The readiest suggestion is that the gas escapes from the water to the surface by its greater penetrating power, but no gas springs have been found, and only a little at higher levels by boring shallow wells. The last problem is the high temperature of the water from some of the wells.

T. C. Chamberlin, in a communication on stoping as a means of forming terraces, said in brief that the Chippewa River, of Wisconsin, showed four systems of terraces separated by rock barriers. Glacial Lake Agassiz, in the Dakotas and Minnesota, showed four systems of beaches, so also does glacial Lake Chicago. Stope-cutting makes the sudden or comparatively sudden transition from one level to another on cutting through resistant material.

E. H. Barbour, of Nebraska State University, contributed a paper on the "Distribution of *Daemoneelix*, or Devil's Corkscrew," in which he said that these strange-looking fossils had been first found in 1891, and were then supposed to be confined to Sioux County in northwestern Nebraska. Now, however, masses of small rootlets are known to occur all over an area of about 500 square miles, with a few widely separated localities, notably Lusk, Wyo., and the Sioux Reservation in South Dakota, where typical individuals have been found.

Local geology naturally received considerable attention at the meeting. S. T. Lee, of Trinidad, Colo., described the areal geology of the Castle Rock region, which lies just to the south of the Denver basin. The ages represented run from the pre-cambrian to the tertiary, with remarkable apparent thickness of the cretaceous beds. The author thinks that a large portion of this apparent thickness is due to mechanical deformation of the beds. Prof. H. B. Patton, of the Colorado School of Mines, read a paper summarizing the work which has been done on the region in the vicinity of Golden, twelve miles west of Denver. Mr. G. L. Cannon, of Denver, presented the "Problems of the Quaternary Deposits of South Platte Valley." These two papers had special bearing upon the geological excursions in and near the city which were taken on three afternoons of the week under the leadership of these two gentlemen.

"The Geological Occurrence of Oil in Colorado" was the title of a paper by A. Lakes, of Denver, in which was brought together the information obtained by recent boring within the borders of the state. Until within a year the small field at Florence, near Cañon City, has been the only productive one and its horizon has been supposed to be the only oil-bearing bed in Colorado. Now, however, it is known that petroleum is widely distributed over the state, and that its signs are to be found in at least six geological horizons. Beginning with the lowest these are, the upper carboniferous strata, in the Rio Blanco basin of Archuleta County; the upper jurassic on Oil Creek, near Cañon City; the Dakota cretaceous sandstones on Turkey Creek, near Golden, in the Denver basin; the Niobrara cretaceous limestone at Pagosa Springs in Archuleta County; the Montana cretaceous shales at Florence, in the Denver basin, and in Archuleta, Routt and Boulder counties; the Wahsatch tertiary series of the book cliffs in the northwestern part of the state. To these may be added the basaltic dikes in Archuleta County and the Huerfano district, which are charged with liquid bitumen derived from undetermined horizons. These facts justify Coloradoans in hoping for a successful oil-field within their state—a hope which was strengthened during the week of the association meeting by the striking of a highly promising well at Boulder.

In the discussion following the reading of Mr. Lakes' paper Prof. Patton spoke of a small flowing oil spring which issues from Archæan rocks in a gulch above Golden, Colo., three-quarters of a mile from the contact with the sedimentary beds and one and a quarter mile distant from the nearest known oil in those beds. This is the only instance known of such a spring in the Archæan, and the oil may come up through a fissure cutting the sedimentaries at a great depth.

