

<b>Virus Name: Louping ill</b>		<b>Abbreviation: LIV</b>
Status <b>Arbovirus</b>	Select Agent <b>No</b>	SALS Level <b>3</b>
SALS Basis <b>Results of SALS surveys and information from the Catalogue.</b>		
Other Information <b>USDA Permit Required, DOC Permit Required, Hepa Filtration, USDA Restricted</b>		
Antigenic Group <b>B</b>		

#### SECTION I - Full Virus Name and Prototype Number

Prototype Strain Number / Designation	Accession Number	Original Date Submitted <b>6/1/1984</b>
Family <b>Flaviviridae</b>	Genus <b>Flavivirus</b>	
Information From <b>C.E. Gordon Smith</b>	Address <b>London School of Hygiene and Tropical Medic</b>	
Information Footnote <b>Revised</b>		

#### Section II - Original Source

Isolated By (name) <b>Pool, et al. (1)</b>	Isolated at Institute <b>Moredun Institute, Edinburgh</b>	
Host Genus <b>Sheep (Ovis aries)</b>	Species	Host Age/Stage <b>Ewe and lamb</b>
Sex <b>Not Answered</b>		
<u>Isolated From</u>	<u>Isolation Details</u>	
<b>Organs/Tissues</b>	<b>Brain and spinal cord</b>	
Signs and Symptoms of Illness <b>Incoordination of gait, tremors esp. of head, salivation, champing of jaws.*</b>	Arthropod	
Time Held Alive before Inoculation		
Collection Method <b>Sick animal destroy material col. at autopsy</b>	Collection Date <b>1/1/1929</b>	
Place Collected (Minimum of City, State, Country) <b>Selkirkshire, Scotland</b>		
Latitude <b>55° 30' N</b>	Longitude <b>3° 0' W</b>	
Macrohabitat <b>Tick-infested hill sheep farm</b>	Microhabitat	Method of Storage until Inoculated <b>In 50% glycerol</b>
Footnotes		

**Section III - Method of Isolation**

Inoculation Date	
Animal (Details will be in Section 6) <b>Sheep, pig</b>	
Route Inoculated <b>Intracerebral</b>	Reisolation <b>Yes</b>
Other Reasons <b>Transmission by Ixodes ricinus (19). Demonstration of immunity following natural infection (19).</b>	
Homologous Antibody Formation by <u>Source Animal</u> <b>Not tested</b>	
Test(s) Used	
Footnotes	

**Section IV - Virus Properties**

Physicochemical		
Pieces (number of genome segments)	Infectivity	Sedimentation Coefficients(s) (S)
Percentage wt, of Virion Protein	Lipid	Carbohydrate
Virion Polypeptides: Number	Details	
Non-virion Polypeptides: Number	Details	
Virion Density	Sedimentation Coefficients(s) (S)	
Nucleocapsid Density	Sedimentation Coefficients(s) (S)	
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<b><u>Stability of Infectivity (effects)</u></b>		
pH (infective range)		
Lipid Solvent (ether - % used to test) <b>1:2</b>	After Treatment Titer <b>4.9 dex</b>	Control Titer <b>8.1 dex</b>
Lipid Solvent (chloroform)	After Treatment Titer	Control Titer
Lipid Solvent (deoxycholate) <b>0.1%</b>	After Treatment Titer <b>4.5 dex</b>	Control Titer <b>7.1 dex</b>
Other (formalin, radiation) <b>Not inactivated by 0.05% trypsin (1 hour, 37/C)</b>		
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<b><u>Virion Morphology</u></b>		
Shape	Dimensions	
Mean nm	Range nm	
Measurement Method	Surface Projections/Envelope	Nucleocapsid Dimensions, Symmetry

### Morphogenesis

Site of Constituent Formation in Cell	Site of Virion Assembly	Site of Virion Accumulation
Inclusion Bodies	Other	

### Hemagglutination

Hemagglutination <b>Yes</b>	Antigen Source <b>SMB ext. by acetone-ether; sucrose-acetone; cent. + prot. tr.</b>	Erythrocytes (species used) <b>Goose</b>
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pH Range <b>6.0-6.8</b>	pH Optimum <b>6.4</b>
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Temperature Range <b>4dC - 37dC</b>	Temperature Optimum <b>22dC, 37dC</b>
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#### Remarks

**\* Later unable to stand butkicking vigorously. Progress to and death (1).**

#### Serologic Methods Recommended

**HI, CF, NT, agar gel precipitation (20)**

#### Footnotes

**\* Later unable to stand butkicking vigorously. Progress to and death (1).**

Serum	Louping Ill Antigen/Virus			Antigen or Virus	Louping Ill Serum		
	CF [9] Ht/Ho	NT Ht/Ho			CF [9] Ht/Ho	NT Ht/Ho	
		[9]	[12]			[9]	[12]
LI	128/128=1.0	3.33/3.33	6.9/6.9	LI	128/128=1.0	3.3/3.3	6.9/6.9
RSSE	64/64 =1.0	2.0/3.23	4.6/6.2	RSSE	64/128=0.5	3.0/3.23	5.9/6.2
Czech enc.			3.7/6.8	Czech enc.			6.6/6.8
JE	<2/128=<0.0156			JE	<2/128=<0.0156		
WN	<2/64=<0.0312			WN	<2/64=<0.0312		

Cross-protection tests showing dex of challenge virus protection [9] , [12]

Cross absorptions in agar gel precipitation tests [20] .

