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## HELMINTH AND ARTHROPOD PARASITES OF EXPERIMENTALLY INTRODUCED WHOOPING CRANES IN FLORIDA

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**ABSTRACT:** Nine species of nematodes, unidentified larval nematodes, three species of trematodes, two species of acanthocephalans and a single species of chewing louse were collected from 1993 to 1995 from 25 introduced whooping cranes (*Grus americana*) in Florida (USA). In spite of a quarantine procedure involving anthelmintic therapy, three helminth parasites may have been introduced from captive populations. Other parasites acquired were similar to those found in a local congener, the Florida sandhill crane (*Grus canadensis pratensis*), or only occurred infrequently.

**Key words:** Parasites, whooping crane, *Grus americana*, introduction.

### INTRODUCTION

In spite of its long-term status as an endangered species, we could only find reports of a single helminth parasite (Tuggle, 1983) and three parasitic arthropods (Emerson, 1964; Price, 1970; Windingstad, 1978) in free-ranging whooping cranes (*Grus americana*). There have been several reports of helminth infections and diseases of captive whooping cranes (Carpenter et al., 1980; Carpenter and Derrickson, 1981).

The introduction into central Florida (USA) of a closely monitored experimental population of captive-raised whooping cranes, with rapid recovery of dead birds, gave us the opportunity to study the parasites of an introduced population. Whooping cranes were last observed in Florida in the 1930's (Nesbitt, 1982). The introduction into Florida was an attempt to establish a non-migratory population as a part of the overall recovery plan (U.S. Fish and Wildlife Service, 1994). Parasites of the two subspecies of a congener, the sandhill crane (*Grus canadensis*), have been relatively well studied in Florida. Helminth and arthropod parasites found in Florida sandhill cranes (*G. canadensis pratensis*), a non-migratory subspecies, and the wintering greater sandhill cranes (*G. canadensis tabida*), a migratory subspecies, have been described (Forrester et al., 1974, 1975). Our objective was to doc-

ument the parasites found during the first 2 yr after introduction of whooping cranes (1993 to 1995) and to provide a baseline for future studies.

### MATERIALS AND METHODS

The whooping cranes in this study were reared by parent birds, surrogate parents, or by costumed caretakers from eggs either laid in captivity or collected from nests in Wood Buffalo National Park, Canada, at Patuxent Environmental Science Center (PESC), Laurel, Maryland (USA) or at the International Crane Foundation (ICF), Baraboo, Wisconsin (USA). At 6 to 11 mo of age they were transported to Kenansville, Florida (Osceola County) by airplane and released into a holding pen for 3 to 4 wk before they were allowed to fly freely. Birds were fitted with a leg mounted radio transmitter with mortality switches (Telemetry 2000 Inc., Columbia, Maryland and Advanced Telemetry Systems Inc., Isanti, Minnesota, USA) and monitored daily. Prior to transportation, the birds were subject to a 60-day quarantine which included feed that contained 90 mg/kg monensin (Coban® or Elancoban®, Elanco, a Division of Eli Lilly and Co., Indianapolis, Indiana, USA) (PESC and ICF) or 0.0125 mg/kg amprolium ethopabate (Amprol-25®, MSD Agvet, Rahway, New Jersey, USA) (ICF only). They also received subcutaneous treatment with 0.2 mg/kg ivermectin (Ivomec®, MSD Agvet), and 100 mg/kg oral fenbendazole (Panacur®, American Hoechst Corporation, Somerville, New Jersey) for helminth parasites (only when fecal examinations were positive at ICF, all birds at PESC). Dusting with 5% carbaryl powder (Vet Kem®, Division of Zoecon Corporation, Dallas, Texas, USA) was used for ectoparasites (PESC only, ectoparasites have

not been seen at ICF). Upon arrival in Florida, birds received feed containing monensin in the pen, and were provided with the same feed in the area of the release pen for as long as they returned to it. Birds were re-examined upon release from the pen, opportunistically when captured for other reasons, or upon death. A complete postmortem examination was performed to determine the cause of death. A skin wash and screening of tissues for parasites followed the methods of Kinsella and Forrester (1972). In addition to specifically mentioned papers, Yamaguti (1971) and Anderson et al. (1980) were used to identify parasites. Feces were collected when live birds were handled for examination, and opportunistically, and were stored in 2% potassium dichromate, concentrated with Sheather's sugar solution (Sloss, 1975), and examined for parasite eggs by scanning at 100× power. Live birds were examined visually for arthropod parasites.