G. H. Stone, of Colorado Springs, in a note on the minerals associated with copper in southeastern Arizona and southwestern New Mexico stated that, while the copper-bearing veins of the region are substantially like those of the states northward in respect to the kinds of copper compounds and the occurrence of quartz and the hydrous gangue minerals, they are remarkable for the anhydrous silicates which they contain. One of the common gangue minerals is pyroxene in slender prismatic crystals, tablets and asbestos. Epidote occurs frequently as incrustations and as the filling of veinlets and small rounded cavities in the limestones and in the porphyries which cut them, but in the California mining district in the Chiricahua Mountains there are several exposures of granular epidote forming the filling of a vein three to five feet wide. By far the most abundant of these anhydrous gangue minerals is garnet. The copper ores are usually found beside granular masses of garnet but sometimes are distributed through the garnet mass also. Sometimes the garnets occur isolated in the limestone, but more often they are massed together in bodies which are surrounded by limestone, proving that the latter was replaced by the garnet. In the Chiricahua Mountains the limestones along the copper veins have been largely replaced by garnet to a breadth of 10 to 50 feet or more, while in the Dragoon Mountains the author saw belts of limestone which for a breadth of at least 600 feet showed a fourth as much garnet as limestone. The southern portion of Santa Fe County, New Mexico, seems to be the northern limit of these large bodies of garnet. Mr. Stone also read a paper dealing with the extinct glaciers of New Mexico and Arizona, in which he gave his reasons for not believing them to have been as extensive or as numerous as has been thought. Cloudbursts carry boulders up to 10 and even 15 feet in diameter considerable distances and pile them up in such a way as to make a newcomer think at first that he has to deal with glacial moraines. True moraines have not been found below an altitude of 8,000 feet.

A. C. Lawson, of the University of California, read a paper on the "Oscillations of the Coast Ranges of California," in which he described in brief the topographic history of that part of the Pacific Coast and showed that there had been four periods of depression

of the region west of the Great Valley of California, followed by as many periods of emergence and erosion. The Great Valley has always been a valley since it was first formed, and has been the "hinge" on which the oscillations of the coast ranges have taken place.

C. R. Eastman, of Harvard University, gave a comparative review of certain palæozoic sharks for the purpose of showing that the coiled, serrate fossil which was recently described by A. Karpinsky from the carboniferous beds of Russia and called an exterior organ of defense like the sword of a swordfish, was really a modification of the teeth and had its place within the mouth.

T. A. Rickard, of Denver, made an earnest "Plea for Greater Simplicity in the Language of Science" which struck a very responsive chord in the minds of all his hearers. The scope of his paper is well indicated in its title, and the author illustrated his theme by well-chosen examples of the use of language "which obscures truth and falseness alike to the degradation of science and the total confusion of those of the unlearned who are searching after information." The author strongly urged, in conclusion, that such technical terms as are considered essential should not be used carelessly, and that in the publications intended for an untechnical public, such as most government reports, an effort be made to avoid them and that, where they are unavoidable, those least likely to be understood be translated in foot notes.

In a "Note on Certain Copper Minerals" A. N. Winchell, of Butte, Montana, described the formation of chalcocopyrite and bormite in the iron rails of a smelter in that city. The former mineral had been reported before under these circumstances, but not the latter. These minerals replace the iron of the rails so rapidly, every part being affected except that embedded in the wood of the ties, that new ones have to be put in every eight or ten months.

W. G. Tight, of Albuquerque, New Mexico, read a paper entitled "Interpretation of Some Drainage Changes in Southwestern Ohio," which embodied some of the results of more than ten years' study of that region. The author contends that the present river valleys there date from interglacial time, and that ice-damming had very little to do with the present courses of the streams, while gradual silting up has had much to do with them.

A. H. Purdue, of the University of Arkansas, described the physiography of the Boston Mountains, which lie in the northwestern part of Arkansas and constitute the highest portion of the Ozark Mountains. The rocks of the region are mainly sandstones and shales, those at the base being of lower carboniferous age, while those at the top belong to the coal measure series. The alternating hard and soft beds have produced the terraces of the hill slopes which are so characteristic of elevated regions of horizontal strata. The stage of the drainage is that intermediate between youth and maturity. The streams are vigorous and have completely dissected the plateau by the formation of gorges from 500 to 1,000 feet deep, producing a very rugged topography. Between these gorges the slopes often meet, forming more or less rounded hills, but more frequently the intervening area is occupied by flat-topped sandstone-capped hills of limited extent. The elevation of the region must have taken place in late tertiary or in post-tertiary times and was greatest along the present eastward axis of the plateau, gradually diminishing toward the north.

In a paper on the minerals and mineral localities of Texas, F. W. Simonds, of the University of Texas, stated that 150 mineral species are now known to have been found in Texas, of which 25 or 30, mostly those containing the rare earths, have been found at the Barringer Mound. Only ten minerals of economic importance have been reported, viz., petroleum from 21 counties, limonite from 23 counties, coal, hematite, magnetite, salt, gypsum, asphalt, gold, and silver.

