be adjusted to 25°±1°C. (77°±1.8°F.) and the pH determined as follows (see 5.4):

5.3 The test solution in 5.2 shall be agitated and placed in a 100-ml. beaker. The electrodes shall then be inserted in this solution, immersed at least 0.5 inch, and the solution stirred gently. Avoid contact with the glass electrode to prevent damage to the fragile glass membrane. The pH shall be determined from the potentiometer. The temperature of the solution during the test should be between 24° to 26°C. (75.2° to 78.8°F.).

5.4 Prior to determining the pH of the test solution in 5.3, the apparatus shall be prepared for operation by inserting the calomel electrode and glass electrode in their respective holders and washing with distilled water. The apparatus shall then be standardized by the use of the appropriate buffer solution. The electrodes shall then be washed with distilled water.

6. REPORT

6.1 The pH of the sample unit shall be the average of the results obtained from the specimens tested and shall be reported to the nearest 0.1 pH.

Note: Potentiometers of the type required in this method may be purchased from the Leeds Northrup Co., 4901 Stenton Ave., Phila., Pa.; National Technical Laboratories, South Pasadena, Calif.; and Beckman Instruments, Inc., Fullerton, Calif.

DETERMINATION OF TOTAL CHROMIC OXIDE CONTENT OF FEATHER FILLING MATERIALS

1. SCOPE

1.1 This method is intended for determining the total chromic oxide content of treated feather filling materials.

2. TEST SPECIMEN

2.1 The specimen shall consist of 10.0±0.5 gram of feather filling material prepared as specified in 5.1.

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the material specification, two specimens shall be tested from each sample unit.

4. APPARATUS AND REAGENT

4.1 **Apparatus.**

4.1.1 *Analytical balance.*

4.1.2 *Scissors.*

4.1.3 *Muffle furnace.*

4.1.4 *Porcelain evaporating dish, 250-milliliter capacity.*

4.1.5 *Watchglass.*

4.1.6 *500-ml. Erlenmeyer flask.*

4.1.7 *Burette.*

4.1.8 *Circulating air oven.*

4.2 **Reagents.**

4.2.1 *Distilled water.*

4.2.2 *Perchloric acid, reagent grade, 70 percent.*

4.2.3 *Potassium iodide, 10 percent solution.*

4.2.4 *Sodium thiosulfate, 0.1N solution, standardized.*

4.2.5 *Starch indicator, 2 percent solution.*

4.2.6 *Concentrated sulfuric acid, specific gravity 1.83.*

4.2.7 *Concentrated nitric acid, specific gravity 1.43.*

4.2.8 *Phosphoric acid, 40 percent solution.*

5. PROCEDURE

5.1 **Preparation of test specimen.** Approximately 28 grams of material from the sample unit for testing shall be cut into 1/16 inch pieces. A 10.0±0.5 gram portion from the test specimen shall be transferred to a tared weighing container and the specimen dried in a circulating air oven to a constant weight at 105°± 5°C. The weight of the tared weighing container shall be subtracted from the constant weight value obtained from the container and specimen and the difference recorded as "W."

5.1.1 *Weighings.* All weighings shall be determined to the nearest 0.001 gram.

5.2 The dish with specimen shall be placed in a cold muffle furnace, the temperature of the furnace gradually raised 900° to 1000°C. (1650° to 1832°F.), maintained at this temperature until the dish and contents have reached a constant weight (±0.001 grams). If it is difficult to obtain a constant weight, the residue shall be leached with hot distilled water and filtered through an ashless filter paper. The filter paper shall then be placed in the dish and ashed. The filtrate shall be added to the dish and evaporated, the dish placed in the furnace and heated to a constant weight. The dish shall then be cooled in a desiccator to room temperature. (WARNING: The specimen must be burned until free from all carbonaceous materials to prevent explosion on the addition of perchloric acid). To the dish containing the ash, add 15 milliliters of sulphuric acid, specific gravity 1.83; 4 milliliters of nitric acid, specific gravity 1.43; and 10 milliliters of 70 percent perchloric acid. Cover the dish with a watch glass and heat the contents to white fumes (approximately 190°C. (374°F.)) and continue heating until the contents turn to a deep orange color. During the heating, any particles adhering to the dish that are not washed down by condensed acid, shall be washed down by additional 4/10 nitric/perchloric acid mixture. The solution shall be cooled to room temperature and transferred to a 500-ml. Erlenmeyer flask. If a green color persists after 5 minutes of white fumes, the solution should be discarded and the determination started over. The same porcelain evaporating dish should not be used more than 5 times or less if porcelain shows evidence of being attacked. *Caution: do*

not evaporate to dryness, if the reaction becomes too vigorous, remove heat until reaction subsides and then continue heating.

5.4 Distilled water shall be added to make a volume of about 100 milliliters and the solution boiled approximately 30 minutes until all chlorine is removed, as indicated by a negative test when paper moistened with potassium iodide is held in the vapors. Do not let the volume go below 75 milliliters. The solution shall be cooled to 15°±5°C. (59°±9°F.) and made up to 100 milliliters with distilled water at room temperature. Add 30 milliliters of 40 percent phosphoric acid and 10 milliliters of a 10 percent solution of potassium iodide shall be mixed with the solution and the solution allowed to stand in the dark with the flask stoppered for about two minutes. The solution shall be immediately titrated with a 0.1*N* sodium thiosulfate solution using starch indicator near the end of the titration.

6. CALCULATION OF RESULTS

6.1 The percent chromic oxide in the specimen shall be calculated as follows:

$$\text{Chromic oxide } (Cr_2O_3), \text{ percent} = \frac{A \times N \times 0.02533}{W} \times 100$$

Where:

A is the number of milliliters of standardized thiosulfate required to titrate the specimen.
N is the normality of the thiosulfate solution.
W is dry weight of specimen in grams.

7. REPORT

7.1 The chromic oxide of the sample unit shall be the average of the results obtained from the specimens tested and shall be reported to the nearest 0.01 percent.

DETERMINATION OF TURBIDITY (TURBIDIMETER METHOD)

1. SCOPE

1.1 This method is intended for determining the turbidity, as a measure of cleanness, of feather filling materials by means of a turbidimeter.

2. TEST SPECIMEN

2.1 The specimen shall consist of 10.0±0.1 grams of material.

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the material specification, two specimens shall be tested from each sample unit.

4. APPARATUS

4.1 Tumbler jar. The tumbler jar and apparatus shall be as specified in method 5500 of Federal Specification CCC–T–191 except that the jar shall be all glass or stainless steel.

4.2 Jackson turbidimeter.

4.2.1 *Glass tube.* The graduated glass tube, calibrated in centimeters from the bottom of the inside of the tube is partially enclosed in a metal support. The tube shall conform to the requirements for Nessler tubes; i.e., it shall be of the "tall" form, made of resistant glass and selected from uniformly drawn tubing. The glass shall be clear and colorless. The tube shall have a bottom that is plane-parallel. When the tube is filled with liquid and viewed from the top, using a light source beneath the tube, there shall be no dark spots nor any lens-like distortion of the transmitted light. The relationship between Jackson candle turbidity and centimeters is shown in the following table:

Graduation of the candle turbidimeter.

Light path (distance from inside bottom of glass tube)	Turbidity units	Light path (distance from inside bottom of glass tube)	Turbidity units
cm.		cm.	
2.3	1,000	11.4	190
2.6	900	12.0	180
2.9	800	12.7	170
3.2	700	13.5	160
3.5	650	14.4	150
3.8	600	15.4	140
4.1	550	16.6	130
4.5	500	18.0	120
4.9	450	19.6	110
5.5	400	21.5	100
5.6	390	22.6	95
5.8	380	23.8	90
5.9	370	25.1	85
6.1	360	26.5	80
6.3	350	28.1	75
6.4	340	29.8	70
6.6	330	31.8	65
6.8	320	34.1	60
7.0	310	36.7	55
7.3	300	39.8	50
7.5	290	43.5	45
7.8	280	48.1	40
8.1	270	54.0	35
8.4	260	61.8	30
8.7	250	72.9	25
9.1	240		
9.5	230		
9.9	220		
10.3	210		
10.8	200		

4.2.2 *Candle.* A candle, with a maximum length of 6 inches, made of beeswax and spermaceti, which burns at a rate of 114 to 125 grains per hour.

4.2.3 *Support.* A support which aligns the candle and the glass tube in a vertical position so that the center line of the tube passes through the center line of the candle. The candle support shall consist of a spring loaded cylinder designed to keep the top of the candle pressed against the top of the support as the candle burns away. The top of the support for the candle shall be 3 inches below the bottom of the tube.

4.5 Analytical balance.

4.6 Beaker, 2,000 milliliters.

4.7 Sieve, 74 micron (Standard No. 200) conforming to Federal Specification RR–S–366, Sieves, Standard for Testing Purposes.

4.8 Scissors, razor blade, or knife.

4.9 Distilled water.

5. PROCEDURE

5.1 Place 10.0±0.1 grams of feather filling material (based on dry weight) cut into 1/16-inch pieces in a tumble jar with one liter of distilled water and tumble at room temperature for 60 to 65 minutes. The resulting suspension shall be filtered through a sieve into a 2,000-ml. beaker. The stock will be captured by the screen sieve and the wash liquor will pass through into the beaker.

5.2 The applicable procurement document shall state the turbidity value, i.e., the centimeter height required. Based on this value the appropriate amount of filtrate prepared in 5.1 shall be transferred to the calibrated Nessler tube and the tube filled to the exact level (cm.) required.

5.2.1 Care shall be taken to keep the calibrated tube dry on the outside and to avoid scratching of the glass. To insure uniform results, the flame must be kept as near constant size as possible. This will require frequent trimming of the charred portion of the wick and frequent observation to insure that the candle is at the top of its support. All drafts must be eliminated during the measurements to prevent the flame from flickering. The candle shall not be kept burning for more than 2 minutes at a time. Each time the candle is relit, the charred portion of the wick shall be cut off. If difficulty is noted in observing the candle flame, the observation shall be made in subdued light.

6. REPORT

6.1 The turbidity of the sample unit shall be determined by the test of duplicate aliquots of the specimen filtrate and the result of each aliquot reported as "pass" or "fail." Failure of one aliquot shall be cause for rejection.

DETERMINATION OF ODOR OF FEATHER FILLING MATERIALS

1. SCOPE

1.1 This method is intended for determining the odor of feather filling materials upon exposure to water.

2. TEST SPECIMEN

2.1 The specimen shall consist of 10.0±0.5 gram of filling material prepared as specified in section 5.1.

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the material specification, two specimens shall be tested from each sample unit.

4. APPARATUS

4.1 **Standard one-quart jar fitted with screw-on or clamp-type cover.**
4.2 **Analytical balance.**
4.3 **Circulating air-oven.**
4.4 **Distilled water.**

5. PROCEDURE

5.1 **Preparation of specimen.** Approximately 28 grams of material constituting a sample unit for testing shall be exposed in the unpacked state in a container, composed of a solid bottom with screened sides and top until it is in standard condition. The material shall be mixed with a rod over the exposure period to insure complete relaxation and conditioning. A portion, 10.0±0.5 grams, composed of test specimen, shall be transferred to a standard one-quart jar with screw-on clamp-type cover cap containing 100 milliliters of distilled water at room temperature.

5.2 The jar shall then be agitated until the material is thoroughly wet out. The jar shall then be placed in a circulating air-oven at 100° to 105°F. for a period of 24 hours. At the end of this time the jar shall be removed, opened, and examined.

5.3 **Evaluation.**

5.3.1 The presence of the odor of putrefaction shall be considered as evidence of failure of the specimen.

6. REPORT

6.1 The odor of the sample unit shall be reported as "pass" or "fail."

DETERMINATION OF OXYGEN NUMBER COLORIMETER METHCD

1. SCOPE

1.1 This method is intended for determining the oxygen number of filling materials. In the interest of standardization of testing requirements, it is recommended that this method not be used in procurement documents.

2. TEST SPECIMEN

2.1 The specimen shall consist of 10.0±0.1 grams of material prepared as specified in 5.1.

3. NUMBER OF DETERMINATIONS

3.1 Unless otherwise specified in the material specification, two specimens shall be tested from each sample unit.

4. APPARATUS AND REAGENTS AND METHODS CITED

4.1 **Apparatus.**

4.1.1 *Tumble jar.* The tumble jar shall be as specified in method 5500 of Federal Specification CCC–T–191 except that the speed of the jar shall be adjusted to 88±3 revolutions per minute. An equivalent agitating device may be used, but care should be exercised in its selection as the agitation of the material influences the results of the test.

4.1.2 *420 micron (Standard No. 40) sieve.*

4.1.3 *Analytical balance.*

4.1.4 *Micro-burettes (2).*

4.1.5 *Colorimeter.* Photovolt Colorimeter Model 401–T with filter #530 or equivalent.