Representative material has been deposited in the National Parasite Collection, Beltsville, Maryland (USNPC Nos. 84560-84569).

### RESULTS

Fifty-two whooping cranes were released in central Florida between January 1993 and March 1995. The 27 birds examined at death had been in Florida for 1 to 28 mo and ranged in age from 7 to 36 mo of age. We speculate that the cause of death in all cases was predation by bobcats (*Felis rufus*). Postmortem examinations of all birds, including one observed to be killed by a bobcat were characterized by broken necks, a pattern of flesh consumption, and carcasses were often covered by vegetation. In no case did helminths or ectoparasites appear to have caused death or significant disease. Six of the birds, all in Florida for less than 5 mo, were free of parasitic helminths and arthropods. The cranes utilized foraging sites in Osceola, Lake, Orange, and possibly Brevard Counties, and commonly shared foraging sites with both Florida and greater sandhill cranes.

Nine species of nematoda as well as unidentified larval nematodes were found (Table 1). *Ascaridia pterophora* was the most prevalent and abundant helminth and was present in birds just 1 mo after arrival. Ascarid eggs were found in 12 (9%)

of 129 fecal samples examined. Capillarid nematodes were first detected as eggs in the feces of cranes collected from the pen just 16 days after their arrival. In spite of the common finding of capillarid eggs in the feces (22% of 129 samples), adult parasites were found in only five of the 25 cases examined at necropsy. *Eucoleus obtusiuscula* was found under the gizzard lining of four cranes (from ICF and PESC), the first infection being recognized in a bird 1 mo after arrival. A female *Capillaria* sp. found in the small intestine of one whooping crane, also at 1 mo after arrival, could not be identified to species. Capillarid eggs were common in feces of sandhill cranes in the area of the release pen and in feces of captive whooping cranes (from PESC and ICF), but whether their source was *Capillaria* spp. or *E. obtusiuscula* could not be determined. A species of *Strongyloides* appeared in cranes at 2 mo after arrival. Other nematodes occurred infrequently (Table 1).

Three species of trematoda were identified (Table 1). One specimen of *Lyperorchis lyperorchis* was found in a crane 2 mo after arrival, and a gravid specimen in another crane 4 mo after arrival. A gravid specimen of the eyeworm, *Philopthalmus gralli*, and two immature specimens of a species of *Brachylaima* were found in the body wash of a crane 7 mo after arrival. The immature flukes were not sufficiently mature for further identification. Unidentified trematode eggs were only observed in the feces on two occasions.

Two species of acanthocephala were identified (Table 1). Both were immature and found in the small intestine 28 mo after arrival.

Two female chewing lice, *Heleonomus assimilis*, were found on one whooping crane that died 10 mo after arrival (Table 1).

### DISCUSSION

Although the cranes released in Florida underwent a quarantine period with examination of feces and treatment with ant-

TABLE 1. Helminth and arthropod parasites from 27 introduced whooping cranes from central Florida, 1993 to 1995.

Parasite (location) <sup>a</sup>	Prevalence		Number per infected bird		Abundance <sup>b</sup>	First detection <sup>c</sup> (mo)
	Number infected	%	Mean	Range		
<b>Nematoda</b>						
<i>Ascaridia pterophora</i> (Si, Li)	13	48	18.5	1-61	9	1
<i>Strongyloides</i> sp. (Si)	5	19	24.2	1-102	5	2
<i>Eucoleus obtusiuscula</i> (V)	4	16	3.5	1-10	<1	1
<i>Dispharynx nasuta</i> (E, V)	3	11	1	1	<1	1
<i>Hystrichis tricolor</i> (P)	2	7	1.5	1-2	<1	1
<i>Capillaria</i> sp. (V)	1	4	1	1	<1	1
<i>Contracaecum multipapillatum</i> (Si)	1	4	1	1	<1	7
<i>Cyathostoma variegatum</i> (O)	1	4	1	1	<1	1
<i>Physaloptera</i> sp. (V)	1	4	1	1	<1	7
Unidentified larva (Lsi, Cl)	2	7	1.5	1-2	<1	1
<b>Trematoda</b>						
<i>Brachylaema</i> sp. immature (Lsi)	1	4	2	2	<1	7
<i>Lyperorchis lyperorchis</i> (Lit, I)	2	7	1	1	<1	4
<i>Philophthalmus gralli</i> (S)	1	4	1	1	<1	7
<b>Acanthocephala</b>						
<i>Centrorhynchus kuntzi</i> immature (Si)	1	4	1	1	<1	28
<i>Southwellina</i> sp. immature (Si)	1	4	1	1	<1	28
<b>Arthropoda</b>						
<i>Heleonomus assimilis</i> (S)	1	4	2	2	<1	10