Certain sandstone intrusions associated with the asphalt-bearing deposits near Santa Cruz, Cal., were described by J. F. Newsome and J. C. Brauner, of Stanford University, with the aid of numerous stereopticon illustrations.

One geological paper was read before the section of Social and Economic Science by C. W. Comstock, of the Colorado School of Mines. It was on the "Development of the Mineral Resources of Colorado," and showed in the first place the state's leading position in the mineral-producing world, especially in regard to gold and silver. A few years ago 49 per cent of the state's production was silver and 35 per cent gold; last year the ratio was 25 per cent silver and 57 per cent gold. The all-important point in the production of the precious metals is the increased economy in the mining and treatment of ores. This is indicated by the lower grade of ore mined now as compared with earlier years. The causes leading to these reductions are cheaper labor, cheaper fuel, lower freight rates, cleaner work and closer attention to details. One of the potent factors in developing low-grade ores has been the improvement in ore-dressing machinery and methods, together with a wider dissemination of information in regard to them. The figures from one instance of actual practice show that proper mechanical preparation has made a change from a loss of \$5 per ton to a profit of \$2 per ton.

The officers of the section were: C. R. Van Hise, vice-president, and H. B. Patton, secretary; for the ensuing year they are O. A. Derby, of Sao Paulo, Brazil, and F. P. Gulliver, of Southboro, Mass., respectively.

AUSTRALIAN GEM STONES.

CONSIDERABLE quantities of sapphires, rubies, emeralds, and other gem stones have been found in Australia during the last few years, and although there have been comparatively few of commercial value, their abundance naturally leads to the assumption that in the near future discoveries of a superior class of stones will be made. In New South Wales sapphires are found in many places, mostly in alluvial deposits containing gold and tin; but it is only in a few instances that the stones possess sufficiently good color to render them valuable as gems; the majority of the sapphires having a greenish-blue or bottle-green tint, while most of those which are pure blue by transmitted light are of such a deep shade that they appear almost black when seen by reflected light. Sapphires

of indifferent quality are especially numerous a few miles to the east of Inverell, in the northern part of the state, so much so that the name Sapphire has been given to the locality. Rubies are frequently met with but specimens of the oriental, or true ruby, are somewhat rare. It is possible, however, that crystals of sufficient size and purity to be commercially valuable may yet be discovered. The topaz is found in many places in New South Wales, especially in the northern elevated regions. Here, near Emmaville, fine colorless transparent crystals were found associated with emerald, beryl, fluorspar, mispickel, kaolin, and tin-stone in a pegmatite dyke traversing indurated claystones. Many of the topazes have a beautiful pale blue color and are of large size. Professor Liversidge states that a portion of a large bluish-green crystal found at Mudgee, in the western district, weighed several pounds; also that one found at Gundagai, in the south, of a pale blue-green tint, measured three by one and a half inches, and weighed 11 ounces 5 pennyweight, while another of a similar color from Gulgong weighed 18 ounces avoirdupois. The New South Wales emerald mining industry dates from 1890, when a rich deposit was discovered at Emmaville, and 2,225 carats forwarded as a trial shipment to London, some of the gems realizing £4 per carat. About 50,000 carats were obtained during the next two years, but the hardness of the matrix in which the emeralds were found proved a source of considerable difficulty, it being almost impossible to break down the rock without injuring and frequently destroying the stones. In this way, it is asserted, many of the finest and most valuable specimens have been lost. The somewhat inferior character of later shipments to London caused them to prove unremunerative, and during the next few years mining operations became suspended. These have since been resumed, and it is anticipated that in due course deposits of richer quality will be reached. Turquoise has recently been discovered in the coastal region south of Sydney. It occurs chiefly as twin veins, from one-sixteenth to nearly one-quarter of an inch in thickness in the joints of the slate. The color of most of the mineral hitherto found is not sufficiently good to render it marketable, being of a bluish-green instead of the sky-blue which makes turquoise a highly-prized gem. Some of the stones, however, are of fair color, and lend encouragement to the hope that further prospecting may result in the discovery of more valuable material. Zircons of small size are extremely common in the auriferous and stanniferous gravels in different parts of the state, but large stones are comparatively rare. The beach sands of the northern coast, which contain platinum and tin, are largely composed of minute grains or crystals of zircon. The largest specimens of this mineral are found in the neighborhood of Hanging Rock (Nundle); they are colorless and transparent, and possess such a fine luster that the gold-miners have frequently mistaken them for diamonds. Garnets also are of common occurrence in many parts of the state, and they vary in size from minute grains to crystals of one inch or more in diameter; but stones suitable for cutting and polishing as gems appear to be rare, and so far they have not been regarded as of commercial importance. Other stones found in New South Wales include the opal, amethyst, chrysolite, cairngorm, and onyx; in fact, almost every kind of known gem stone is believed to exist in the state, but the absence of surface indications acts as a check upon systematic prospecting. In "The Mineral Resources of New South Wales," published by the State Government, are given a number of plans and views of the localities in which diamonds and other leading gem stones are found, which may interest those connected with the industry.