4.1.6 *Recorder.* Varian Model G11A Strip Chart Recorder set to 25 mv span with chart speed of 2 inches per minute and chart paper type 5A or equivalent.

4.1.7 *Stopwatch or suitable equivalent.*

4.1.8 *Beaker.* 2,000 ml.

4.1.9 *Graduates.* 1,000 ml., 100 ml.

4.2 **Reagents.**

4.2.1 *Distilled water.*

4.2.2 *6N sulfuric acid.*

4.2.3 *0.1N potassium permanganate.*

5. PROCEDURE

5.1 **Preparation of specimen.** Approximately 28 grams of the material shall be exposed in the unpacked state in a container with a solid bottom and screened sides and top until in standard condition. The test specimen consisting of 10.0±0.1 grams shall be taken from the conditioned material.

5.2 The specimen shall be placed in a tumble jar with one liter of distilled water and tumbled at room temperature for 15 minutes. The resulting suspension shall be filtered through a 420 micron (Standard No. 40) sieve into a 2,000-ml. beaker. The stock will be captured by the screen sieve and the wash liquor will pass through into the beaker. Do not squeeze excess water from stock into beaker.

5.3 Remove a 200-ml. aliquot of the filtrate from the 2,000-ml. beaker and put into a colorimeter cell. Add 2 ml. of 6*N* sufuric acid. (Note: If colorimeter and recorder used are of the type that requires a warm up period, the apparatus shall be started and allowed to operate for a period of 5 minutes before use.) Turn on stirrer on colorimeter and switch recorder chart switch from stand-by to low.

5.4 Adjust colorimeter by fine and coarse adjusting controls until the meter reading on the colorimeter is 90 on the percent transmission scale. Indicator pen on the recorder must agree with percent transmission meter reading. If transmission reading and recording line reading are not the same, adjust recorder until recorder is in balance with transmission reading on colorimeter.

5.5 If wash liquor being tested is too turbid to adjust colorimeter to 90 percent transmission, choose a lower percent transmission to which the colorimeter will adjust. Again, colorimeter and recorder must agree.

5.6 When recorder and colorimeter are in adjustment, by means of a 5-ml. burette divided into 0.02-ml. divisions, add 3 drops of 0.1*N* potassium permanganate per minute (utilizing a stopwatch) until the recorder chart paper shows a deviation of not less than 2 lines (numbers) below the original setting, i.e., if original setting was 90, a reading of not more than 88 must be recording at the end of a minute interval before test is stopped. The number of milliliters

of potassium permanganate used to indicate a deviation of not more than two lines or numbers within the specified setting shall be multiplied by a constant (40) to determine the oxygen number of the feather material. The resulting product shall be considered "the initial oxygen number of the feather material" and in calculation of results is indicated as "A." The milliliters of 0.1*N* potassium permanganate used is equal to original reading of 5-ml. burette containing the 0.1*N* potassium permanganate minus the final reading.

5.7 Blank determination distilled water. A blank determination shall be made on the distilled water. This shall be determined as specified in 5.6, excluding the feather material and agitating period. The value determined shall be considered "the blank determination of the distilled water" and in calculation of results is indicated as "B."

6. CALCULATION OF RESULTS

6.1 The true oxygen number of the feather material shall be calculated from the following formula:

True oxygen number of feather material=A−B
Where: A=Initial oxygen number of the feather material
B=Blank determination of the distilled water

7. REPORT

7.1 The true oxygen number of the sample unit shall be the average of the true values obtained from the specimens tested and shall be reported to the nearest whole number.

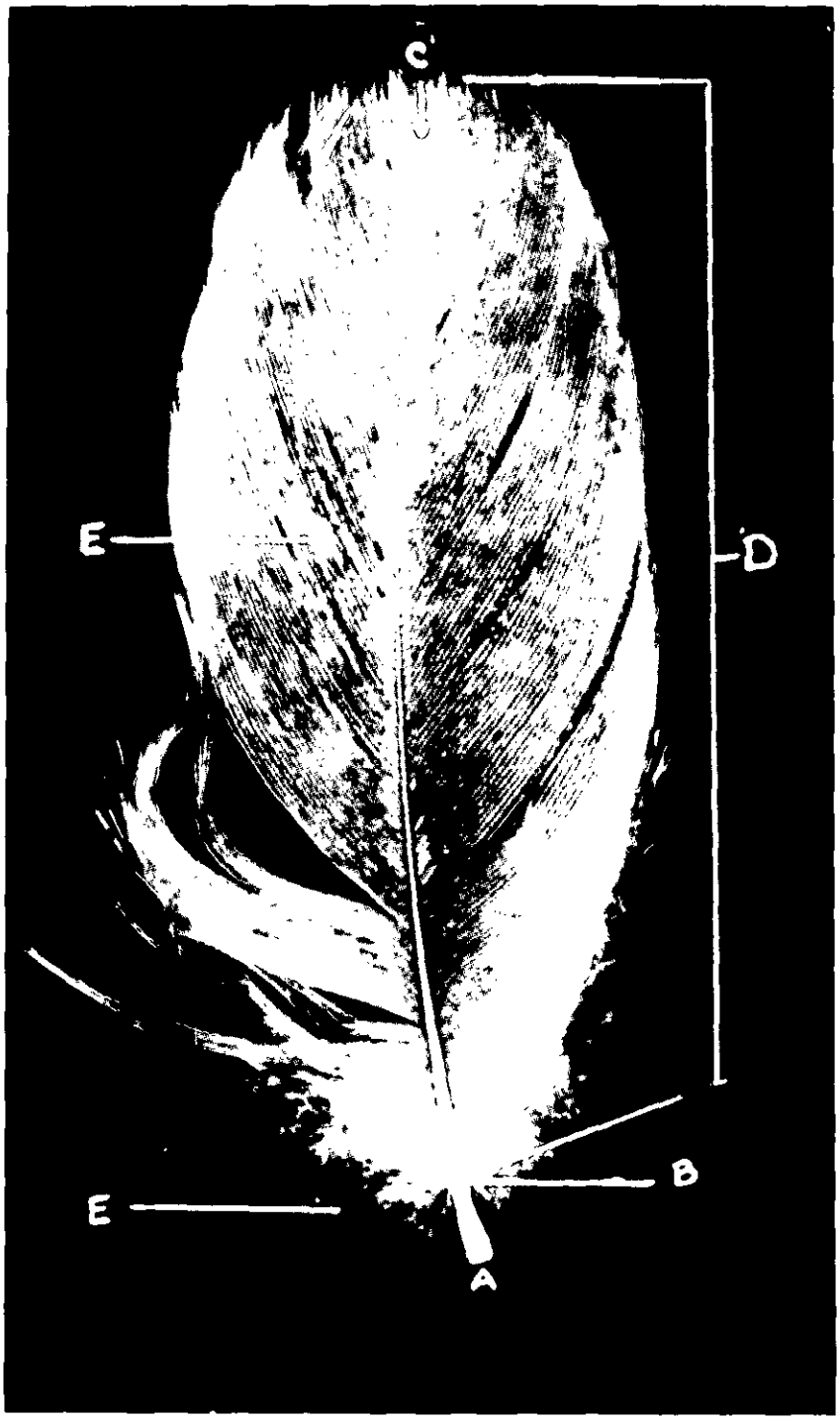

FIGURE 1.—Waterfowl Feather.

A to C—Quill
A to B—Quill Point
B to C—Quill Shaft
E—Barbs

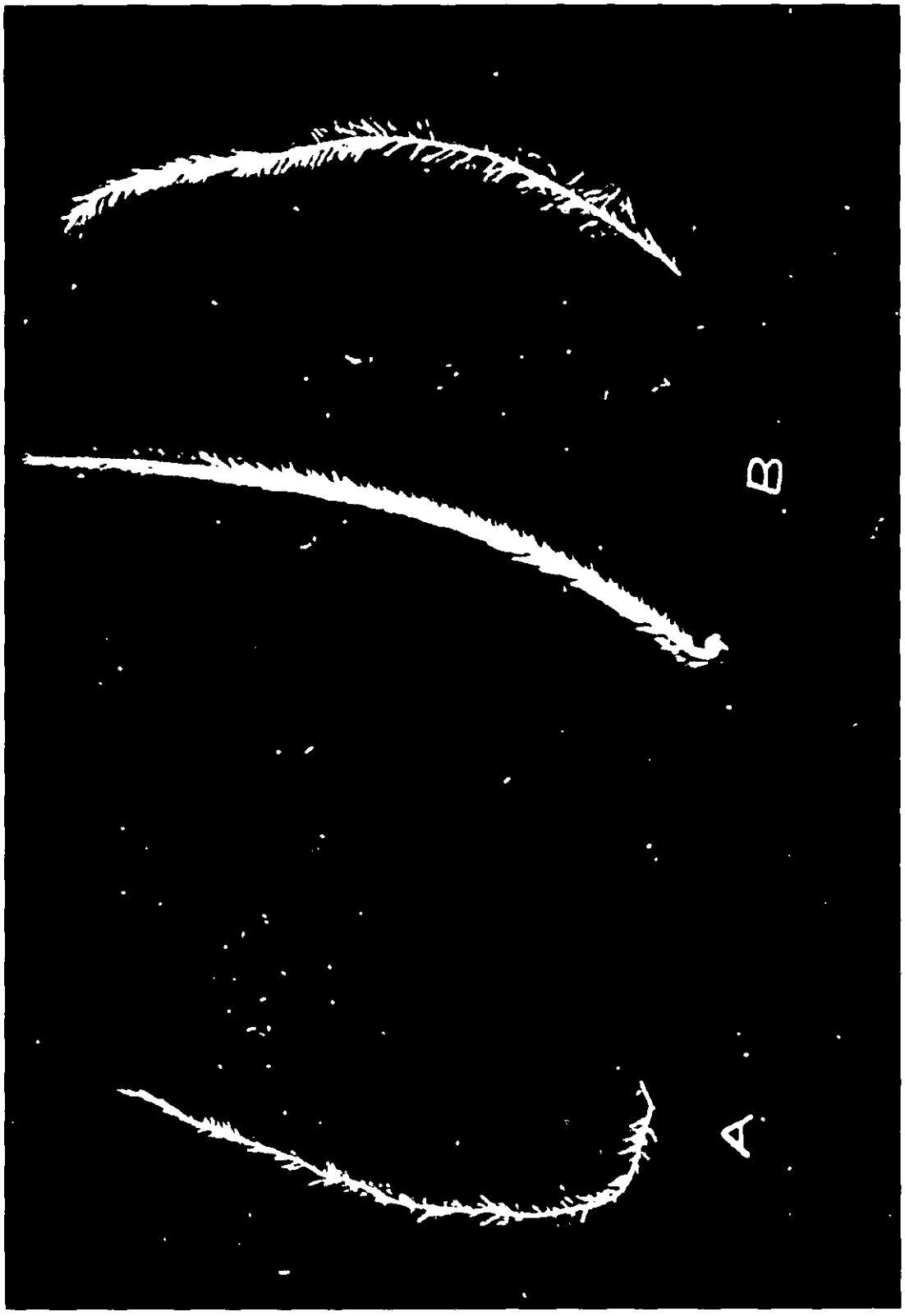

FIGURE 2.—A—Down Barb. B—Feather Barbs.