<sup>a</sup> Location in host S = skin, O = oral cavity, E = esophagus, V = ventriculus (gizzard), P = proventriculus, D = duodenum, Si = small intestine, Lsi = lower small intestine, Li = large intestine, Lit = lower intestinal tract, I = intestine, Cl = cloaca.

<sup>b</sup> Abundance = mean number per infected bird times the prevalence.

<sup>c</sup> Time after arrival in Florida when parasite was first detected in introduced cranes.

helminths, it is possible that some parasites (*A. pterophora*, *E. obtusiuscula*, and *C. variegatum*) were introduced since they have not been reported in wild sandhill cranes (Forrester et al., 1974, 1975) or in other hosts from Florida. Capillarid (ICF and PESC) and ascarid (PESC only) eggs were found in feces of whooping cranes in quarantine, and ascarid eggs were found in feces from other crane species at ICF (J. Langenberg, pers. comm.). *Ascaridia pterophora* previously has been known only from a gruiform, *Cariama cristata*, in Brazil (Cristofaro and Feijo, 1975). Although no ascarids have been reported from sandhill cranes in Florida, a 2-yr-old Florida sandhill crane raised at PESC and released in Osceola County in 1990 later was found infected with *A. pterophora*. *Ascaridia pterophora* was found in four cap-

tive whooping cranes that died at PESC (R. Cole, pers. comm.). *Ascaridia* spp. have a direct life cycle (Levine, 1968). The intensities of infection with *A. pterophora* appeared to increase with time since release from a mean ( $\pm$ SE) of  $10 \pm 14$  parasites in birds ( $n = 10$ ) up to 6 mo after arrival to  $45 \pm 16$  parasites in birds ( $n = 3$ ) after 6 mo in Florida. Continued use of the release pen area may have exposed birds to fecal contamination in a manner similar to a captive situation. Although *E. obtusiuscula* had not been reported in previous studies of sandhill cranes in Florida, it was found subsequently in a greater sandhill crane from PESC that died 1 mo after release into Alachua County (USNPC Helm. Coll. No. 84570). Sergeeva and Barus (1988) list many gruiform and charadriiform birds as hosts of *E. ob-*

*tusiuscula* in Europe and Asia, but these are apparently the first records from any host in North America. The *Cyathostoma* sp. reported from captive whooping cranes by Carpenter and Derrickson (1981) and from captive sandhill cranes by Carpenter et al. (1976) was identified as *C. coscorobae*. However, specimens from captive sandhill cranes deposited in the National Parasite Collection (USNPC 66545 and 77941) have been determined by us to be *C. variegatum*, the common gapeworm of gruiforms and ciconiforms in Europe and Asia (Ali, 1970). This species caused the death of a sandhill crane transported to Florida in 1991 from PESC, and was found in another PESC-raised sandhill crane released in Alachua County. *Cyathostoma* sp. have been found at necropsy of other crane species at ICF. Only time will tell if these helminths become established with the introduced population of whooping cranes and in wild sandhill cranes. Therapy regimes for these parasites in whooping cranes have not been established and should be evaluated.