AUSTRALIAN OPAL AND OPAL MINING.

By JOHN PLUMMER.

CONSIDERABLE quantities of opal are found in Queensland and New South Wales. In the latter state the commoner kinds are found in many localities, especially in the neighborhood of Orange, but they possess little or no commercial value. Precious or noble opal is obtained principally at White Cliffs, in the dry western country, about 780 miles from Sydney and 65 miles from Wilcannia. The latter township is about 100 miles from Broken Hill, and the whole country is said to be rich in minerals, but the deficient water supply seriously retards the efforts of prospectors. According to Mr. E. F. Pittman, in his work on "The Mineral Resources of New South Wales," the precious opals of White Cliffs, as in the case of many other valuable mineral deposits, were discovered by accident. In 1889 a hunter, while tracking a wounded kangaroo, picked up a piece of the brilliantly colored mineral on the surface; after the find had been reported, a careful search of the locality was made, with the result that several more pieces were discovered; prospecting trenches were then excavated, and the gem was found in situ. Since that time mining operations have been carried on continuously, though sometimes under great difficulties, as in time of drought the locality is very badly provided with water; opal mining has, however, now become a settled industry, and a thriving township has been established at White Cliffs. The area within which the mineral has been found in the district is about fifteen miles long by about two miles wide. Prospecting for precious opal is a decidedly hazardous business, because, as a rule, there are no indications whatever on the surface of the occurrence of the mineral below. It is only in very rare instances that an outcrop of the gem can be seen, and the usual procedure is to dig a trench or pit in such a position as fancy may dictate, and trust to luck. Fortunately, sinking is easy, as the rock is of a soft nature, and, in a fair number of instances, the opal has been met with at a very short distance from the surface, though a large majority of the pits are unsuccessful. For several years the belief existed among the miners that it was useless to prospect for precious opal at a greater depth than twelve feet from the surface; but of late the incorrectness of this view has been proved, and the stones have been discovered at a depth of nearly fifty feet. According to an authority quoted by Mr. Pittman, there is a wonderful variety of opal found on the field, and the prices paid locally run from zero to \$125 per ounce, the ounce being the unit for purchasing in the rough. It is