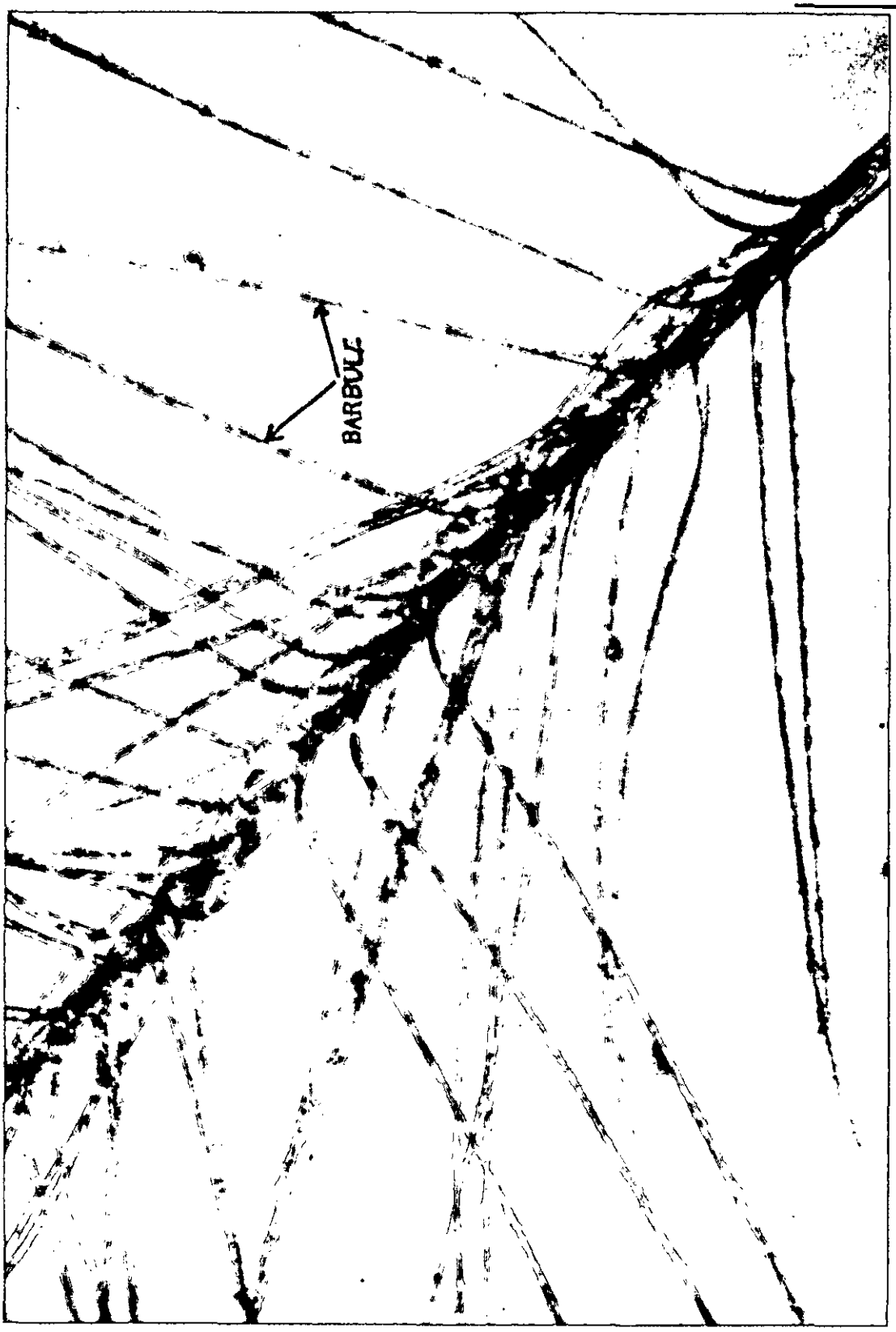

FIGURE 3.—Barb–Microscopic Appearance.

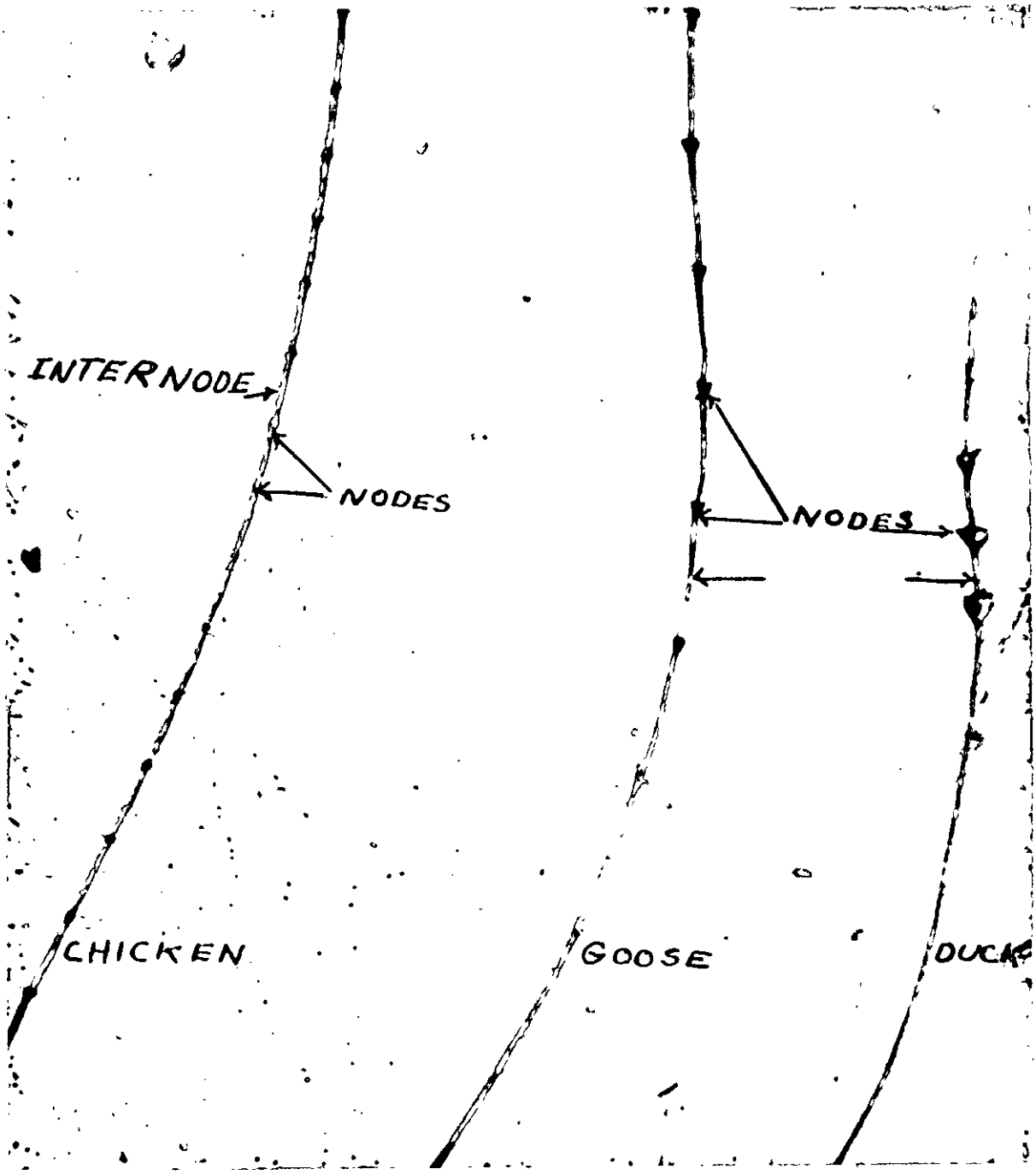

FIGURE 4.—Feather Barbules (Landfowl and Waterfowl).

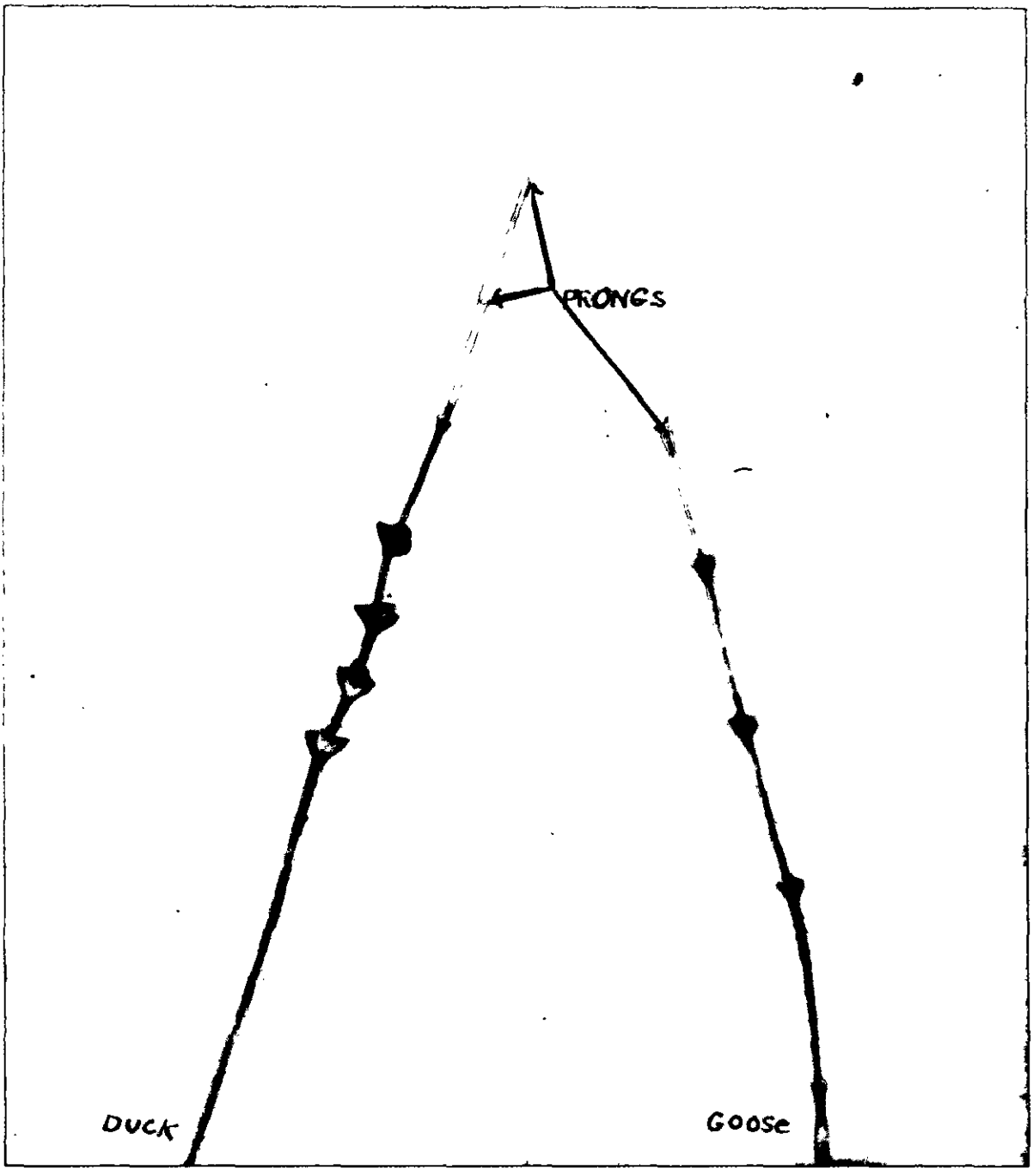

FIGURE 5.—Waterfowl Feather Barbules.

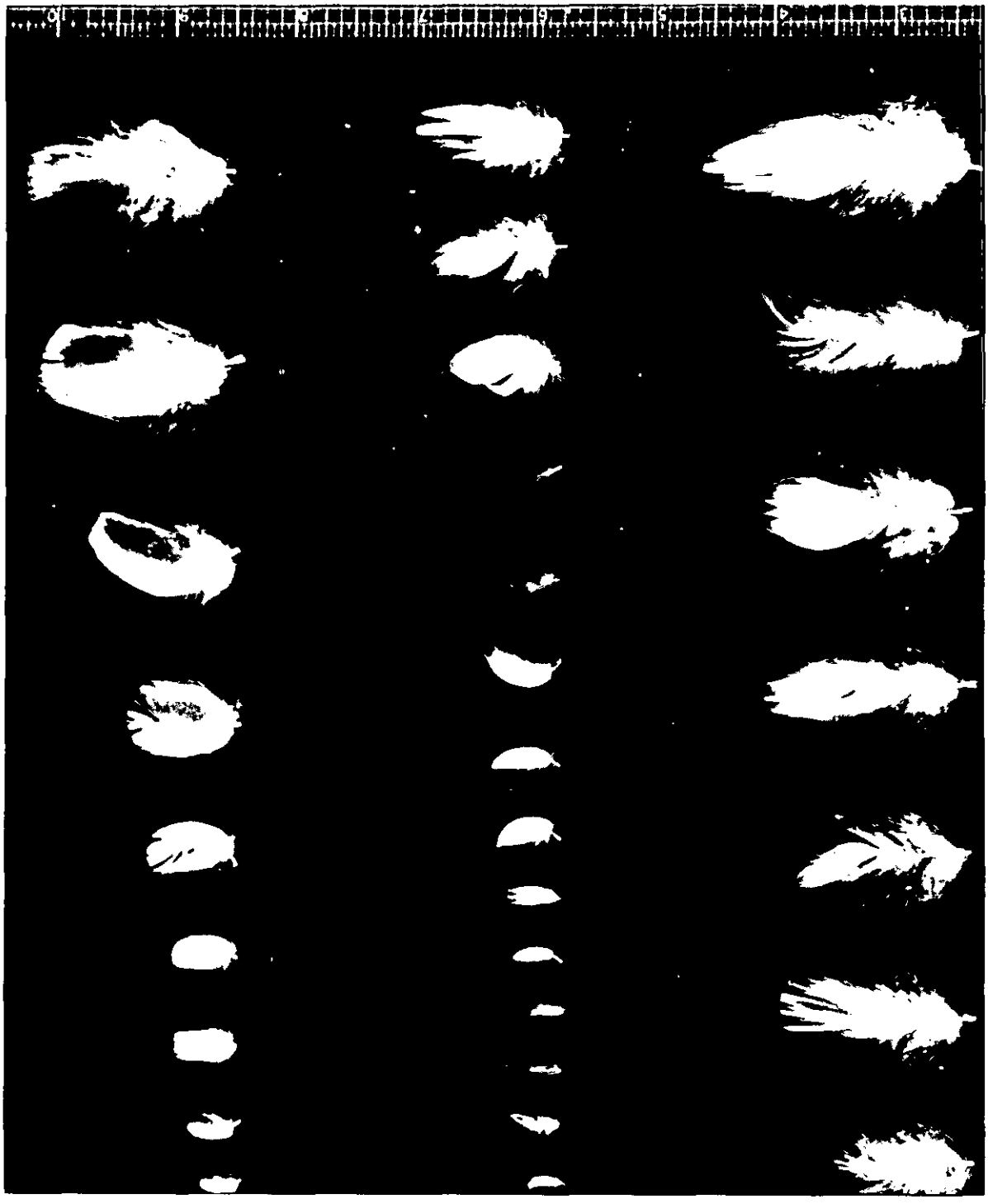

FIGURE 6.—Small Waterfowl Feathers.