Louping ill falls into Group B and as far as is known is not related to any viruses not in this group. It is more closely related to the tick-borne viruses than to others in Group B. For further information on relationship to other tick-borne strains consult References [20] and [33] .

Virus Source (all VERTEBRATE isolates)

Lab Methods of Virus Recovery (ALL ISOLATIONS)  
Newborn mice

Cell system (a)	Virus passage history (b)	Evidence of Infection							
		CPE			PLAQUES			Growth Without CPE +/- (g)	
		Day (c)	Extent (d)	Titer TCD50/ml (e)	Day (c)	Size (f)	Titer PFU/ml (e)		
Pig kidney cells(CL)	Several	2-3	CPE (21)						
Chick embryo (PC)	Several				3	Plaques (15)			
Vero(CL)	P-4				15	4 mm	7.9** (28)		
LLC-MK2(CL)					4	4 mm	8.6 (28)		
HeLa, KB, Detroit-6(CL)			CPE (13)						
Rana temporaria (PC) tadpoles	369T2, MB 3,4		No CPE						+ (31)
Rhipicephalus appendiculatus (CL) (RA-243)	MB 2-4		No CPE						+ (32)

\*\* Expressed in dex

Vertebrate (species and organ) and arthropod	No. isolations/No. tested	No. with antibody/No. tested Test used	Country and region
Man (natural)	Rare	Probable cases only	Scotland, N. England
Man (laboratory infections)(11)	5/5	Several	
Cattle	Rare	Several	North Scotland, N. England
Horses	None	Rare	
Sheep	Numerous	Very numerous	Ayrshire, North Scotland, N.England(1)
Sheep		HI, NT (22)	Erie; N. Ireland (1)
Red deer	None	37% NT	Scotland (16, 17)
Red deer		22% in 300	
Hares	None	9/9 HI, NT	Scotland
Hares		0/56	From other areas
Grouse	Yes	1/2 HI, NT	Forres, Scotland (21)
Grouse		14/43 HI	Glenesk, Scotland (29)
Grouse		0/10 NT	
Ixodes ricinus	Numerous		Scotland (19, 22)
Apodemus sylvaticus	2/30	0/30 HI	Ayrshire, Scotland(23)
Sorex araneus	1/99	4/30 HI	Ayrshire, Scotland(23)
Horses	1		Ireland (29)

Experimental host and age	Passage history and strain	Inoculation Route-Dose	Evidence of infection	AST (days)	Titer log <sub>10</sub> /ml
Mice (nb)	Several strains	ic	Death	3-4	
Mice (nb)		ip			
Mice (nb)		sc			
Mice (wn)	Moredun	ic	Paralysis and death	7	8
Mice (wn)		ip	Paralysis and death(scattered)	10	6-7
		sc	Viremia, death,antibody (21)	7-8	
embryon.eggs (6-10 day)		ys	Viral mult. in embryo(11)		
hamsters (4-22 day)	LI 31 P-5	ic,ip	Viremia, encephalitis(ic)death (24)		
Microtus agrestis		ic,footpad	Antibody only (25)		
guinea pig (20 day)	Moredun, P-6	ic	Paralysis, death(27)	9-12	2-5
red grouse (4-7 mo)	SB 1526, MB 2	tarsal pad	Viremia, encephalitis,death; antibody in survivors (30).		>7.6 (serum)

Also sheep (1,19), monkeys (2), field voles(4), pigs (1), cattle and horses(6);rabbit, guinea pig,rats (9).

**Section IX - Experimental Arthropod Infection and Transmission**

Arthropod species & virus source(a)	Method of Infection log10/ml (b)		Incubation period (c)		Transmission by bite (d)		Assay of arthropod, log10/ml (e)		
	Feeding	Injected	Days	°C	Host	Ratio	Whole	Organ	System

NOTE: In red grouse, LI virus prod. focal non-suppurative meningitis; encephalitis in fore brain with perivascular accumulation of mononuclear inflammatory cells; lesions different from LI in sheep, resembles EEE in pheasants (34).

**Section X - Histopathology**

Character of lesions (specify host)

**Sheep: diffuse meningoencephalitis, marked destruction of Purkinje cells (3); changes in Golgi material. Pig, mice: diffuse encephalomyelitis, mild meningeal involvement (2,3). Monkeys: diffuse meningoencephalomyelitis, massive destruction of Purkinje cells (2).**

Inclusion Bodies

Intranuclear

Organs/Tissues Affected

**Brain (LV), spinal cord (LV)**

Category of tropism

**Neurotropic**

**Section XI - Human Disease**

In Nature  
**Significant**

Residual  
**Significant**

Death

Subclinical  
**Significant**

Overt Disease  
**Significant**

Clinical Manifestations

**Fever, headache, prostration, conjunctival inflammation, stiff neck, myalgia, arthralgia, CNS signs (including encephalitis, CNS pleocytosis, rash, vomiting, and ataxia, dysarthria. Based on very few natural cases.**

Number of Cases

**8 cases known (18); lab. cases (26)**

Category (i.e. febrile illness, etc.)

**Encephalitis**

**Section XII - Geographic Distribution**

Known (Virus detected)

**Scotland, N. England, N. Ireland, Eire**

Suspected (Antibody only detected)

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**Remarks**