rarely that the price paid exceeds \$100 per ounce. In valuing opal a good many points have to be taken into account. Needless to say, color is the first, red fire, or red in combination with yellow, blue and green being the best. Blue by itself is quite valueless, and green opal is not of great value, unless the color is very livid, and the pattern good. That the color should be true is a vital point. However good it may be, if it runs in streaks or patches, alternating with colorless or inferior quality that is untrue, it is of comparatively small value. Pattern is an important factor in the value, the various kinds being distinguished respectively as "pinfire," when the grain, if it may so be called, is very small; "harlequin," when the color is all in small squares, the more regular the better; and "flashfire," or "flash opal," when the color shows as a single flash, or in very large pattern. Of course, there are many intermediate classes. The harlequin is the most uncommon and also the most beautiful. When the squares of color are regular and show as distinct minute checkers of red, yellow, blue and green, this class of opal is truly magnificent. The flash opal is often very beautiful in color, especially when of the true ruby or pigeon's blood color. As a rule, however, it shows green or red flash according to the angle at which it is held. The direction of the pattern has also to be considered. Often a stone that shows a very good edge pattern will not look nearly so well on the face, while a stone which shows somewhat streaky in the shorter direction on the edge will sometimes give a fine harlequin pattern on the face. On this account the shape of the stone comes into the reckoning. Thus, a thick stone, with a good edge pattern, may often be cut up, so as to use that pattern as a face to all the stones cut from it; while a thin stone, though of equally good edge pattern, which could only be cut with the natural face, would probably not be worth nearly as much, weight for weight. It is difficult to obtain separate stones of absolute similarity in color and pattern; therefore, for suites of jewelry, a large, true stone, from which the whole could be cut, is worth a great deal more per ounce than so many smaller stones, approximately similar. Again, the ground or body of the opal must be taken into account. This is not a constant quantity, as the various patterns require slightly different ground. It should neither be too transparent nor too opaque, almost clear, with a slight milky tinge, translucent being about the best ground in general. Some of the opal is more brittle than others. Of course, the harder and tougher the stone the better it is, as, when cut, it is less likely to be injured, and retains the polish better. Many valuable opals have been found from time to time, one, weighing about four and a half ounces, being sold by the finder for \$500. Of course, in London it would bring a considerably higher price. Another opal, weighing nine ounces, was accidentally broken in two, the pieces weighing seven and two ounces respectively, and was valued locally at \$3,500. The value of the opal obtained since the discovery of the deposits in 1889 to the end of 1899 is estimated at \$1,882,995, but much of the opal obtained is not officially reported.

THE FOOD OF NESTLING BIRDS—BLUEBIRDS, ROBINS, AND HOUSE WRENS.*

By SYLVESTER D. JUD, Ph.D., Assistant Biologist, Biological Survey.

GENERAL REMARKS.—The amount of food consumed by nestling birds is not generally appreciated. The number of broods and of young vary according to the species and the region under consideration, but it is safe to say that on the average 2 or 3 broods of 3 to 5 each are raised every season. The young, from the time the eggs are hatched until the last offspring has left the nest, demand the most constant and untiring industry on the part of the parents. The labor of feeding begins before sunrise and continues with little rest until after sunset. Meals are very frequent,

Treadwell required 60 earthworms a day, and the young of a pair of European jays, observed by Dr. Brewer, were fed half a million caterpillars in a single season. The character of the food consumed in such quantity by different species of nestlings, apart from its scientific interest, is of great importance to the farmer, since many nests are placed in proximity to growing crops and the nesting season corresponds with the period of greatest agricultural activity.

Species of birds having a homogeneous diet, either animal or vegetable, rear their young upon food similar to that which they themselves take. Thus, gulls, terns, pelicans, herons, kingfishers, and the like pis-

FIG. 1.—BLUEBIRD AT EDGE OF NEST WITH GRASSHOPPER IN MOUTH.

FROM PHOTOGRAPH BY REV. P. B. PEABODY.

civorous birds, bring up their broods principally on fish; truly raptorial birds, such as hawks and owls, feed their young on birds and mammals; exclusively insectivorous birds, such as cuckoos and swallows, feed nothing but insects; and exclusively granivorous birds, such as doves and pigeons, feed only starchy seed materials. But birds that subsist on both animal and vegetable matter usually feed their young almost entirely on insects, chiefly such injurious kinds as grasshoppers and cutworms. Many of our common birds are comprised in this class.

Seed-eating birds and those that subsist on a mixed animal and vegetable diet, composed largely of hard material, have powerful muscular grinding gizzards, for food of this kind resists digestion and requires to be broken up in the stomach; but birds which live on insects or vertebrates that are soft and easily digested have thin-walled, comparatively weak, non-muscular stomachs. These anatomical peculiarities and consequent differences of function must not be lost sight of in the study of the food of young birds, for they are responsible for marked differences of diet as maturity is approached. Whatever may be the character of the parents' stomach structure, however, the stomach of a newly-hatched nestling is in most cases merely a membranous sac with comparatively little muscular development, and cannot assimilate anything but the softest, most readily digestible

food is three-fourths vegetable matter, will serve as an illustration: The first meal of the nestlings often consists of plump spiders of soft texture, which suit the delicate embryonic stomach; and these, together with tiny young grasshopper nymphs and soft small cutworms, continue for a while to form the food. As the stomach develops, however, the diet changes; such hard insects as beetles soon become a part of the fare, and by the time the young blackbirds are nearly or quite half grown their stomachs are strong enough to digest corn. Corn is then given to them freely, and in increasing quantity, until, when they are ready to leave the nest, it forms about one-quarter of their food.