FIGURE 7.—Waterfowl Quill Feathers.

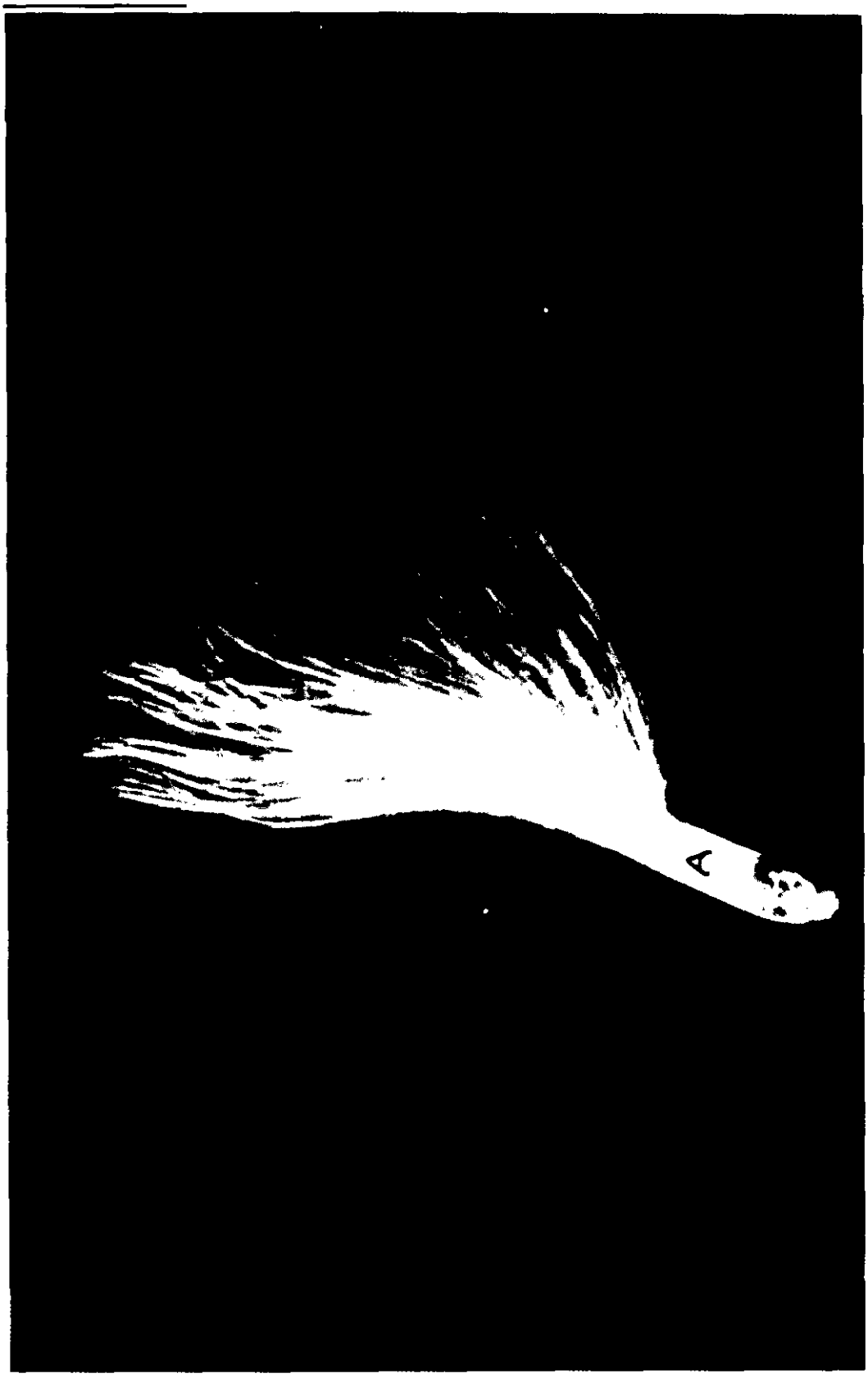

FIGURE 8.—Nestling Feather. A—Sheath.

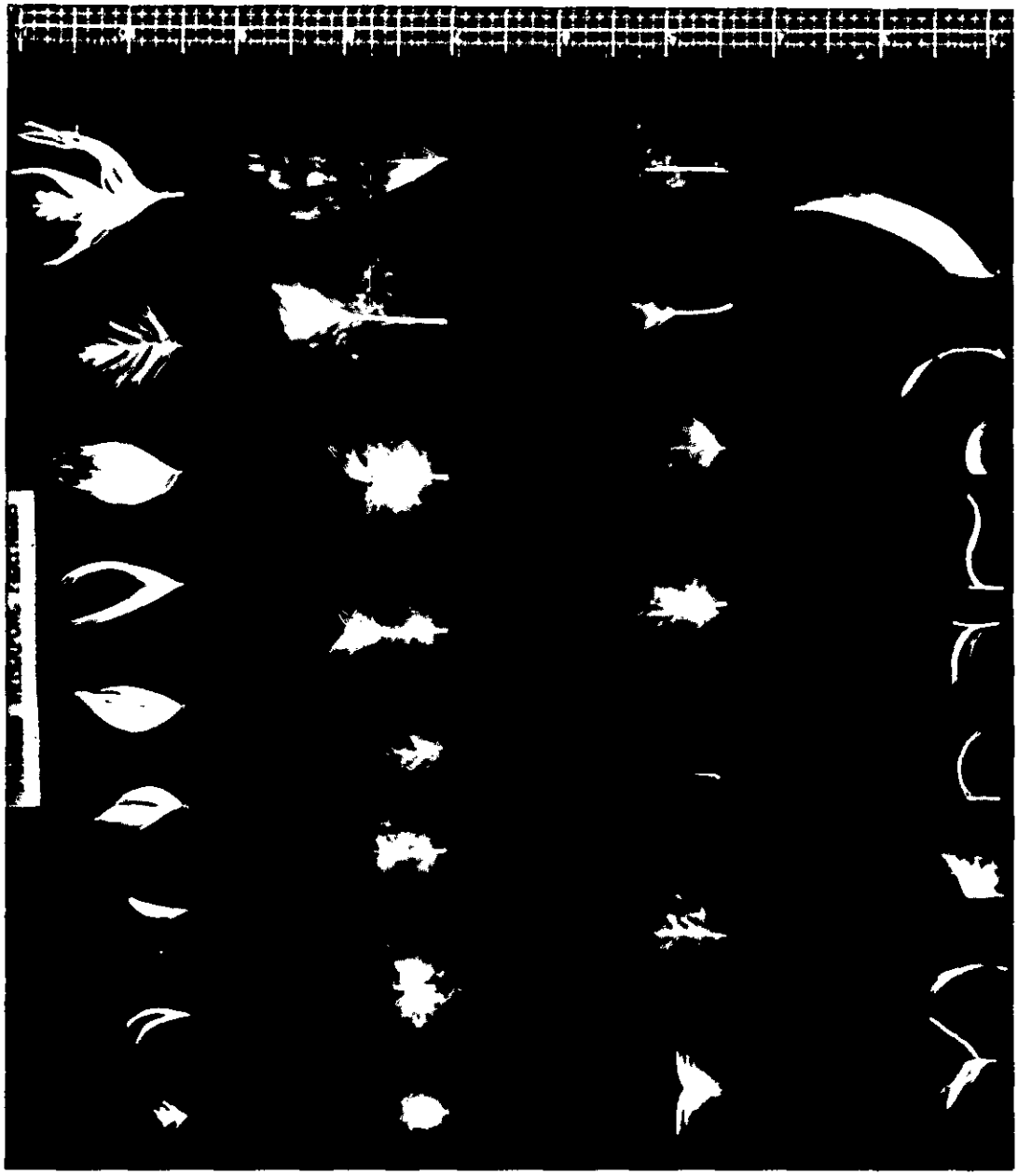

FIGURE 4.—Damaged Waterfowl Feathers.

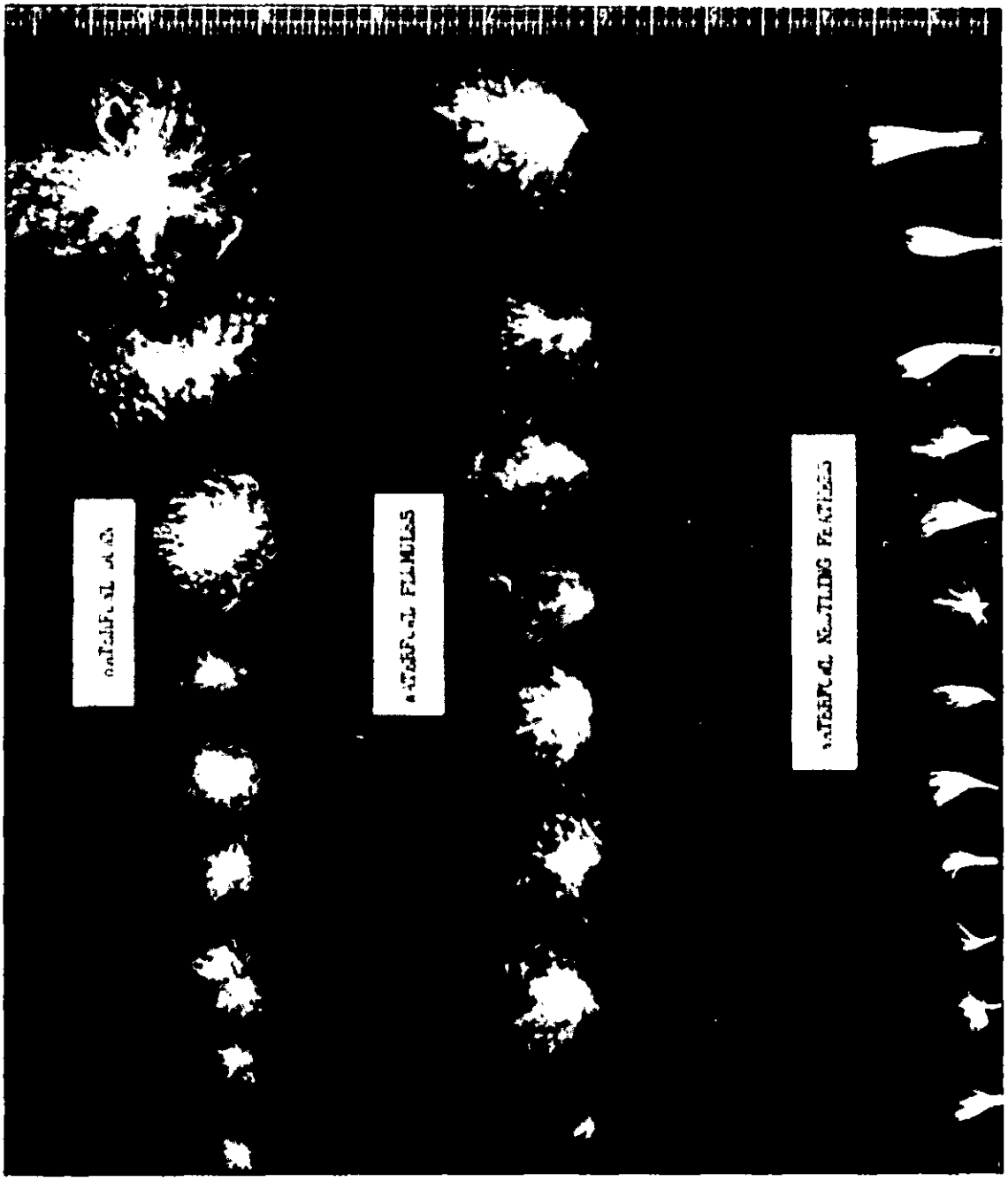

FIGURE 10.—Down, Plumules, Nestling Feathers (Waterfowl).