Two parasites were shared with both Florida and greater sandhill cranes from Florida. *Dispharynx nasuta* was reported once in each subspecies of sandhill crane, and is a common parasite of various bird species in Florida, and four species of chewing lice, including *H. assimillis*, have been found on sandhill cranes in Florida (Forrester et al., 1974, 1975). Three other parasites not identified to species may be shared with both Florida and greater sandhill cranes. *Brachylaima fuscatum* and *Strongyloides* sp. were relatively common in both sandhill subspecies (Forrester et al., 1974, 1975). Specimens of *Strongyloides* spp. from whooping cranes averaged slightly smaller in total length (2.14 to 2.50 mm) and esophageal length (430 to 560  $\mu$ ) than those reported from sandhill cranes. An unidentified *Capillaria* sp. was found in the small intestine of both subspecies (Forrester et al., 1974, 1975). Another nematode, a physalopterid larva, may be

shared with Florida sandhill cranes (Forrester et al., 1975).

Six parasites that occurred in one or two whooping cranes have not been previously reported in sandhill cranes. *Contraecaecum multipapillatum* is a common parasite of fish-eating birds in Florida (Courtney and Forrester, 1974; Threlfall, 1982; Sepúlveda et al., 1996). *Hystrichis tricolor* has been reported from purple gallinules (*Porphyrio martinica*), common moorhens (*Gallinula chloropus*), and American coots (*Fulica americana*) in Florida (Kinsella 1973; Kinsella et al., 1973) and is considered a cosmopolitan parasite of ducks and geese (McDonald, 1969). *Lyperorchis lyperorchis* is a prevalent parasite of limpkins (*Aramus guarauna*) in north central Florida (Conti et al., 1985). *Philopthalmus gralli* has been reported in Florida from fulvous whistling-ducks (*Dendrocygna bicolor*) (Forrester et al., 1994) and is found in Florida great blue herons (*Ardea herodias*) and wood storks (*Mycteria americana*) (M. Kinsella and M. Spalding, unpubl.). *Centrorhynchus kuntzi* is a common parasite of hawks in Florida (Kinsella et al., 1995). *Southwellina* sp. may be the same species that occurs in brown pelicans and roseate spoonbills in Florida (Courtney and Forrester, 1974; Sepúlveda et al., 1994). Since both these acanthocephalans were immature, it is uncertain whether they would have established as adult parasites.

Introduced whooping cranes did not have two of the most abundant parasites in greater sandhill cranes (*Tetrameres grusi*, *Orchipedum jolliei*) and two of the most abundant parasites in Florida sandhill cranes (*Strigea gruis*, and *Stomylotrema vicarium*) (Forrester et al. 1974, 1975). *Tetrameres grusi* and *O. jolliei* were rare or never found in Florida sandhill cranes, and thus, it is possible that the life cycle of these species is not completed in Florida. The failure to acquire *S. gruis*, the most abundant parasite in Florida sandhill cranes, might reflect a difference in choice of food items. *Stomylotrema vicarium* is common in Florida white ibis (*Eudocimus*

*albus*) (Bush and Forrester, 1976) and was not seen in greater sandhill cranes. Sandhill cranes and turkeys (*Meleagris gallopavo*) may be accidental hosts of this fluke in Florida (Forrester et al., 1975).

As in any helminth community, sporadic infections derived from less closely related ecological associates contribute a number of species, but are of little importance to the overall community. Probably included in this category are *L. lyperorchis*, *P. gralli*, *H. tricolor*, *D. nasuta*, *C. multipapillatum* and the larval *Physaloptera* sp. Other such accidental species will no doubt occur in the future.

Little information is available on the impact of these parasitic infections and infestations in cranes. All but three of the birds had abundant body fat. These three birds had greater numbers of parasitic species (two to five species), and greater numbers of the two most abundant parasites (29, 45, 61 *A. pterophora*, and one, 14, 102 *Strongyloides* sp., respectively. *Cyathostoma variegatum* has caused death from suffocation in both captive whooping and sandhill cranes (Carpenter and Derrickson, 1987; M. Spalding, unpubl.), but appeared to be incidental in the case reported here. *Capillaria* sp. caused death and debilitation of captive Mississippi sandhill cranes (*G. canadensis pusilla*) (Carpenter and Derrickson, 1987). *Hystrichis tricolor* and *D. nasuta* have both caused lesions in the proventriculus of various birds (Rickard, 1985; Karmanova, 1968) but, thus far, intensities have been low in whooping cranes.