In the following study of the food of nestlings of the various kinds of birds each group is taken up separately. The material has been gathered from detailed field observations by the writer and others and from examination of the contents of the stomachs of 700 nestlings.

BLUEBIRD.

The food of 6 feathered nestling bluebirds (*Sialia sialis*), the stomachs of which were examined in the laboratory, consisted of beetles, caterpillars, grasshoppers, spiders, and a few snails. Adult birds collected during the breeding season had eaten about three times as many beetles and a few ants, while 8 per cent of the food consisted of black raspberries.

ROBIN.

The robin (*Merula migratoria*) is about as troublesome to the horticulturist as are the catbird and cedar waxwing. Prof. F. E. L. Beal found that young nestlings, watched for several hours, were fed from five to six times an hour. Subsequent examination of the stomachs of 14 of these nestlings and of 8 of their parents showed that raspberries, blackberries, blueberries, cherries, and serviceberries formed only 7 per cent of the food of the young, while it formed 70 per cent of that of the old birds. In the case of the young, many of the stomachs contained pellets of grass, one in each stomach, the significance of which is not yet clear. The insect food of the young consisted chiefly of caterpillars, locusts (*Locustidae*), grasshoppers, crickets, and beetles (carabid beetles, May-beetles, and their larvæ). Spiders, snails, and earthworms were present in smaller quantities.

HOUSE WREN.

The house wren (*Troglodytes aëdon*) is exclusively insectivorous, and is one of the most useful birds on the farm. That nestlings are fed very frequently and consume an enormous quantity of food is well shown by a half day's observation made by the writer at Marshall Hall, Md., on June 17, 1899, of the feeding of a brood of three. The family was found housed in a cavity in a locust tree, and was transferred to a baking-powder can, which was nailed to the trunk of the tree four feet above the ground, a convenient eight for observation. The young were about three-fourths grown. The following is a detailed account of the feeding.

FEEDING OF A BROOD OF HOUSE WRENS.