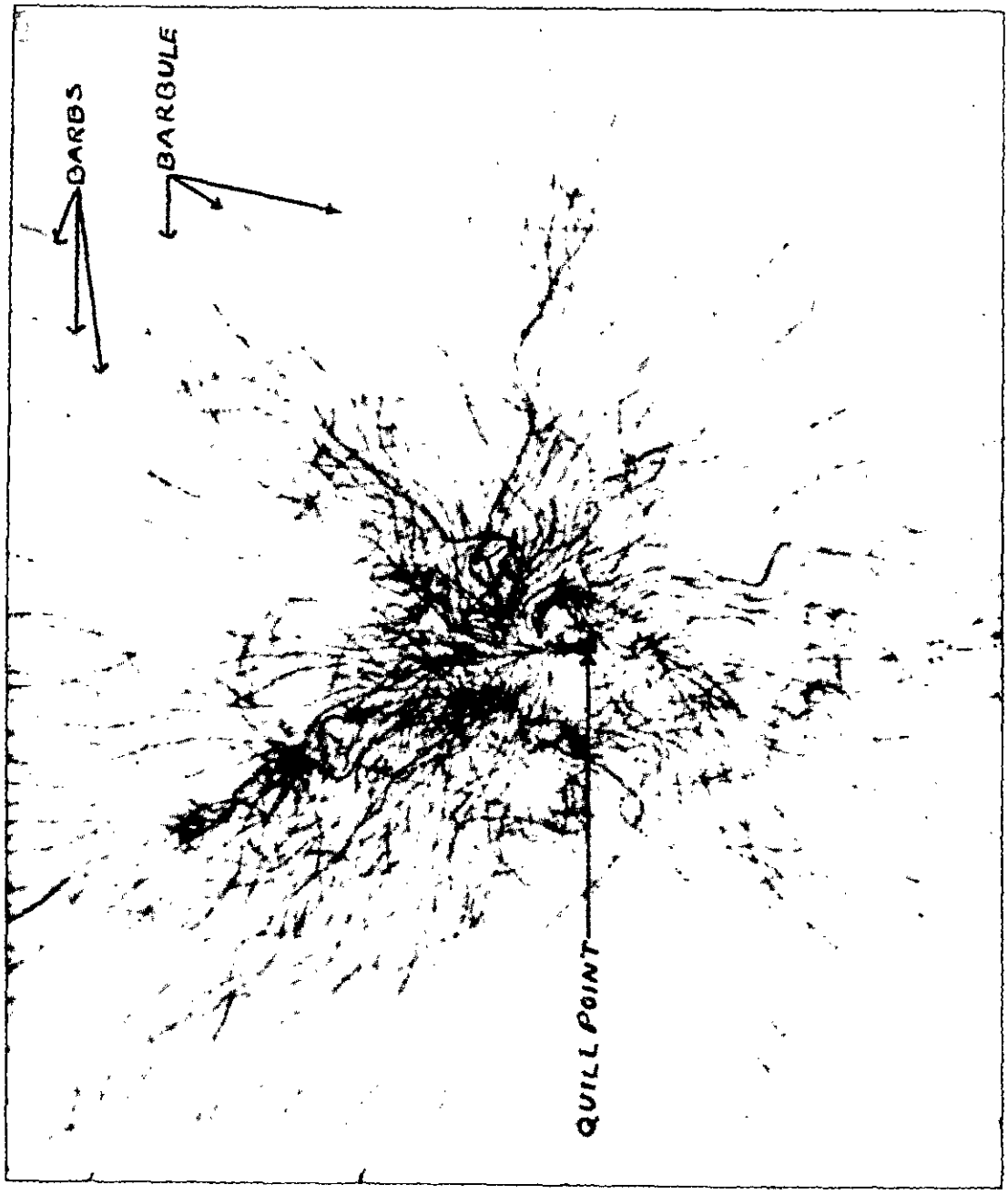

FIGURE 11.—Down Cluster.

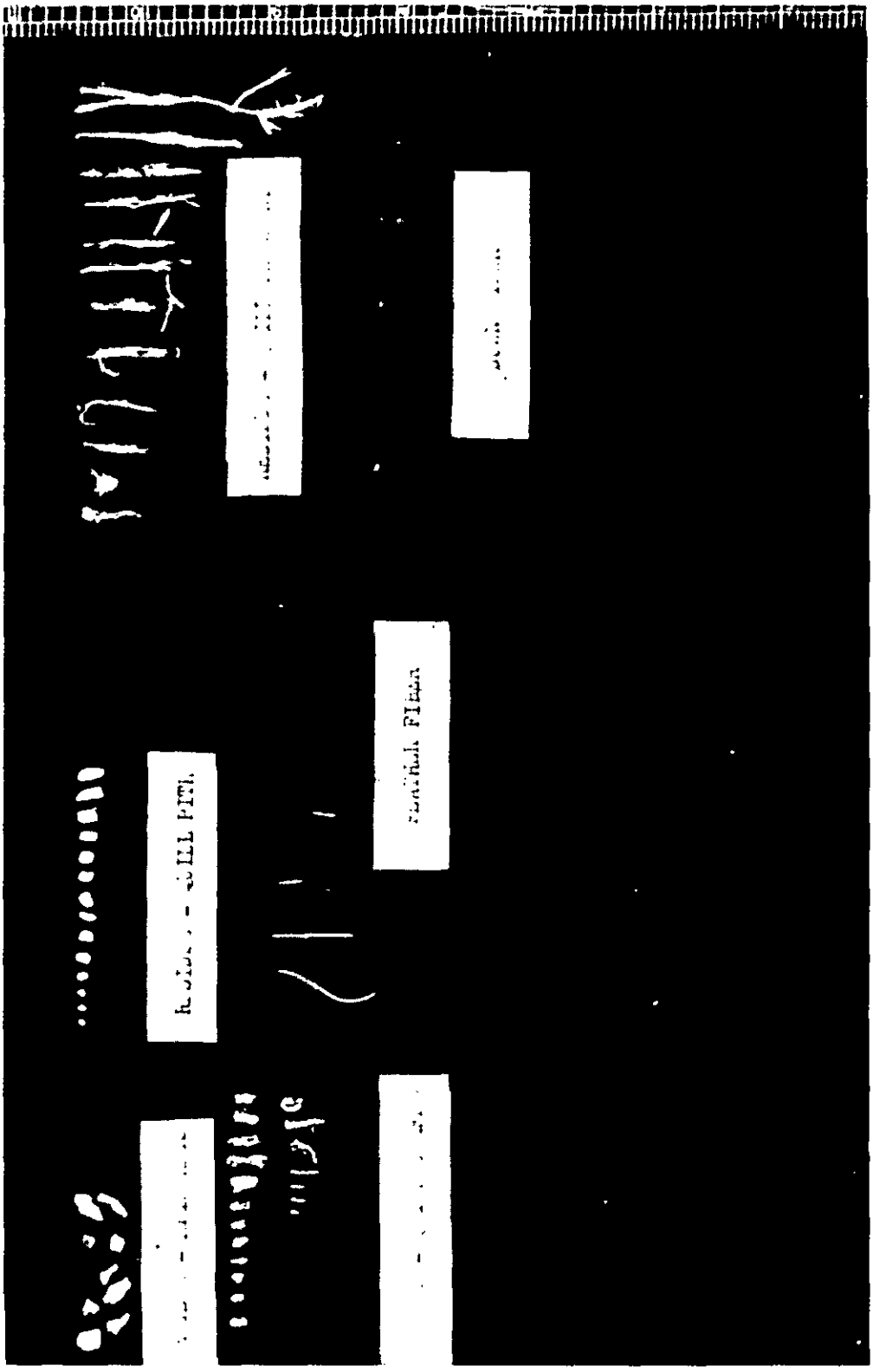

FIGURE 12.—Residual Matter, Feather Fiber and Down Fiber—Waterfowl.

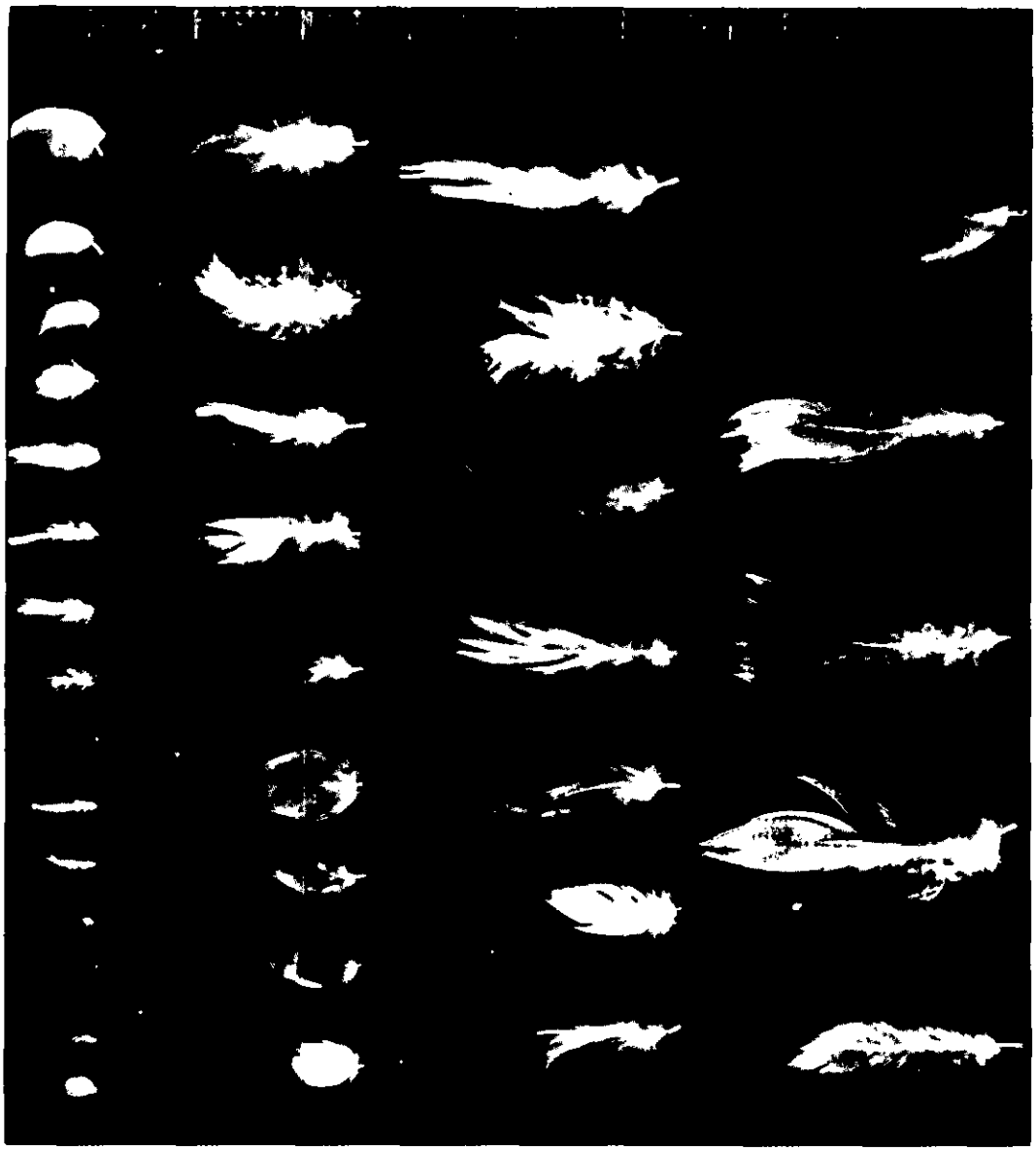

FIGURE 13.—Waterfowl Feathers.