We identified 14 species of helminths present in Florida whooping cranes within 2 yr of release, a number of which (*C. variegatum*, *Strongyloides* sp., *H. tricolor*, *D. nasuta*) could contribute to future morbidity or mortality if prevalence and intensities of infections increase. These data are a baseline with which to evaluate any changes. In spite of attempts to introduce relatively parasite and disease free individuals, it appears that a number of helminth parasites were introduced. The introduc-

tion of parasites and diseases can be a consequence of translocation (Castle and Christensen, 1990) whether intentional or not and should be documented when the decision to translocate is made (Spalding and Forrester, 1993).

Since only *T. grusi* (Tuggle, 1983) has been reported from free-ranging whooping cranes previously, all of the helminth parasites reported here are first reports in free-ranging whooping cranes.

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#### LITERATURE CITED

- ALI, M. M. 1970. A review and revision of the subfamily Cyathostominae Nicoll, 1927 (Nematoda, Syngamidae). *Acta Parasitologica Polonica* 17: 237-246.
- ANDERSON, R. C., A. G. CHABAUD, AND S. WILLMOTT. 1980. Commonwealth Institute of Helminthology keys to the nematode parasites of vertebrates. Nos. 1 to 10. Commonwealth Agricultural Bureaux, Farnham Royal, England.
- BUSH, A. O., AND D. J. FORRESTER. 1976. Helminths of the white ibis in Florida. *Proceedings of the Helminthological Society of Washington* 43: 17-23.
- CARPENTER, J. W., AND S. R. DERRICKSON. 1981. Whooping crane mortality at the Patuxent Wildlife Research Center 1966-1981. *In Proceedings of the 1981 Crane Workshop*, J. C. Lewis, (ed.). National Audubon Society, Tavernier, Florida, pp. 175-179.
- , AND ———. 1987. Infectious and parasitic