A. M.		A. M.	
5:55.	Greencaterpillar (<i>Heliothis dipsaceus</i>).	9:37.	(Two cabbage worms placed on edge of tin can.)
5:56.	May-fly.	9:38.	<i>Acronycta obliqua</i> .
6:00.	May-fly.	9:39.	<i>Heliothis dipsaceus</i> .
6:02.	Undetermined.		(Refused cabbage worm.)
6:05.	<i>Heliothis dipsaceus</i> .	9:39½.	May-fly.
(Observations suspended till 7:20 A. M.)		9:45.	Grasshopper.
7:21.	Undetermined.	9:46.	Cutworm.
7:23.	May-fly.	9:50.	Grasshopper (<i>Melanoplus</i>).
(Observations suspended till 7:45 A. M.)		9:52.	Saw-fly larva (?).
7:46.	Harvest-man (<i>Phalangidae</i>).	9:54.	Miller (noctuid).
7:47.	May-fly.	9:55.	<i>Heliothis dipsaceus</i> .
7:48.	Undetermined insect.	9:57.	<i>Heliothis dipsaceus</i> .
7:49.	Undetermined.	10:00.	Spider.
7:51.	Undetermined.	10:01.	<i>Heliothis dipsaceus</i> .
7:55.	Undetermined.	10:05.	Black chrysalis.
7:56.	Undetermined.	10:08.	Cutworm.
7:57.	Undetermined.	10:15.	Spider.
7:57½.	Undetermined.	10:16.	Caterpillar.
8:00½.	Undetermined.	10:20.	May-fly.
8:01.	Undetermined.	10:23.	Spider.
8:03.	Undetermined.	10:26.	Clay-colored grasshopper.
8:03½.	Undetermined.	10:29.	Clay-colored grasshopper nymph.
8:06.	<i>Heliothis dipsaceus</i> .	10:30.	<i>Acronycta obliqua</i> .
8:08.	Undetermined insect.	10:35.	Green caterpillar.
8:11.	Undetermined insect.	10:38.	<i>Heliothis dipsaceus</i> .
8:13½.	Brown caterpillar.	10:41.	<i>Heliothis dipsaceus</i> .
8:16.	Undetermined insect.	10:46.	Clay-colored grasshopper.
8:18.	Undetermined insect.	10:48.	Spider.
8:20.	Undetermined insect.	10:50.	Miller (noctuid).
8:22.	Undetermined insect.	10:52.	Clay-colored grasshopper nymph.
8:23.	Two May-flies.	10:54.	Miller (noctuid).
8:24.	May-fly.	11:02.	May-fly.
8:29.	Brown orthopterous insect.	11:02½.	May-fly.
8:30.	<i>Heliothis dipsaceus</i> .	11:15.	Green caterpillar.
8:35.	Undetermined.	11:20.	Miller (noctuid).
8:38.	Caterpillar.	11:21.	Black chrysalis.
8:41½.	May-fly.	11:22.	Saw-fly larva (?).
8:43.	May-fly.	11:25.	Spider.
8:45.	Brown caterpillar (cutworm?).	11:26.	Grasshopper (<i>Melanoplus</i>).
8:46.	<i>Heliothis dipsaceus</i> .	11:30.	<i>Heliothis dipsaceus</i> .
8:47.	Undetermined insect.	11:30½.	May-fly.
8:48.	Undetermined insect.	11:32.	Spider.
8:49.	Undetermined insect.	11:34.	Grasshopper (<i>Melanoplus</i>).
8:50.	Undetermined insect.	11:34½.	Saw-fly larva (?).
8:52½.	Cutworm (?).	11:36.	<i>Acronycta obliqua</i> .
8:55.	<i>Heliothis dipsaceus</i> .	11:39½.	May-fly.
8:56.	Undetermined insect.	11:47.	Cutworm.
8:59.	Pentatomid bug (<i>Nazara</i> ?).	11:48.	May-fly.
9:03.	Cutworm (?).	11:50.	Cutworm.
9:05.	Cutworm.	11:51.	<i>Heliothis dipsaceus</i> (2).
9:10.	Caterpillar (<i>Acronycta obliqua</i>).	11:59.	<i>Heliothis dipsaceus</i> .
9:13.	Brown soldier bug.	P. M.	
9:17.	Green caterpillar (noctuid).	12:02.	<i>Heliothis dipsaceus</i> .
9:20.	White grub.	12:06.	Spider.
9:25.	Clay-colored grasshopper.	12:07.	<i>Heliothis dipsaceus</i> .
9:25½.	Grasshopper.	12:09.	Cutworm.
9:30.	Undetermined insect.	12:11.	Spider.

The mother wren thus made 110 visits to her little ones in four hours and thirty-seven minutes, and fed them 111 insects and spiders. Among these were identified 1 white grub, 1 soldier bug, 3 millers (*Noctuidæ*), 9 spiders, 9 grasshoppers, 15 May-flies, and 34 caterpillars. On the following day similar observations were made from 9:35 A. M. till 12:40 P. M., and in the three hours and five minutes the young were fed 67 times. Spiders were identified in 4 instances, grasshoppers in 5, May-flies in 17, and caterpillars in 20. The usual difference between the food of adult birds and that of their young is less marked in the case of the house wren.

FIG. 2.—NESTLING CROWS.

FROM PHOTOGRAPH BY REV. P. B. PEABODY.

often averaging one every two minutes. At first the nestlings consume more than their own weight of food in a day, and make a daily gain in weight of 20 to 50 per cent. At this time they appear to consist of little else than mouth and stomach, and spend nearly all their waking moments in eating. The total of the material required to satisfy their voracity is astonishingly large. A young robin kept in captivity by Prof.

material. Therefore in the case of many species the food of the young must differ radically from that of the adult. Such grain-eating birds as pigeons, possessed of strong gizzards, feed their squabs on the so-called "pigeon's milk," which is digested grain of semi-fluid consistency, disgorged by the parent bird into the gullet of its offspring. Many birds that are largely vegetarians, but not endowed with this power of regurgitating digested food, rear their young for a time on insects. The crow blackbird, whose annual

* Abridged from Yearbook U. S. Department of Agriculture for 1900.