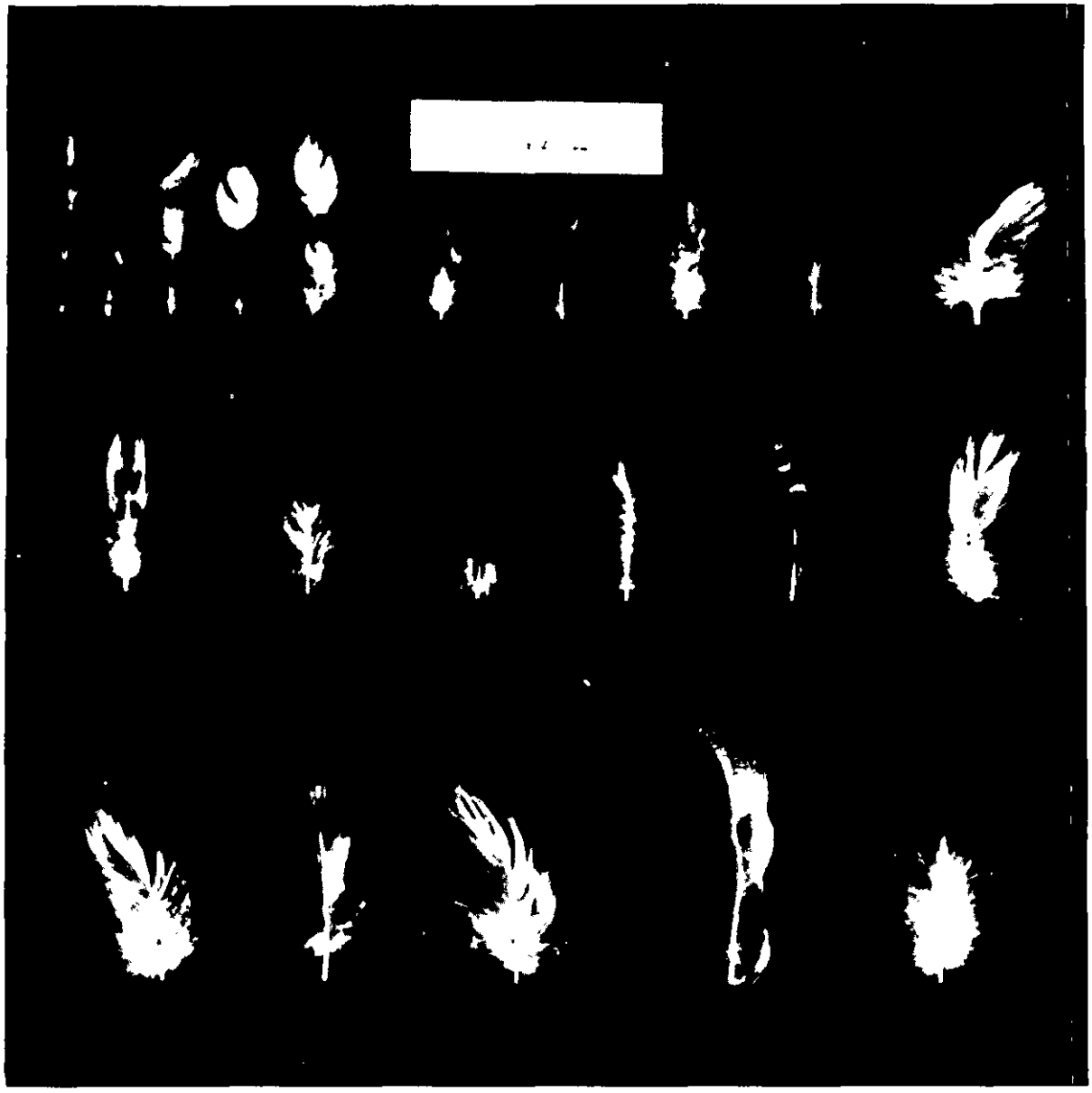

FIGURE 14.—Waterfowl Feathers.

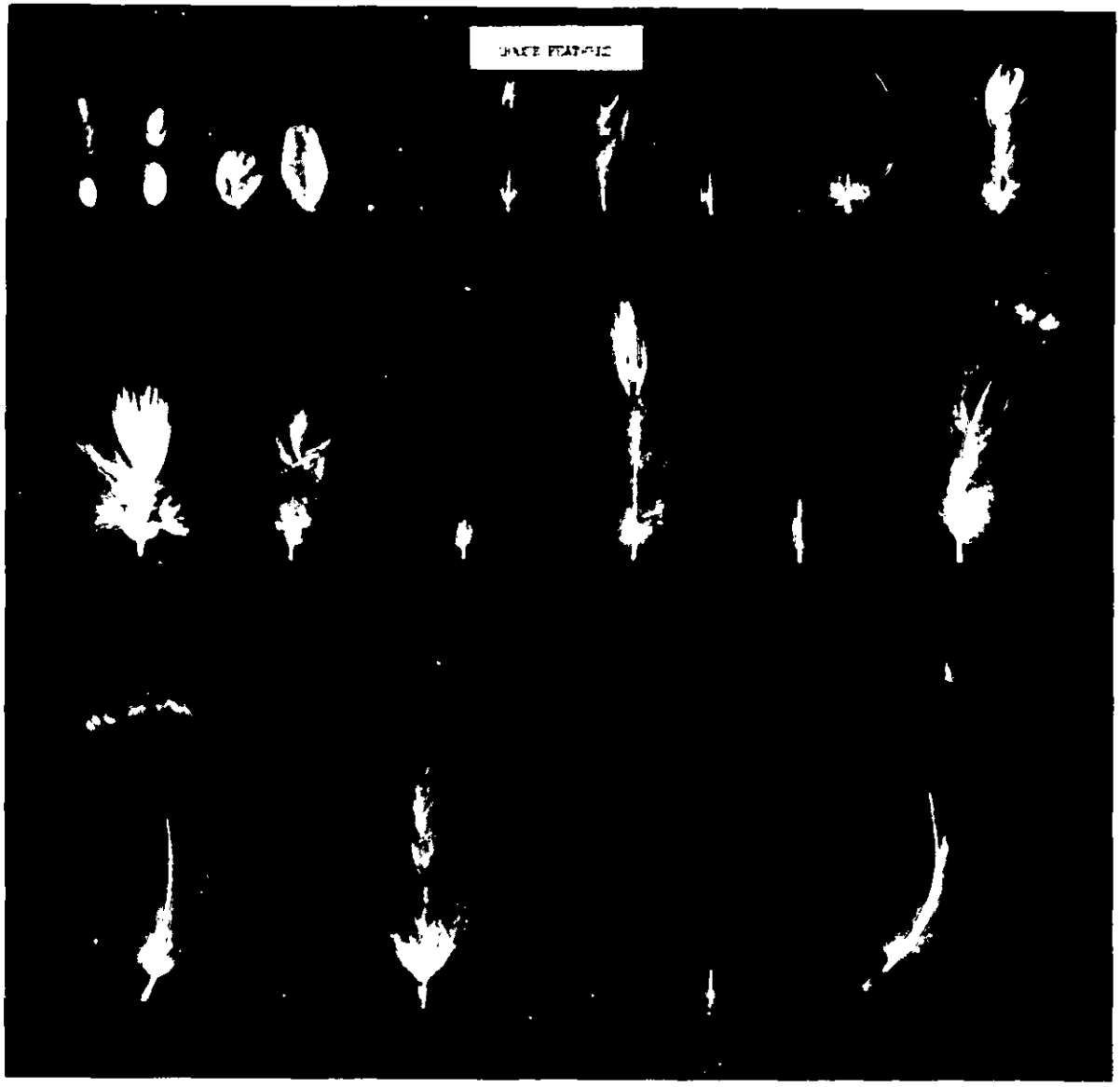

FIGURE 15.—Waterfowl Feathers.