- diseases of cranes: Principles of treatment and prevention. In Proceedings of the 1983 International Crane Workshop, G. W. Archibald and R. F. Pasquier (eds.). International Crane Foundation, Baraboo, Wisconsin, pp. 539–553.
- , L. N. LOCKE, AND J. C. MILLER 1976. Mortality in captive sandhill cranes at the Patuxent Wildlife Research Center 1966–1975. In Proceedings of the 1975 International Crane Workshop, J. C. Lewis (ed.). Oklahoma State University Publications, Stillwater, Oklahoma, pp. 268–283.
- , T. R. SPRAKER, AND M. N. NOVILLA. 1980. Disseminated visceral coccidiosis in whooping cranes. *Journal of the American Veterinary Medical Association* 177: 845–848.
- CASTLE, M. D., AND B. M. CHRISTENSEN. 1990. Hematozoa of wild turkeys from the midwestern United States: Translocation of wild turkeys and its potential role in the introduction of *Plasmodium kempfi*. *Journal of Wildlife Diseases* 26: 180–185.
- CONTI, J. A., D. J. FORRESTER, AND S. A. NESBITT. 1985. Parasites of limpkins, *Aramus guarana*, in Florida. *Proceedings of the Helminthological Society of Washington* 52: 140–142.
- COURTNEY, C. H., AND D. J. FORRESTER. 1974. Helminth parasites of the brown pelican in Florida and Louisiana. *Proceedings of the Helminthological Society of Washington* 41: 89–93.
- CRISTOFARO, R., AND L. M. F. FEIJO. 1976. Contribucao ao estudo da fauna helmintologica do Estado Mato Grosso. *Atas da Sociedade de Biologia do Rio de Janeiro* 18: 53–57.
- EMERSON, K. C. 1964. Checklist of the Mallophaga of North America (north of Mexico). Part II, Suborder Amblycera. Dugway Proving Ground, Dugway, Utah, 104 pp.
- FORRESTER, D. J., A. O. BUSH, L. E. WILLIAMS, JR., AND D. J. WEINER. 1974. Parasites of greater sandhill cranes (*Grus canadensis tabida*) on their wintering grounds in Florida. *Proceedings of the Helminthological Society of Washington* 41: 55–59.
- , ———, AND ———. 1975. Parasites of Florida sandhill cranes, *Grus canadensis pratensis*. *The Journal of Parasitology* 61: 547–548.
- , J. M. KINSELLA, J. W. MERTINS, R. D. PRICE, AND R. E. TURNBULL. 1994. Parasitic helminths and arthropods of fulvous whistling-ducks (*Dendrocygna bicolor*) in southern Florida. *Journal of the Helminthological Society of Washington* 61: 84–88.
- KARMANOVA, E. M. 1968. Diocetophymidea of animals and man and the diseases caused by them. [Translated from Russian] *Principles of Nematology*, Vol. XX, K. I. Skryabin (ed.). Izdatelstvo Nauk, Moscow, U.S.S.R., 261 pp.
- KINSELLA, J. M. 1973. Helminth parasites of the American coot, *Fulica americana americana*, on its winter range in Florida. *Proceedings of the Helminthological Society of Washington* 40: 240–242.
- , AND D. J. FORRESTER. 1972. Helminths of the Florida duck, *Anas platyrhynchos fulvigula*. *Proceedings of the Helminthological Society of Washington* 39: 173–176.
- , L. T. HON, AND P. B. REED JR. 1973. A comparison of the helminth parasites of the common gallinule (*Gallinula chloropus cachinnans*) and the purple gallinule (*Porphyrula martinica*) in Florida. *The American Midland Naturalist* 89: 467–473.
- , G. W. FOSTER, AND D. J. FORRESTER. 1995. Parasitic helminths of six species of hawks and falcons in Florida. *Journal of Raptor Research* 29: 117–122.
- LEVINE, N. D. 1968. Nematode parasites of domestic animals and of man. Burgess Publishing Company, Minneapolis, Minnesota, 600 pp.
- MCDONALD, M. E. 1969. Catalogue of helminths of waterfowl (Anatidae). Special Scientific Report No. 126, Bureau of Sport Fisheries and Wildlife, Washington D. C., 692 pp.
- NESBITT, S. A. 1982. The past, present, and future of the whooping crane in Florida. In Proceedings of the 1981 Crane Workshop, J. C. Lewis (ed.). National Audubon Society, Tavernier, Florida, pp. 151–154.
- PRICE, R. D. 1970. A review of the genus *Heleonomus* (Mallophaga: Menoponidae) from the cranes. *Annals of the Entomological Society of America* 63: 1162–1174.
- RICKARD, L. G. 1985. Proventricular lesions associated with natural and experimental infections of *Dispharynx nasuta* (Nematoda: Acuariidae). *Canadian Journal of Zoology* 63: 2663–2668.
- SEPÚLVEDA, M. S., M. G. SPALDING, J. M. KINSELLA, R. D. BJORK, AND G. S. MCLAUGHLIN. 1994. Helminths of the roseate spoonbill, *Ajaia ajaia*, in southern Florida. *Journal of the Helminthological Society of Washington* 61: 179–189.
- , ———, ———, AND D. J. FORRESTER. 1996. Parasitic helminths of the little blue heron, *Egretta caerulea*, in southern Florida. *Journal of the Helminthological Society of Washington* 63 (in press).
- SERGEVA, T. P., AND V. BARUS. 1988. On *Capillaria vanelli* and *Capillaria obtusiuscula* (Capillariidae: Nematoda). *Helminthologia* 25: 207–216.
- SLOSS, M. M. 1975. Veterinary clinical parasitology. Iowa State University Press, Ames, Iowa, 250 pp.
- SPALDING, M. G., AND D. J. FORRESTER. 1993. Disease monitoring of free-ranging and released wildlife. *Journal of Zoo and Wildlife Medicine* 24: 271–280.
- THRELFALL, W. 1982. Endoparasites of the double-crested cormorant (*Phalacrocorax auritus*) in Florida. *Proceedings of the Entomological Society of Washington* 49: 103–108.

- TUGGLE, B. N. 1983. *Tetrameres grusi* (Nematoda: Tetrameridae) from foster-raised whooping crane. Proceedings of the Helminthological Society of Washington 50: 332.
- U.S. FISH AND WILDLIFE SERVICE. 1994. Whooping crane recovery plan. U.S. Fish and Wildlife Service, Albuquerque, New Mexico, 92 pp.
- WINDINGSTAD, R. M. 1978. Diseases and parasites of the greater sandhill crane. M.S. Thesis. University of Wisconsin, Stevens Point, Wisconsin, 66 pp.
- YAMAGUTI, S. 1971. Synopsis of digenetic trematodes of vertebrates. Volumes I and II. Keigaku Publ. Co., Tokyo, Japan, 1074 pp. + 349 plates.

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