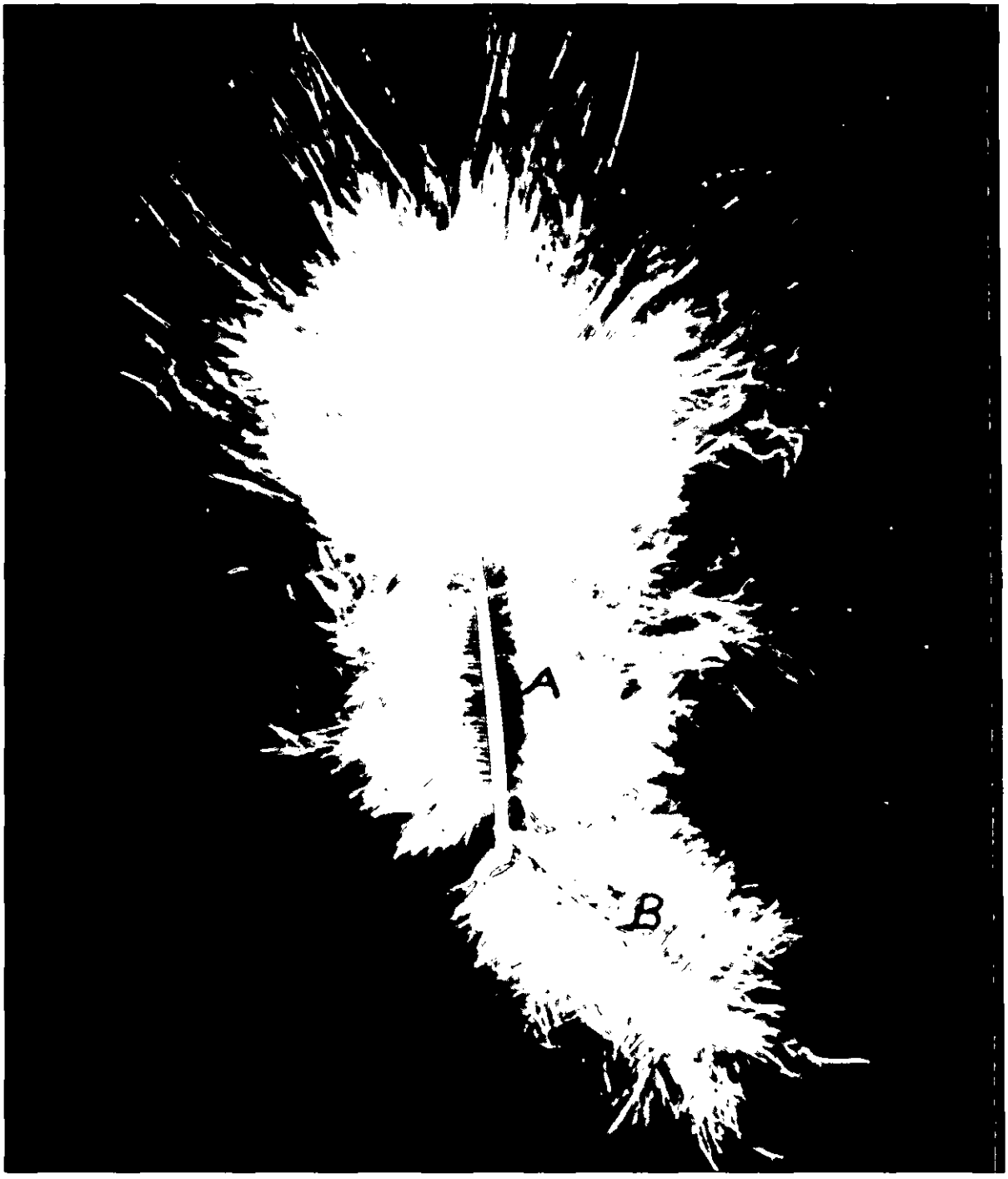

FIGURE 16.—Chicken Feather.
A—Ladder-like Structure
B—Aftershaft

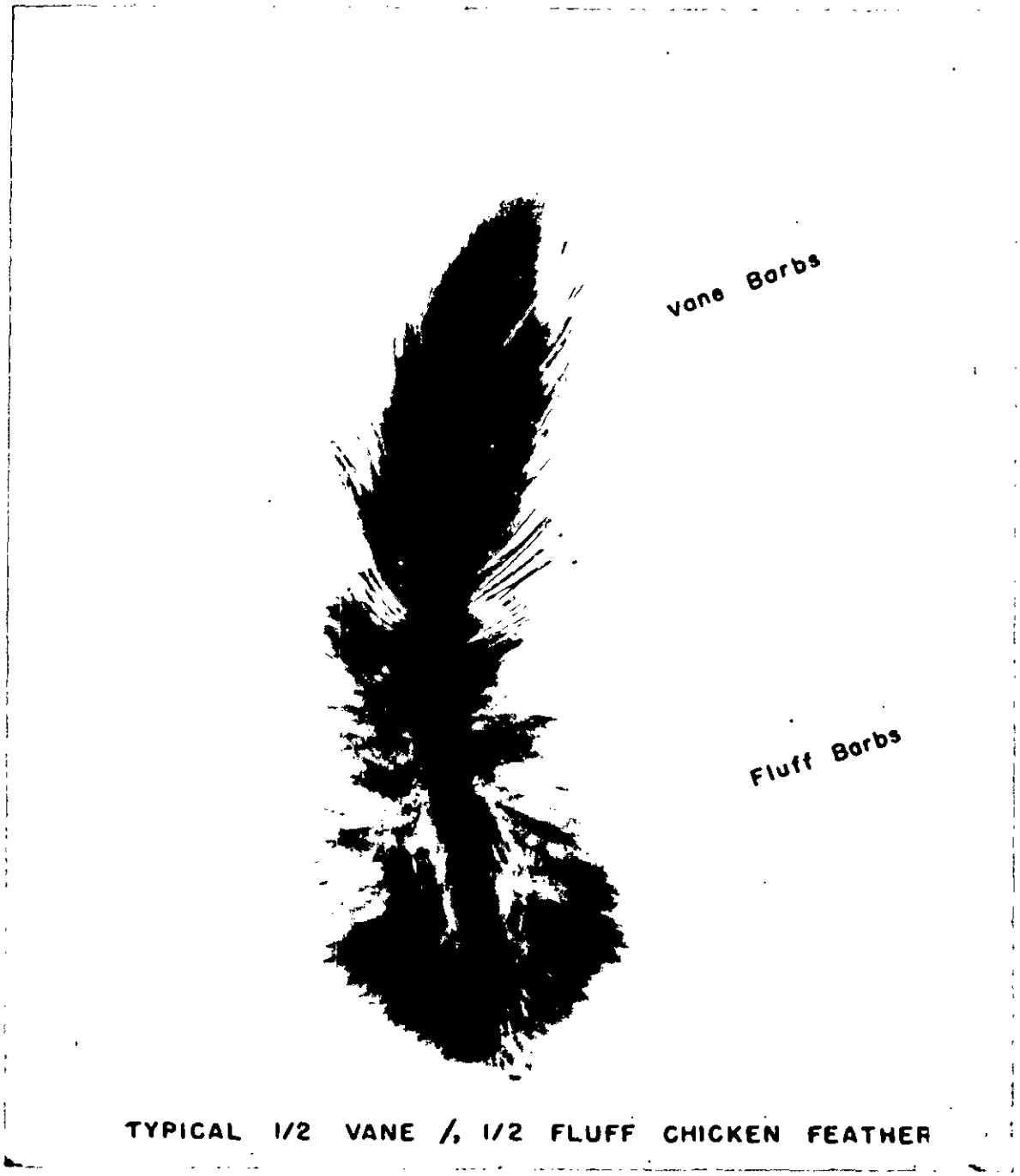

FIGURE 17.—Chicken Feather.

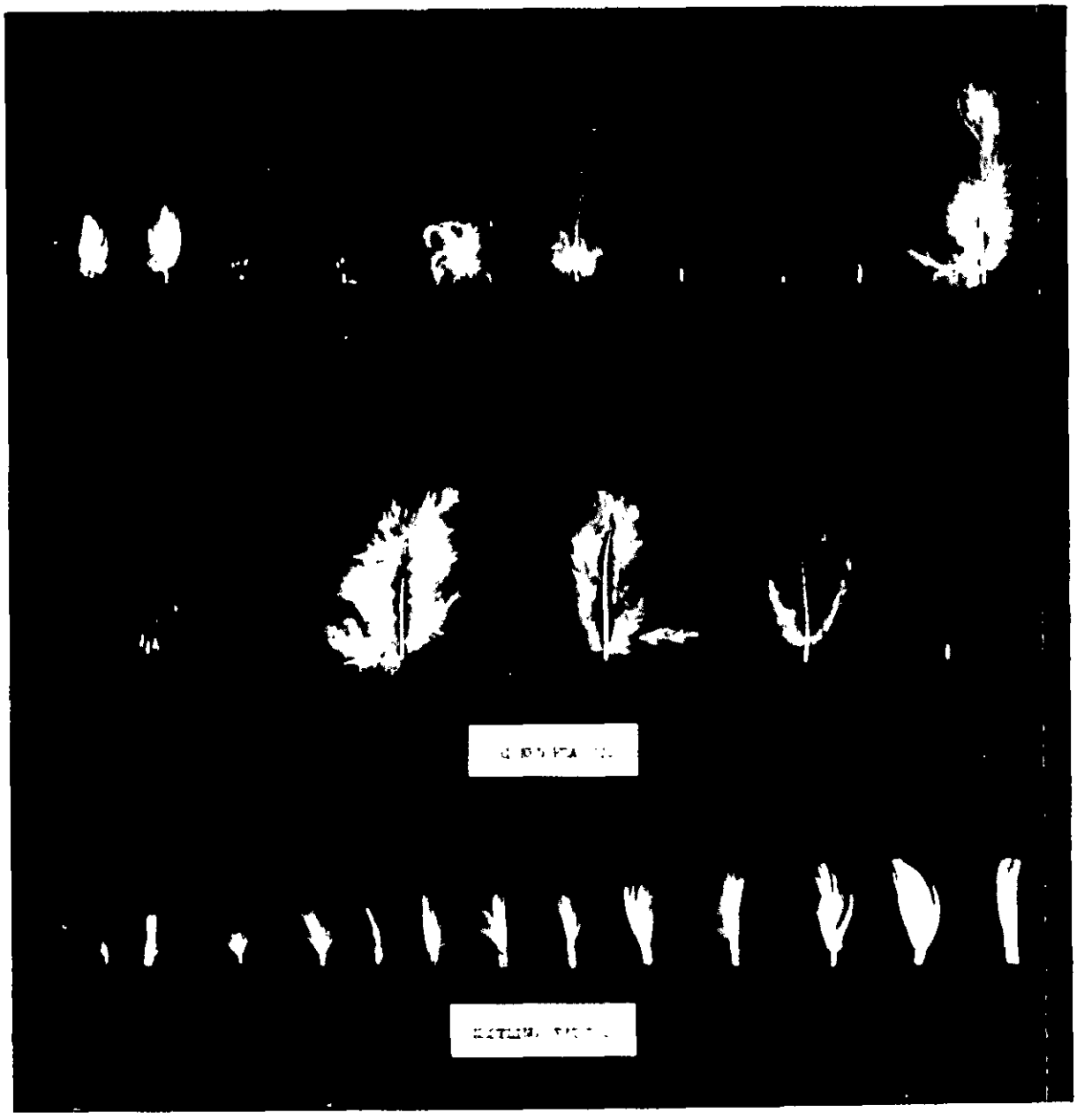

FIGURE 18.—Landfowl Feathers.

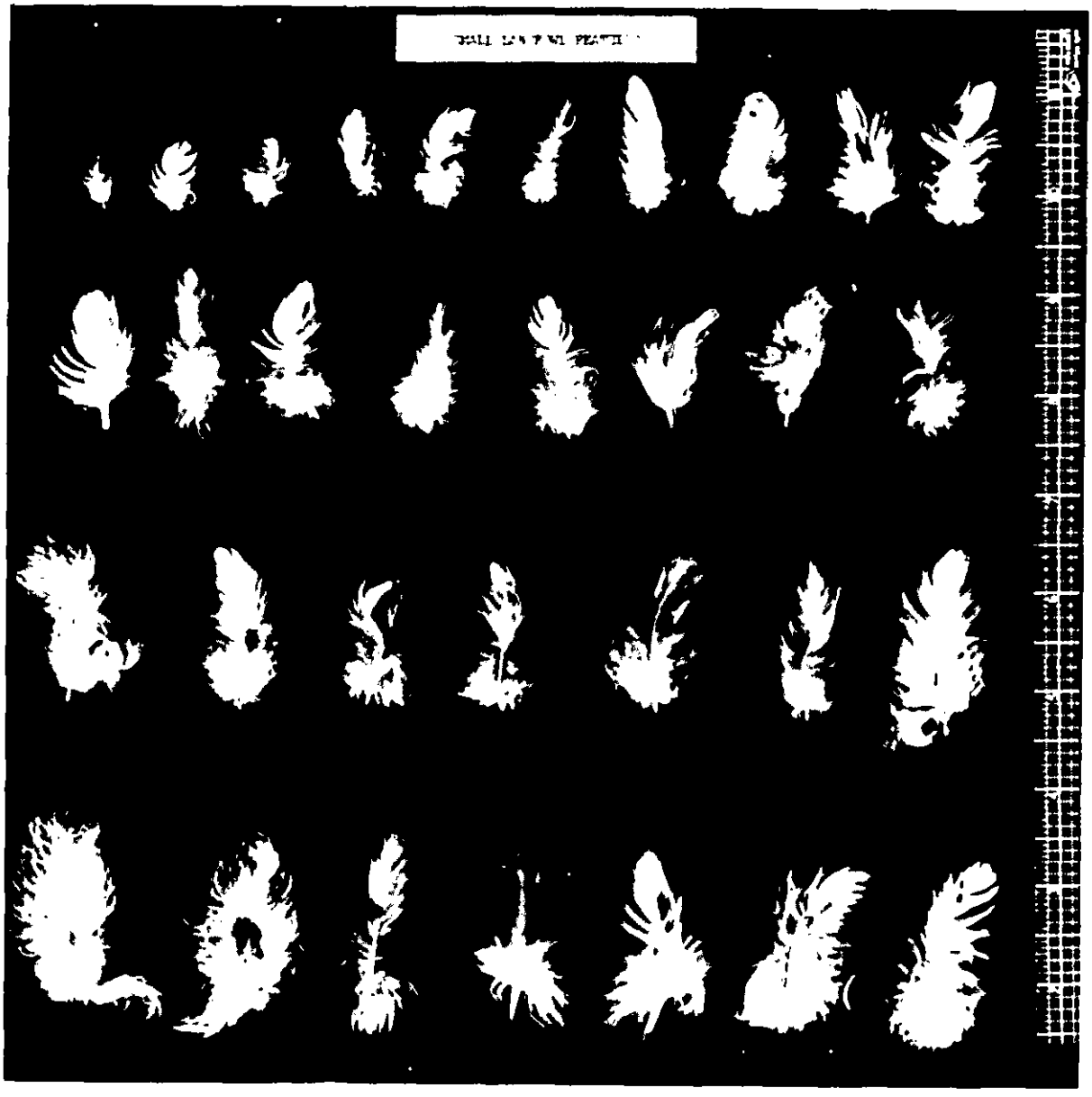

FIGURE 19.—Small Landfowl Feathers.

FIGURE 20.—Landfowl Quill Feathers.

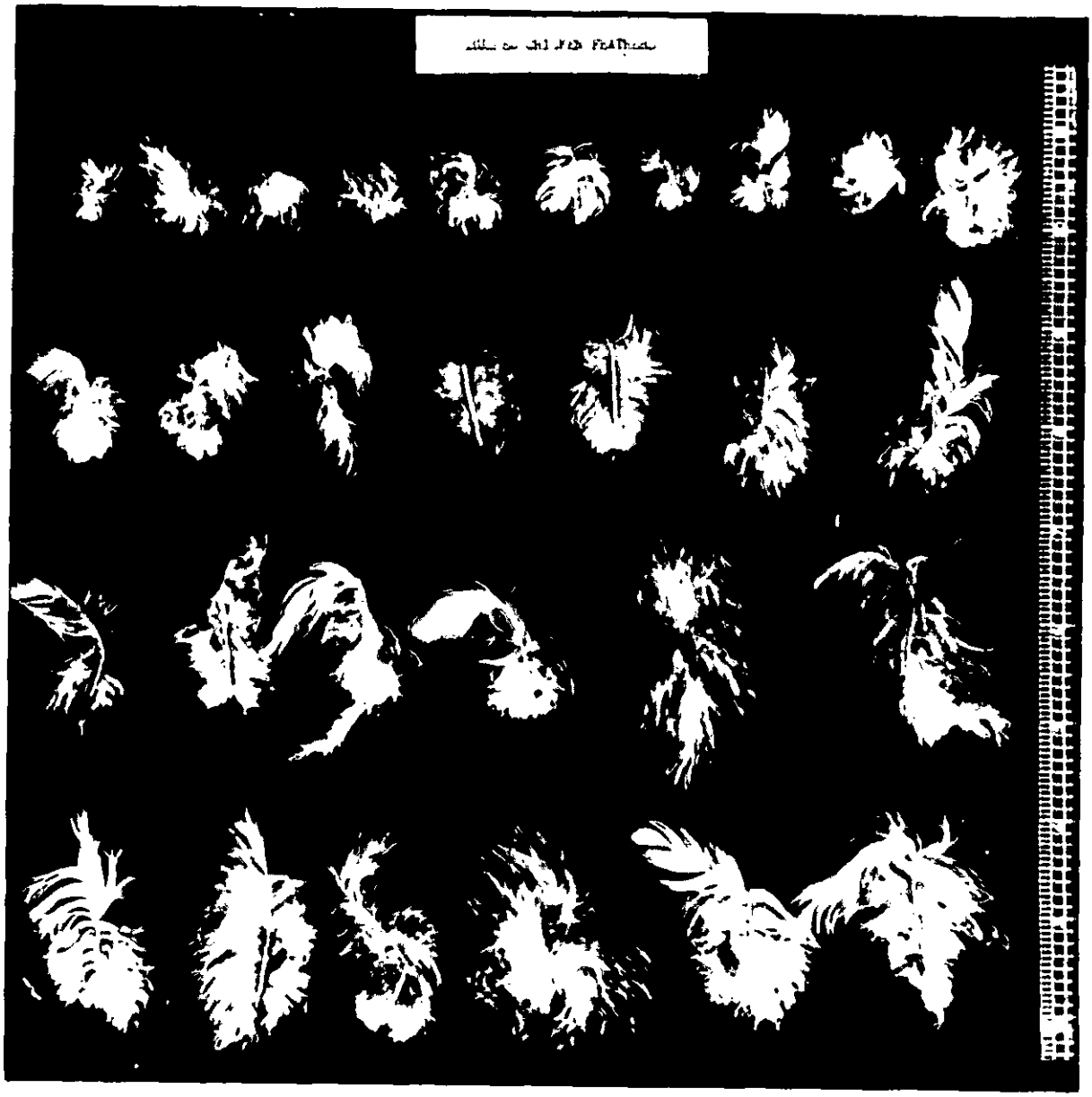

FIGURE 21.—Crushed Landfowl Feathers.

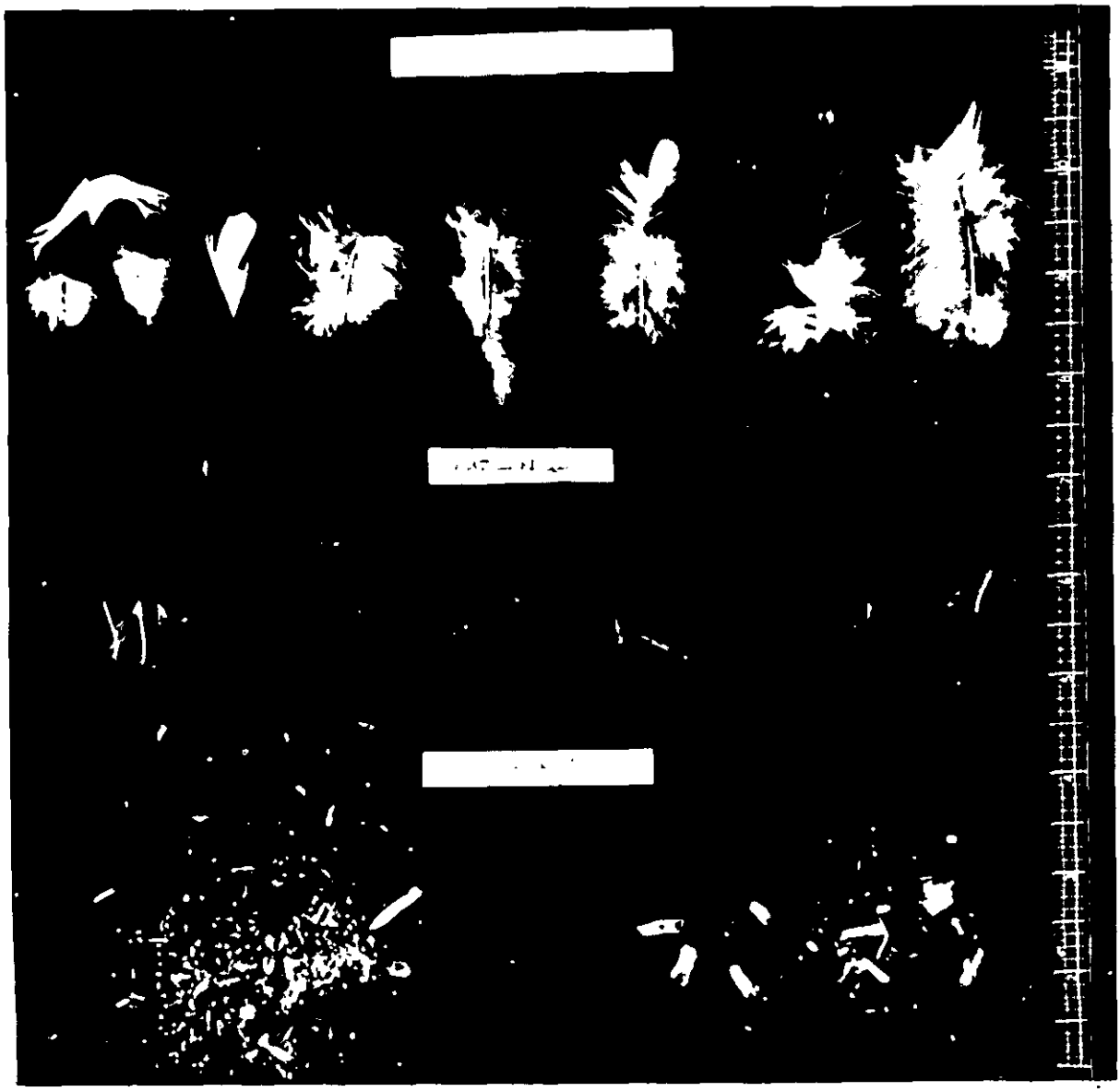

FIGURE 22.—Residual Matter, Damaged Feathers, Feather Fiber (Landfowl).

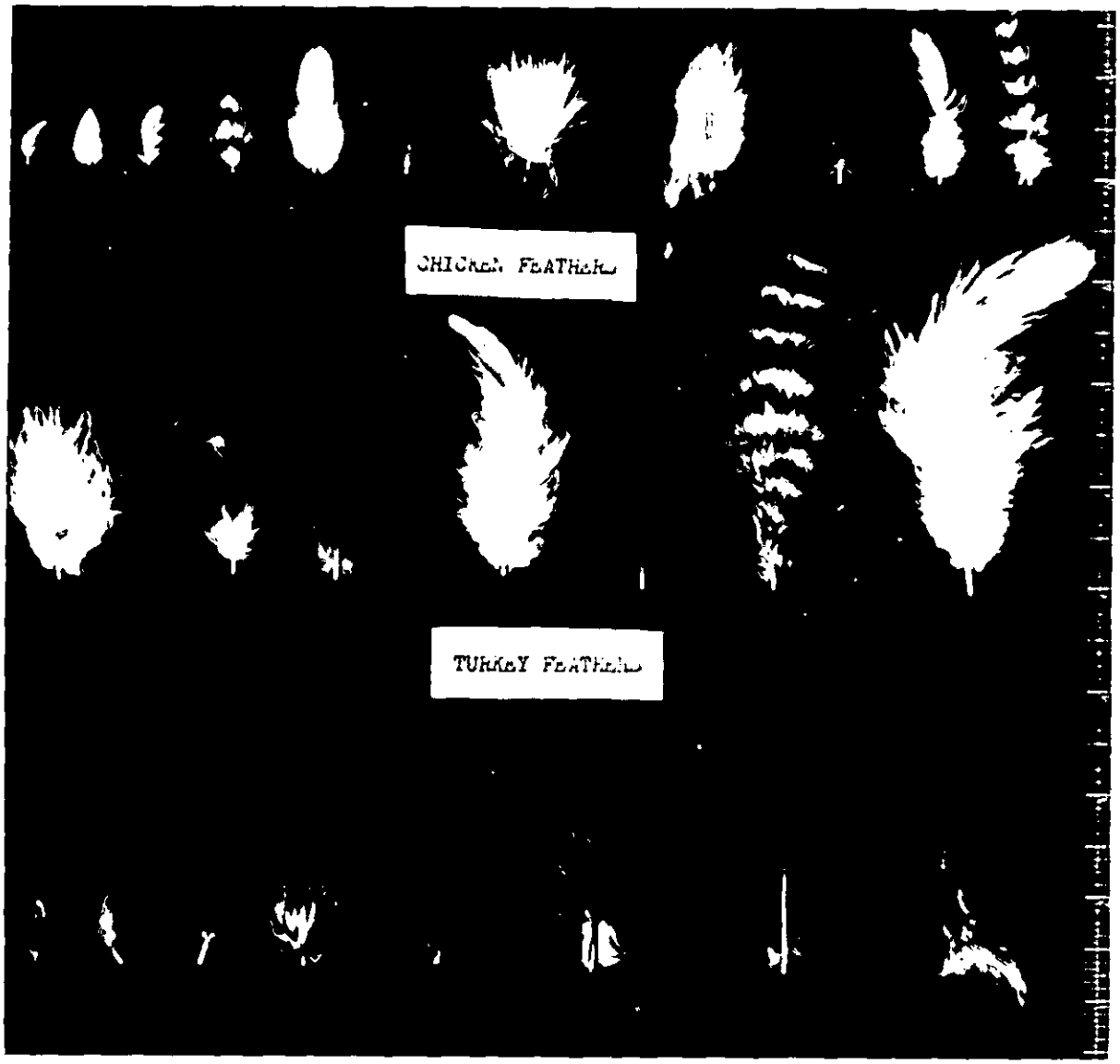

FIGURE 23.—Landfowl Feathers.

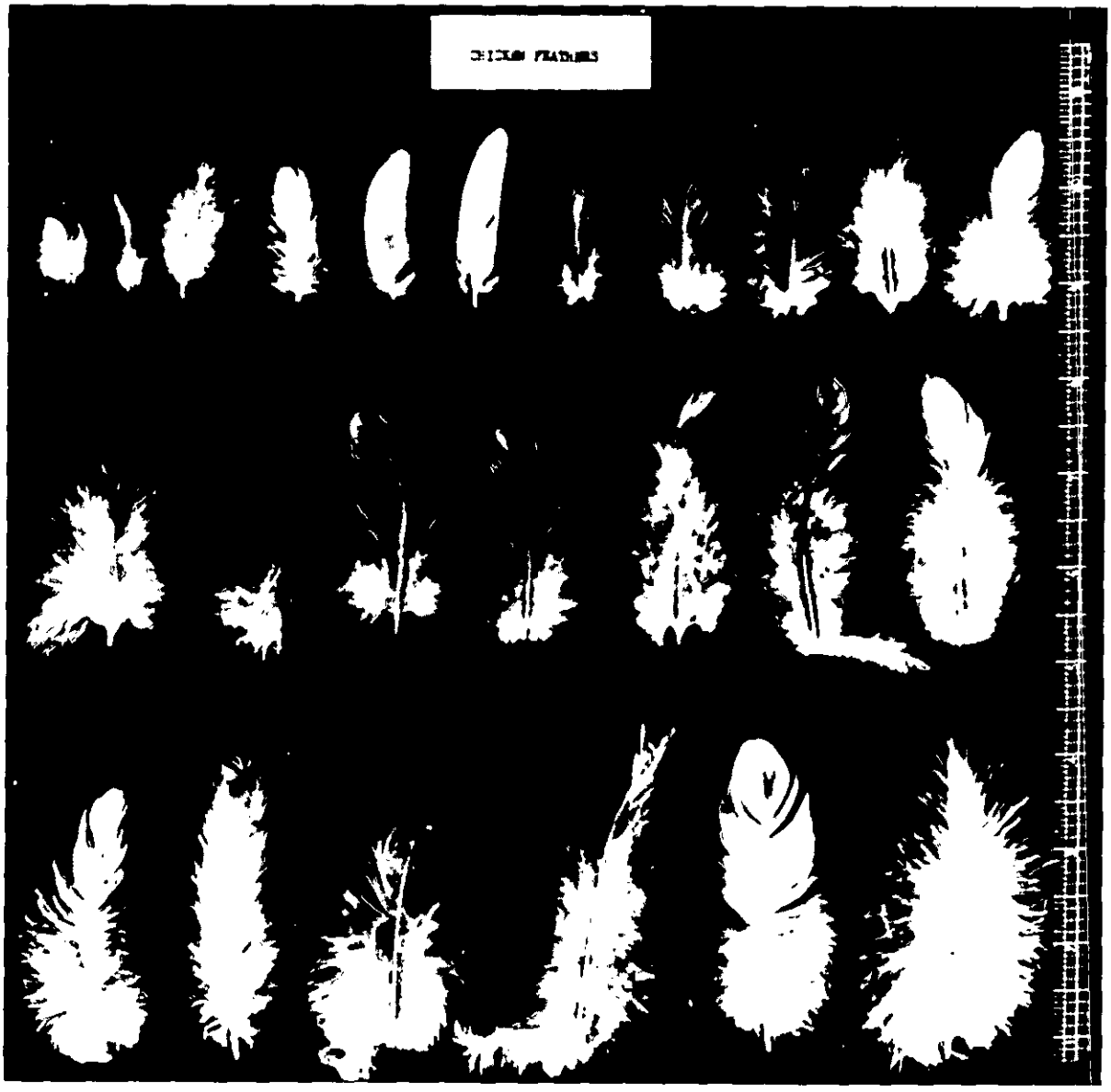

FIGURE 24.—Landfowl Feathers.